INTERNATIONAL MARITIME ORGANIZATION

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MARINE ENVIRONMENT PROTECTION COMMITTEE
57th session
Agenda item 4

MEPC 57/4/5
21 December 2007
Original: ENGLISH

PREVENTION OF AIR POLLUTION FROM SHIPS

Report of the Intersessional Correspondence Group on Greenhouse Gas Related Issues

Submitted by Australia and the Netherlands

SUMMARY

Executive summary:	This report summarizes the work of the Intersessional Correspondence Group on Greenhouse Gas Related Issues established by MEPC 56. It provides comments and proposals for consideration in the development of measures to limit or reduce greenhouse gas emissions for international shipping.
Action to be taken:	Paragraph 8
Related documents:	MEPC 56/23, paragraphs 4.67.12 to 4.67.14; and MEPC 57/INF.15

1 Introduction

1.1 MEPC 56 approved the proposal by the Air Pollution Working Group to establish an Intersessional Correspondence Group on GHG Related Issues (GHG CG) with the following Terms of Reference:

The Correspondence Group on GHG Related Issues is instructed, with a view to providing input on the ongoing discussions in accordance with the adopted GHG work plan, to:

- *discuss possible approaches on technical, operational and market-based measures to address GHG emissions from ships; and*
- *present a written report to MEPC 57.*

MEPC 56 furthermore noted that Australia and the Netherlands would serve as joint co-ordinators of the GHG CG. MEPC 56 encouraged Member States and observers to put forward concrete and practical proposals for technical, operational and market-based mechanisms to address GHG emissions from international shipping.

1.2 The aim of the work of the MEPC on GHGs is founded on Assembly resolution A.963(23), which urges the MEPC to undertake further work to identify and develop the necessary mechanisms needed to achieve limitation or reduction of GHG emissions from ships. Furthermore, the MEPC aims to identify and further develop options in order to make recommendations to the twenty-sixth Assembly in 2009. According to the Work Plan adopted at MEPC 55 (MEPC 55/4), at MEPC 57 the Committee should consider technical, operational and market based methods for dealing with GHG emissions (action 1(d) of resolution A.963(23)).

2 CG GHG Process

2.1 To ensure the proper conduct of the Correspondence Group on GHG Related Issues (CG GHG) the co-ordinators referred and adhered to the *Guidelines on the organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies* (MSC-MEPC.1/Circ.1, 15 December 2006). Co-ordinators made every effort to ensure strict compliance with these Guidelines, making clear that the work of a correspondence group would not pre-empt formal consideration of relevant matters by the parent body, or the positions taken by IMO Member Governments or international organizations participating in the correspondence group.

2.2 The GHG CG undertook its discussions from July 2007 to December 2007 and participation in the correspondence group was open to all delegations (governments and organizations) that could provide the necessary expertise on a timely basis, or had a particular interest in the issue.

The following 30 Member States participated in the CG:

> Australia, Bahamas, Barbados, Belgium, Brazil, Canada, China, Denmark, Finland, France, Germany, Greece, Iran (Islamic Republic of), Ireland, Italy, Japan, Malta, the Netherlands, Norway, Panama, the Republic of Korea, the Russian Federation, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Turkey, the United Kingdom and the United States;

the following Associate Member of IMO:

> Hong Kong, China;

the following United Nations specialized agency:

> UNFCCC;

the following intergovernmental organization:

> The European Commission;

and by the nine following non-governmental organizations:

> BIMCO, CEPSA, CLIA, FOEI, INTERCARGO, INTERTANKO, IACS, ICS and OCIMF.

2.3 Throughout the process, member input was circulated to the whole group to facilitate discussion, tables were updated and clarification was sought on submissions. Members were asked to comment on the report and its annexes throughout the drafting process, and to pose questions for discussion.

2.4 The resulting report to MEPC 57 summarizes the discussions of the CG, with areas of disagreement identified throughout. To help target future discussion by the Committee on potential future action by IMO on GHG emissions from international shipping, emissions reduction mechanisms discussed by the group and summarized herein were divided into short and longer-term options (see also Chapter 4).

2.5 The annexes to this report summarize submissions received and discussions undertaken as follows:

Annex 1 submissions received;

Annex 2 submissions offering general comments;

Annex 3 submissions on technical measures;

Annex 4* submissions on operational measures; and

Annex 5* submissions on market-based measures.

3 General Comments

The role of IMO

3.1 All GHG CG members acknowledge that, although shipping is the most GHG efficient way of transporting goods, the shipping sector has a role to play in reducing GHG emissions. Members acknowledged the leading role of the IMO for limiting and reducing GHG emissions from international shipping.

3.2 Members agreed that IMO's work should be forward-looking and pro-active. Such work should recognize the complementary role of technical, operational and market based measures. Members also supported research to enhance understanding and develop necessary metrics on GHG emissions from international shipping in order to target efficient and environmentally effective approaches. Reducing or limiting GHG emissions from international shipping should not shift pollution away from one ecosystem and remove it to another.

3.3 Members agreed that the IMO's GHG work should stimulate multilateral co-operation, and that the IMO should acknowledge and work closely with other relevant UN bodies, such as the UNFCCC. Reference was also made to the IPCC, highlighting the importance of liaising closely on scientific developments on climate change as they relate to GHG emissions from international shipping.

The global nature of international shipping and regional/national approaches

3.4 It was acknowledged that shipping is a global enterprise, and several members were of the opinion that a global approach is required. These members also stressed the need for equal application of IMO measures to all vessels/flags based on the 'no more favourable treatment' principle in port State control, and to avoid market distortion. Furthermore, some members suggested that if such a global approach was not forthcoming, other regional or national regimes to address GHG emissions from international shipping could emerge.

3.5 It was by some members argued that any regional or national systems should not be applied to international shipping unless agreed to by the States affected. It was also suggested by some members that any measures adopted by IMO should only be applicable to Annex I Parties to the UNFCCC and its Kyoto Protocol. Another member suggested shipping be considered as a Clean Development Mechanism (CDM)-category, and that this might encourage reduction of GHG emissions without touching upon the issue of allocation.

* Annexes 4 and 5 are in document MEPC 57/4/5/Add.1.

The role of shipping in international trade

3.6 The vital role international shipping plays in international trade was acknowledged by all CG members, as was the need for measures to be based on the principle of sustainable development.

3.7 Several contributions referred to the risk of transfer of cargo to less energy efficient modes (possibly leading to more GHG emissions). However, for the vast majority of intercontinental freight transport there is no serious competition. Some regional routes might experience mode competition, but road fuel duties, state aid, road charging and restrictions on driving hours often mitigate the effect of modal shift.

General comments on measures

3.8 In principle, all measures were considered as to be "properly designed" in order to allow consistent comparisons.

3.9 GHG CG members agreed **energy efficiency measures** had the potential to reduce or limit GHG emissions from shipping, and that innovation and research and development (R&D) should be promoted and facilitated by Governments and the shipping sector.

3.10 The difference between the emission reduction impact of **voluntary versus mandatory measures** was discussed. It was pointed out that voluntary measures – as stand-alone measures – might not result in immediate and tangible reductions.

3.11 Some members acknowledged that measures should preferably be **target based** and, where effective, should not prescribe specific methods. Measures should also be cost effective, practical, transparent, fraud free, enforceable and have relatively low administrative burdens. A fundamental consideration across all mechanisms was defining effective control and enforcement mechanisms, as well as developing guidelines for monitoring and reporting GHG emissions from international shipping guaranteeing a global level playing field. It was suggested that measures should make use of, and benefit from, schemes and structures already in place, such as existing emissions trading schemes that have proven potential as effective GHG emissions reduction mechanisms.

Potential future considerations

3.12 Measures could also be categorized for "new build" and "existing vessels." Some measures are suitable only for new builds as a longer-term measure (e.g., revised hull design), while others can be applied for both new build and existing vessels as a short-term measure (e.g., Energy Efficient Management Plan). It was suggested that there is a difference in the effectiveness of measures for existing and new ships. In particular, existing ships would have to adapt their systems, which (technically) cannot always be optimized. However, the GHG CG did not have sufficient time to consider and discuss this issue in detail. The Committee may wish to discuss the extent to which proposed measures could have a GHG reduction effect on new buildings, and how to address technical improvements for existing ships.

3.13 A number of members also addressed the issue of terminology. Due to, amongst other things, the time schedule of the group it was not always possible to provide clear definitions of terms used. It is recognized that, at a later stage, this will require further work in order to provide

consistency and clarity for analysis and comparison of all potential measures to reduce GHG emissions from ships.

4 Defining short and longer-term options

4.1 The Committee, when considering this report, is invited to taking into account the following deliberations made in relation to the distinction between short-term and longer-term emissions reduction measures discussed herein that:

.1 international IMO agreements, including on financial instruments and requiring implementation in national legislation, will in general take significant time;

.2 changes in production methods that require additional investments by the private sector might take some years before coming into effect;

.3 in climate change policy, "short-term" measures refer to measures that reduce emissions in the short term not measures that can be decided in the short term. The key issue is when the reductions take place. Similarly "longer-term" measures are those that will reduce emissions in the longer term;

.4 whereas, in general, all binding options needing international agreement are considered longer term, the actual implementation and reduction effect could in fact occur faster than some of the of so-called short-term measures;

.5 measures such as reducing speed could very easily be adopted in the short-term, as is already occurring in California/USA. Voluntary measures could provide a first step towards more binding measures; and

.6 technical measures, such as hull optimization, choice of propeller, efficient power plants, in-engine improvements such as fuel injection, heat recovery systems and measures that reduce ship hull friction, are considered longer term. This is because developing new designs will take time. However, as technical measures for ships are an important subject that would justify initiatives from IMO, the adoption of IMO guidelines on such measures in the short term would be helpful.

5 Short-term measures

5.1 The following section outlines potential options proposed by GHG CG members to reduce maritime GHG emissions. For the purposes of this report short-term measures are those that will result in GHG reduction impact in a short term (see also Chapter 4). For further information on individual measures see the attached annexes.

Technical (short-term) measures

5.2 *Improvement of specific fuel consumption*

Summary: GHG emissions from ships can be reduced through an optimization of specific characteristics of engines (e.g., ships could run at a speed that maximizes the efficiency of the engines, in order to improve specific fuel consumption).

Advantages: This measure can reduce GHG and other air pollutant emissions.

Disadvantages: This is a voluntary measure, so the effectiveness of this option will be limited, although it could provide a basis for effective policies.

5.3 *Energy Efficiency Design and Management Plan/Using a Test Mode for estimating CO_2-index of new-build ships*

Summary: Presently, the design of a new ship is mostly controlled by the builder, manufacturers and ship designers. The shipowner obtains a complete package from the building yard with little possibility to affect the design without increased costs and prolonged delivery time. Ship operators/owners and propulsion system manufacturers, ship designers and ship builders could be involved in the development of a tool for energy efficient design and operation of ships: an Energy Efficiency Design and Management Plan. The purpose would be to identify the elements leading to energy efficiency optimized design, modification and operation of ships. More specifically, a Test Mode for the assessment of the CO_2 index of each new build ship would be required for ship builders and shipowners. This could be considered a short-term measure, because it is an analytical tool and does not require large investment, and can therefore result in short-term reductions.

Advantages: The tool addresses the potential for reductions as a result of both the design and the operational stages of shipping, and would allow shipowners to select more easily GHG reduction technology at the point of ship construction.

Disadvantages: Several measures to reduce GHG emissions identified by the tool might not be economical, and would therefore be less attractive to owners/operators and not effective unless targets were legally binding. Also the measure is not in itself a complete solution, as it is an "information based" measure, and there is the risk that such a Management Plan might be perceived as being all that needs to be done.

5.4 *Onshore power supply*

Summary: This measure addresses the provision of onshore power supply to ships while at berth. Onshore power supply (cold ironing) could, depending on the power source, lead to decreased GHG emissions. This measure could be considered short term, as work is already ongoing on this topic, including ISO and IEC (at IMO's request) work to develop international standards for onshore power supply to ships. It is already in operation at a limited number of ports around the world. In introducing onshore power, consideration should be given to the cost effectiveness, technical standard for high-voltage onshore power supply and the (possible) increase of emissions from the onshore power plant.

Advantages: This measure could reduce GHG emissions from power generation, and could also reduce the emissions of other air pollutants (SOx, NOx, PM) and benefit local air quality. The significance of GHG reductions depends on the power source for the electricity generation.

Disadvantages: Agreement on an international standard for ship plug-ins and port facilities might need time. This could potentially delay investments in this technology by port authorities and the shipping industry. Depending on the class of vessel, in some cases only a small portion of energy is consumed while being at berth. In specific cases – depending on the source of the power – total GHG reduction would be limited due to extra production elsewhere (onshore power plants). In some circumstances, total GHG emissions (and other pollutants) could increase.

5.5 *Use of wind power*

Summary: This measure proposes the use of sails and kites for commercial shipping. It could be considered a short-term measure because experiments are already ongoing in this field and the option is not technically complicated. However, pending which technique is used, it may have consequences for the complexity of the construction, adaptations to ships and operation of the sail or kite system. It was noted that experiments are also being carried out, for example, with solar power, and that this measure represents just one of the potential future renewable energy options for the sector.

Advantages: Along with reducing GHG emissions, the measure is considered relatively cost-effective. Similar reductions in air pollutants could also be achieved. Some techniques/construction requires only limited adaptations to certain types of ships.

Disadvantages: Implementation would require relearning skills and bring navigational challenges. The question is whether the technology is yet mature, and that goal-based standards would be required to provide the financial incentive for sail/kite technologies to become commercially viable. Such standards may take some time to be established internationally.

Operational (short-term) measures

5.6 Voluntary/mandatory requirements to report CO_2 index values, information exchange/ outreach and rating performance of ships and operators

Summary: Ship operators would be requested to determine the IMO CO_2 index of their ship. This would be based on a number of parameters, including the amount of cargo units transported, the fuel consumption, the emissions factor of the fuel used and the distance travelled for each voyage leg with different amounts of cargo. Data would be inputted into a calculation program on board after each arrival in port, with reports provided annually to the relevant authority (e.g., IMO Member State/IMO). This option could be accompanied by the introduction of an 'Econometer' to calculate the optimal speed of a ship with respect to fuel consumption. Developing best practices could provide easy and practical means for shippers and owners to increase fuel efficiency and decrease emissions. Information exchange would also assist in improving data on global GHG emissions from shipping. This is important, as there is no current, comprehensive and reliable data set on global GHG emissions from international shipping. Better data is imperative to support work towards developing policy solutions. The measure would rate the performance of ships and operators with regard to GHG emissions and give incentives based on the rating, thereby promoting reduced GHG emissions. This could be considered a short-term measure, because best practice information is already available.

Advantages: This measure would provide (additional) necessary data for assessing GHG emissions from international shipping and developing policy solutions to reduce or limit emissions, such as setting more effective and efficient fuel efficiency standards, while also raising awareness of GHG emissions. It would also contribute to broader analysis of climate change impacts. More information exchange could be considered as an essential objective, as better access to information would improve the progress of technical, scientific and industrial knowledge and be helpful in the decision-making process. It could also create competition between less and more energy efficient ships.

Disadvantages: As a stand-alone measure a CO_2 index/information exchange is not likely to result in immediate and tangible reductions. External verification of index calculations would also need to be addressed.

5.7 *Strict limitations on leakage rates of refrigerant gases*

Summary: A strict limit on the leakage of refrigerant (GHG) gases on board ships could be set. This could be considered a short-term measure because better maintenance and record keeping in respect of refrigerant gases would be cost-effective and therefore more acceptable too, and taken up more easily by, operators. However, the international uptake of any such limit would need to be agreed through an appropriate multilateral forum, which could prolong implementation.

Advantages: Present high leakage factors could be reduced relatively easily. This would improve efficiency and be a cost-effective and therefore attractive measure to operators. In parallel it reduces the deterioration of the ozone layer. It was noted that similar initiatives have been undertaken by the IMO already with respect to ozone depleting substances. Other measures, such as to improve recording on board (part of Annex VI revision process) and the International Air Pollution Prevention Certificate (IAPP Certificate), could be helpful in the assessment of the global quantity of the leakage of refrigerant (GHG) gases on board ships.

Disadvantages: Potential problems could arise with quality control of the data (and evasion), including if the measure were not implemented on a global basis. This is because ships involved in international trade could buy refrigerant gases in countries where monitoring and reporting of sales was less stringent. International agreement, through an appropriate forum such as the IMO, would be desirable. This could prolong implementation.

5.8 *Vessel speed reductions*

Summary: The introduction of a phased-in programme of (mandatory or voluntary) speed reductions, either in specified zones (e.g., within 200 miles of any coastline) and/or globally has the potential to offer early reductions in GHG emissions from international shipping. This measure could effectively be combined with several other operational measures, such as weather routing and voyage planning[1], in order to ensure that fuel consumption and emissions from ships were minimized for every voyage. It was noted that speed is weather dependent and does not necessarily correlate with fuel use or GHG emissions. There is a need to do further work on the management and planning of ship voyages in order to avoid situations where ships are travelling at high speeds in certain parts of their voyage, and therefore must stop, queue or sail at sub-optimal speeds in network bottlenecks or ports. Increasing the efficiency of logistics for shipping could mean a considerable lowering of GHG emissions. If ports could give ships a timeslot (e.g., in line with aviation), ships could be operated at economic speeds and shorten waiting times (just in time planning). This suite of measures could be considered a short-term option(s), because – depending on infrastructure constraints – it would be relatively feasible/easy to implement. (See also below: Paragraph 5.10 *Voluntary measures to improve traffic control, fleet management, cargo handling operations.*) Implementation of vessel speed reduction measures could have consequences for the logistic chain (e.g., for the "right-on-time" principle used and in relation to adequate storage facilities and the short "selling lifetime" of some products).

[1] In the 2000 IMO Study of Greenhouse Gas Emissions from Ships these options are dealt with separately (see tables 1-4).

Advantages: This option(s) could result in a significant reduction of GHG emissions and an improvement in local and global air quality, providing that the speed is adapted to the nominal load of the engine and that enforcement of speed limits by harbour authorities is feasible within harbours/harbour zones. Limiting speed could reduce CO_2 levels significantly (with a 4% speed reduction resulting in around a 13% emissions reduction). Developing such a limit, based on optimal engine levels could, produce rapid emission reductions that could be phased in over time to allow the global economy to adapt. Having slower sailing vessels could also potentially improve logistics at port.

Disadvantages: This option could result in operational problems for ships permanently operating at slower speeds. Vessel speed is primarily an issue between producers and consumers, with ships having to make commercially competitive decisions to gain trade. As transports are made to fill customer demand, speed reductions will slow down sea transports. In specific cases, for example where there are cost-effective alternatives for maritime transport, the transport customer may choose other means of transport. Speed reduction might require more ships to handle the same amount of transports, because the goods would stay a longer time at sea. Other means of transport and/or more vessels could mean more emissions, having an adverse net environmental impact. Moreover, the use of additional vessels to carry the same amount of cargo might have cost implications for both the vessel operator/owner and the shipper of the cargo. The nature of the present global economy and the "just in time" supply chain could potentially undermine any development of these measures. While having slower sailing vessels could potentially improve logistics at port, it could also adversely impact on logistics, causing bottle-necks at ports if goods were to "pile-up" while awaiting transport.

5.9 *Measures to improve traffic control, fleet management, cargo handling operations and energy efficiency*

Summary: E-navigation, optimized ship design, optimized cargo handling operations and peak spreading programmes at port terminals could reduce truck traffic and port congestion, and optimize berthing, mooring and anchoring operations. Waiting times in ports, turn around time and GHG emissions from international shipping could be reduced. In general, increased energy efficiency at sea and in port offers significant reductions in GHG emissions (e.g., some organizations are using incentive-based schemes to leverage operational improvements and lower their fuel costs by optimizing engine, hull, and propeller efficiencies and reduce associated maintenance costs). This is considered a short-term measure because the abovementioned options are often already part of standard company policy, or would be relatively easy to introduce due to parallel efficiency gains.

Advantages: Such measures would be both cost-effective and environmentally effective in their reduction of fuel consumption and GHG emissions. Energy efficiency measures offer immediate and tangible global GHG emissions reductions, with future improvements promising further reductions.

Disadvantages: These measures would grant a larger commercial advantage to operators. As these measures are voluntary, compliance is unsure and therefore so is the potential impact on emissions reductions. Research on voluntary measures has shown that such measures have little effectiveness.

5.10 *Consider Black Carbon and Nitrogen Oxides in evaluation of GHG emissions from ships*

Summary: Marine vessels account for a significant share of black carbon ('soot') emissions and nitrogen oxide emissions. Both have a significant Global Warming Potential (GWP). Engine-focused measures could reduce the GWP-impact of shipping emissions. Consideration of black carbon and nitrogen oxides in evaluating GHG emissions from ships is a short-term measure because the framework of the ongoing revision of MARPOL Annex VI – which aims to reduce air pollution by ships – addresses these issues.

Advantages: Engine-focused measures that improve local air quality and reduce inefficient fuel combustion, combined with GWP-reduction efforts, would be a win-win situation. Improvements in air quality bring significant direct benefits to human health.

Disadvantages: There may be trade-offs that need to be made between reduced emissions of nitrogen oxides and black carbon, and GHG emissions. The impact of nitrogen oxides and black carbon on global warming is complex and further scientific work would be needed to properly assess the impacts.

Market-based (short-term) measures

5.11 *Hybrid mechanism: Charge-cap-and-trade/a charge on all fuel for shipping combined with a fund to buy credits/ marine fuel charge*

Summary: This approach has several variations. A marine fuel charge could be related to fuel sold, with revenues going to national governments.

5.11.1 A more elaborated system could set a cap on total GHG-emissions from international shipping and introduce a charge on GHG-emissions from all international shipping, imposed on fuel sold. The easiest charge system to design and administer would be related to fuel purchases. The bunker supplier would be able to keep track of the quantity delivered to the ship. The number of bunker suppliers (fuel delivery companies) is limited, which would facilitate the verification process. Another option could be a charge on the ship operator or owner on the basis of bunker delivery notes – more in line with the "polluter pays" principle.

5.11.2 The revenue from such a scheme would be (partly) brought back to the shipping sector through a fund established under the IMO and controlled by an IMO-Board. The collected funds could go to:

- maritime industry for GHG improvements/climate change mitigation measures;
- GHG-credits purchased on the emissions trading markets (i.e., including other industries), including CDM;
- climate change adaptation in developing countries; and/or
- technical co-operation through IMO.

5.11.3 The first two options would jointly deliver the required emission reductions to meet the cap through improvement programmes and emission offsets. The level of the GHG charge would be assessed for adjustment at certain intervals in order to keep the GHG emissions from ships within the agreed limit. The following matters would need to be addressed: the entity responsible for reporting and paying the charge to the IMO fund, the charge and cap levels, the compliance-regime, and the distribution of the funds.

5.11.4 This measure could be considered short term as this system would be relatively easy to implement, provided that the charge system could be agreed to and effectively enforced at a global level.

Advantages: The measure would demonstrate international shipping's willingness and ability to deliver a short-term and effective contribution to address GHG emissions from shipping. It would encourage fuel efficiencies among all vessels, new and old, and could encourage lower speeds and improved efficiencies at ports. The system would bring about GHG reductions from the sector corresponding to the level set by the agreed cap. The system would allow for increased emissions from the shipping sector. However, purchasing credits on emissions trading markets, including credits from CDM projects in developing countries, would compensate for any excess emissions. There would be no need for allocation of emissions, development of baselines or estimations of historical emissions. Since the system covers all emissions, evasions would be avoided. The sector could pay for the damages caused by GHG emissions in developing countries through funding adaptation projects.

Disadvantages: Seaborne transport competes in specific cases with rail and road transport. A marine fuel charge could, in certain areas, give an advantage to shore-based transport modes. This could result in higher total GHG emissions from the transport sector. Reaching agreement internationally on such a charge would be complicated.

5.12 *Voluntary commitments between economic sectors and government*

Summary: Voluntary commitments could include efficiency improvements, differentiated harbour dues, fuel efficiency and IMO GHG index per ship. Parties could be ship builders, ship operators, ports, users of shipping services and governments. Such measures could be implemented using a "certificate scheme" where ships with high quality environmental performance received premiums (e.g., Green Award system and Green Flag system). This is considered a short-term measure because commitments could start early with a limited ambition to be further developed to more ambitious goals in the future. Experiences with voluntary agreements have demonstrated that this category of instruments could be followed by adoption of regulatory measures.

Advantages: Voluntary agreements could serve as a vehicle to other instruments. For example, shipowners could use a voluntary GHG index per ship to distinguish themselves from competitors, using public online access such as EQUASIS.

Disadvantages: Absolute GHG emissions reductions could be, in general, hard to achieve using voluntary agreements. Any voluntary commitments in shipping could result in "free-riding", and this could cause a distortion of the market and evasion. The efficiency of this instrument in reducing GHG emissions is uncertain, as there is a risk that adoption of other measures could be postponed.

6 Longer-Term Measures

6.1 The following section outlines possible options as proposed by GHG CG members to reduce maritime GHG emissions. For information on the distinction in this report between short-term and longer-term measures see chapter 4 of this report. For further information on individual measures see the attached annexes.

Technical (longer-term) measures

6.2 *Technical measures for ship design*

Summary: Technical measures could include optimized hull, choice of propeller, efficient power plants, in-engine improvements, such as fuel injection, heat recovery systems and measures that reduce ship hull friction. Such improvements are considered longer-term as developing new designs will take time. However, as technical measures for ships are an important subject that would justify initiatives from IMO, the adoption of IMO guidelines on such matters in the short-term would be helpful. Some technical measures were considered to bring longer-term emissions reductions due to the time required for, amongst other things, new hull designs.

Advantages: According to the IMO GHG study from 2000, such measures have significant potential to reduce GHG emissions – by up to 30% for new ships, and up to 20% for existing ships. Such measures also save money through reducing fuel use, and some technical measures would have short pay-back periods, especially during periods of high fuel prices. Heat recovery alone can improve efficiency by 10%. Such technology has been proven and is already available.

Disadvantages: With respect to technical measures such as more effective hull design: alteration of existing ships might not be economically feasible and might not be practically achievable – or at least be more difficult to achieve than with new ships. Also adverse effects – due to complexity – on GHG-emissions would have to be avoided. The design of an optimal propeller for a specific ship would require considerable design and testing time. In-engine improvements are not viable on all existing ships as some engines are already as efficient as possible considering the balance between fuel consumption and NOx-emissions (i.e., higher fuel efficiency from improved combustion would increase NOx emission). Furthermore, it might not be possible to alter some engines at all, or even to find the necessary manufactured parts that would make them more efficient.

6.3 *Use of alternative fuels*

Summary: Alternative fuels like natural gas and biofuels, and use of fuel cell technology, have the potential to significantly reduce GHG emissions from shipping. These options are considered longer term because use of such fuels might require additional technical changes on ships, and their use on existing ships in particular may need time and require additional technical requirements.

Advantages: Significant GHG reductions are possible, for example from the direct use of natural gas in high-temperature fuel cells employed in large ships and the use of natural gas-derived hydrogen in fuel cells installed in smaller ships. Experience with biofuels in the maritime sector is already available.

Disadvantages: Biodiesel production is limited and an increase of production could cause adverse environmental impacts (e.g., deforestation and destruction of wetlands), and increase the price of food products. The biofuels currently being used are not necessarily environmentally sustainable and may not lead to GHG emissions reductions. With respect to natural gas: the availability of natural gas is still low and can only be used in certain areas until a global distribution system has been developed, which would take considerable time. It would be difficult for existing ships to switch to gas, because it would be almost impossible to alter old fuel tanks to gas tanks. There are also crew and other safety issues to be solved before natural gas

could be more widely used as fuel. Furthermore, when not used in a dedicated engine, use of natural gas (LNG) is less efficient than traditional fuel, which takes away the GHG benefit. While fuel cells would be more environmentally friendly and could be a solution for use in some ship applications in the future, they are currently still being trialled and considerable research is still required.

6.4 *A mandatory CO_2-design Index for new ships*

Summary: A mandatory CO_2-design index for new ships, which separated technical and design-based aspects from operational and commercial aspects, would require new ships to have design parameters that yielded an index that would be below an internationally defined benchmark. An index could be designed based on data already available.

Advantages: Despite the shipping industry's continuous endeavours to optimize fuel consumption, there is still large potential for further improvement. A mandatory CO_2-design index for new ships could stimulate and create an incentive for developing efficient engines and ships. Being only dependent on the technical performance of the ship and its engine, rather than on operational or commercial aspects, such an index would be simple to deploy, consistent and based on a generally accepted methodology. Moreover, the parameters would already be available.

Disadvantages: The impact would be limited initially, mainly due to its application to new ships only. However, the potential exists for significant beneficial environmental impacts over time.

Operational (longer-term) measures

6.5 *External verification scheme for CO_2 index*

Summary: An external verification scheme for an IMO CO_2 index would be implemented with only CO_2 indexes verified through this scheme used in reduction measures. This option would be used for every technical, operational and market-based measure. The measure could first be implemented at the national level and later at the international level. This is considered a longer-term measure because the development and adoption of an external verification scheme – in particular at the international level – could take some time.

Advantages: In order to promote the uptake of such new technologies, and be truly environmentally effective, a globally recognized standard for indexing of ships would need to be considered. In particular, if an external verification scheme could be established, it would enhance and ensure measures like 'voluntary/mandatory requirements to report CO_2 index values' and 'rating performance of ships and operators'. Use could be made of work already done on the voluntary IMO CO_2 index.

Disadvantages: There are still arguments over how indexing should cover, for example, the amount of cargo moved, the time it takes to move this cargo, the distance the cargo is moved, routing issues, loading rates, operating in ballast/with empty containers and weather delays. Implementation of a globally recognized verification scheme could be very complicated and take some time.

6.6 *Unitary CO_2 index limit combined with penalty for non-compliance*

Summary: Ship operators would be required to meet a unitary CO_2 index value (in gram CO_2/ton mile). A penalty would be imposed on ships that did not comply with the limit. This is considered a longer-term option because a significant amount of time is needed to differentiate the limit to ship size and cargo type and to exclude the factors that are out of control of parties.

Advantages: The measure would directly reduce GHG emissions. The enforcement mechanism would provide strong incentive to build new ships with a lowest GHG index possible.

Disadvantages: It would be difficult to set a fair and efficient limit value for the significant range of vessels, cargoes and operating environment. Issues such as how indexing should cover the amount of cargo moved, the time to move this cargo, the distance the cargo is moved, routing issues, loading rates, operating in ballast/with empty containers and weather delays would need to be solved. Due to such external factors it would be difficult to meet a CO_2-index limit at all times. Customer demand for transport time and delay on deliveries due to other factors not under the control of the operator would need to be considered when choosing the subject for penalties.

Market-based (longer-term) measures

6.7 *Emissions Trading Scheme (ETS)*

Summary: Ship owners would be required to obtain and have allowances for GHG emissions, and to participate in a cap-and-trade system. It is considered a longer-term option because developing and deciding upon an environmentally effective, cost-effective and fair ETS system could take considerable time. Such schemes would need to have mechanisms in place to ensure that there were no obstacles for new entrants.

Advantage: Emissions trading is the only option to set a hard cap on overall shipping emissions. An ETS could bring significant GHG reductions and could be combined with existing regional trading systems and existing credit systems (e.g., Clean Development Mechanism under the Kyoto Protocol). Since each operator would be free to choose the best option for them to comply, reductions could be achieved at the lowest cost. This option could also generate significant revenue, which could be used for the benefit of the maritime sector (e.g., research into emissions reductions, mitigation and adaptation in developing countries, data collection and analysis, best practice programmes, etc.). An 'open scheme' would allow ship operators to sell emission credits to other sectors (e.g., aviation).

Disadvantages: Decisions on allocation criterion, thresholds, baselines, recognition of past efforts, avoidance of evasion, trading entity, compliance and scope of the system (e.g., types of ships, geographical scope) would be needed. Reaching agreement internationally on these criteria would be complicated, and would need to be made in line with other relevant international agreements. For a fair ETS, with the aim to reduce overall CO_2 emissions, other transport modes would have to be involved in the trading scheme. Otherwise, in some places, transport could move from ship to other transport modes (see also chapter 3, paragraph 3.11).

6.8 *Inclusion of mandatory CO_2 element in port infrastructure charging*

Summary: Ship operators would pay harbour dues to port authorities for the use of the harbour. In principle, harbour dues could be differentiated – and include a bonus when standards were met – in order to provide incentives to reduce GHG emissions. The basis for the differentiation could

be a technical standard, a performance standard or a management system. This measure – when implemented on a global scale – is considered longer-term because developing and deciding upon an environmentally effective, cost-effective and fair harbour due system could take considerable time.

Advantages: Institutions for charging port dues are already in place. Ship operators have the freedom of choice to reduce cost or travel time. The measure would promote innovation and development of efficient ships.

Disadvantages: Differentiated port dues are a very commercially sensitive issue, and have proved difficult at the regional level, let alone the global level. The measure could distort the competitive market of ports. It would require limiting the autonomy that port authorities currently have in setting their charges. Furthermore, there are various kinds of harbour dues (including port entrance dues, tonnage dues, port service charges, port cleaning maintenance dues, pilotage, towage, dockage, and so on). It is difficult to adopt a single rule for differentiation, which complicates a mandatory CO_2 element in port infrastructure charging at a global level.

7 Role of IMO in promoting potential measures

7.1 Chapter 3 provides general comments on the responsibilities of IMO Member States. This chapter presents the diverging views of GHG CG members on the role of the IMO. One view stresses the need for a global approach and equal application of IMO measures to all flags based on the 'no more favourable treatment principle' in port State control. Another view stresses the applicability of IMO measures to Annex I Parties to the UNFCCC only, taking into account the general principle of 'common but differentiated responsibility' established under the UNFCCC and Article 2.2 of the Kyoto Protocol. It was also acknowledged by some members that this is a political matter that requires further discussion in the Committee.

7.2 The views of members of the GHG CG also diverged on how the Committee should respond to this report. No disagreement existed on the fact that, according to the Terms of Reference for the Group, this report would be submitted to MEPC 57 for consideration. However, some members considered that this report should be submitted to MEPC 57 according to the *Work Plan to identify and develop the mechanisms needed to achieve the limitation or reduction of CO_2 emissions from international shipping* adopted by MEPC 55, and that MEPC 57 might request the group to continue its work if deemed necessary.

7.3 Other members suggested that, when considering the report, the MEPC might decide to adopt a staged approach. One option under a staged approach would be to task an MEPC 57 working group to further address the short-term measures outlined herein, with the aim of selecting the most promising measures for further consideration and decision making. The same members also suggested that the MEPC 57 working group could start to provide some general comments on the longer-term measures addressed herein. These members considered that MEPC 57 might also wish to ask the GHG CG to continue its work:

i) prioritizing practical short-term options;

ii) further elaborating on long-term measures;

iii) considering the appropriate level of reductions to be achieved; and

iv) addressing legal aspects of introducing and enforcing measures.

8 Action requested of the Committee

The Committee is invited to consider this report, along with the underlying annexes, and to take action as appropriate.

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ANNEX 1

SUBMISSIONS RECEIVED

	TECHNICAL MEASURES	OPERATIONAL MEASURES	MARKET-BASED MEASURES
AUSTRALIA	General Submission	General Submission	General Submission
CANADA	General Submission	General Submission	General Submission
CHINA	General Submission	General Submission	General Submission
DENMARK	General Submission (2)	General Submission (2)	General Submission (2): including proposal for levy/ETS scheme
EC		Requirement for ship operators to use IMO CO_2 index and report annually Requirement for ships to meet a unitary CO_2 index limit or target Future inclusion of refrigerant gases from shipping in EU regulation and/or an indexing scheme parallel to the CO_2 index	Inclusion of CO_2 emissions from shipping in the EU Emissions Trading Scheme (ETS) Inclusion of mandatory CO_2 element in port infrastructure charging Voluntary Commitments (Summary CE Delfts Study)
FOEI	Technical measures effective in reducing ships GHG emissions Submission on Nitrogen Oxides and Black Carbon (2)	Vessel speed reductions and operational measures can significantly reduce GHG emissions from ships	Market-based measures combined with other emissions reductions initiatives have the potential to control GHG emissions from international shipping
GERMANY		Considerations how to address GHG emissions from international shipping	Considerations how to address GHG emissions from international shipping

	TECHNICAL MEASURES	OPERATIONAL MEASURES	MARKET-BASED MEASURES
ICS	General Submission	General Submission	General Submission
JAPAN	Principles of dealing with GHG emissions from international shipping Estimation for CO_2 Index of new-build ship using real test mode (Option C)	Principles of dealing with GHG emissions from international shipping To provide an external verification scheme for CO_2 Index (Option B) Mechanisms for dealing with GHG emissions from international shipping (Option D)	Principles of dealing with GHG emissions from international shipping Mechanisms for dealing with GHG emissions from international shipping (Options E, F, G, H, I)
NETHERLANDS	General Submission	General Submission	General Submission
NORWAY	General Submission	General Submission	General Submission
UK	General Submission (2) commenting on technical, operational and market-based measures and answering questions posed by co-ordinators.	General Submission (2) commenting on technical, operational and market-based measures and answering questions posed by co-ordinators.	Establishing the scope of market based measures to reduce carbon dioxide emissions from shipping. General Submission (2) commenting on technical, operational and market-based measures and answering questions posed by co-ordinators.
US	General Submission	General Submission	General Submission

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ANNEX 2
GENERAL COMMENTS

AUSTRALIA		
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**QUESTIONS/ COMMENTS**
Greenhouse gas (GHG) emissions from international shipping comprise about two per cent of global emissions. Emissions from international shipping should be addressed by the international community through the appropriate multilateral forum of the IMO. Concrete action to address emissions from international shipping should be prioritized by the IMO and all Member States. Effective means to limit and reduce emissions from international shipping should be based on a range of technical, operational and market based measures that are implemented according to the principles of multilateral co-operation and mutual consent. Australia will submit in coming phases further detail on its approach to technical, operational and market-based measures and their incorporation in a future IMO framework on GHG emissions from international shipping.	. Acknowledges that the shipping sector has a role to play in reducing GHG emissions. . Important that the international shipping community, through the IMO, embrace a comprehensive framework for limiting and reducing emissions from ships. . The framework should be forward-looking and pro-active, and must acknowledge the vital role international shipping plays in international trade. . It should also acknowledge the complementary role of technical, operational and market based measures. . To be effective, a future IMO framework should be equally applicable to all Member States, be practical and flexible, and be undertaken in the context of ongoing sustainable development and the promotion of global trade. . An effective framework would recognize and harness the range of policy measures that Member States can adopt and deploy to reduce GHG emissions, and facilitate co-operation across a range of actions with climate-friendly outcomes. . Encourages the development of an IMO emissions framework that includes technical and operational measures to address GHG emissions, along with the complementary and incremental development of market-based policy measures, including emissions trading, introduced on the basis of mutual agreement by affected parties only.	

	. Further detailed analysis of a range of technical, operational and market-based options to address GHG emissions from international shipping from an environmental, safety and commercial perspective is important before such measures are considered for adoption. . It is thus important to continue work, such as the CO_2 indexing trials and updated IMO GHG study, to enable informed decisions to be made on how to address most effectively emissions from international shipping in a manner that is environmentally effective, economically efficient, non-discriminatory and does not distort trade. . Such work will make an essential contribution to the sound scientific and economic foundations upon which a coherent and comprehensive IMO framework should be built. ***Recommendations*** . The IMO should pursue, as a matter of priority, the development of a coherent and robust emissions framework for international shipping. . This framework should be based on a comprehensive assessment of various technical, operational and market-based measures to limit and reduce GHG emissions, taking into account environmental, safety and commercial perspectives, and being based on the principles of multilateral co-operation and mutual consent.	

CANADA		
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**QUESTIONS/ COMMENTS**
MEPC 56 has instructed the Correspondence Group on GHG Related Issues to discuss and compile possible approaches on technical, operational and market based measures to address GHG emissions from ships. Any successful approach will require IMO Members to co-operate on an international level towards a common goal.	. IMO remains the appropriate UN body to develop environmental goals with respect to shipping and to work with Parties to translate these goals into effective action. . Critical for IMO to maintain leadership and continue important efforts to address shipping's environmental impacts, including fostering cost-effective solutions for use by Parties to achieve its environmental goals, in order to ensure the sustainable growth of shipping with all the benefits it brings to the world. . IMO should strive to secure international support and co-operation on a systematic and comprehensive framework to manage the impacts of shipping's emissions through a combination of science, technology, operational and market-based measures. . To successfully address the challenge of shipping emissions growth, IMO should seek collaboration from Parties on a comprehensive approach to manage the impacts of shipping's emissions through a combination of efficiency, technology, operational and policy measures. Such an approach should: a) Facilitate research on critical scientific issues to enhance understanding and develop necessary metrics on the impact of shipping greenhouse gas emissions in order to ensure that measures and approaches are targeting reductions in the most cost-effective manner; b) Foster the necessary research and development to provide more environmentally efficient engine and ship designs in a timely manner; c) Support the use of cost-beneficial market-based measures, such as emissions trading, based on mutual consent between Parties if applied to another Parties' carriers.	

CHINA		
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**QUESTIONS/ COMMENTS**
China appreciates the initial inputs made by members of the correspondence group, and holds the view that discussions of the correspondence group should strictly abide by the principle of "common but differentiated responsibility" established in the UNFCCC and its Kyoto Protocol. Due to time constraint, priority of the correspondence group should be given to the technical and methodological aspects to address GHG emissions from international shipping. It is also our understanding that any measures to be adopted by IMO concerning the reduction of GHG emissions from international shipping should only apply to Annex 1 Parties to the UNFCCC. To facilitate the work of the correspondence group, discussions should not cover implementation and application issues at present stage.		**Japan:** As international shipping is operated in a world-wide single market, it should be address under a common international rule. GHG reductions should be achieved through corporation of all countries. **Denmark:** It is of extreme importance that whether a solution for international shipping is found within the IMO or under the auspices of UNFCCC, a possible differentiation of obligations will by no means be related to the distinction between Annex I and non-Annex I parties. Hence, IMO Members should – without distinction to Annex I and non- Annex I – contribute constructively to the future work in the IMO.
DENMARK		
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**QUESTIONS/ COMMENTS**
Denmark regards the IMO as the appropriate UN body to develop global and binding greenhouse gas goals for international shipping. Denmark is contemplating a submission to the MEPC 57 to be held in March 2008. Denmark finds that a set of the basic principles should apply to any future regulation regarding CO_2 emissions from international shipping and sees an imminent need for both short term economic and market based measures as well as long term sustainable technical solutions.	• An ambitious objective with a view to achieving reductions in energy consumption throughout international shipping will most likely not be possible on the basis of available technical and/or operation measures in a short-term period. Therefore, the only short-term solution offered appears to be the use of cost-efficient and well-established market-based measures such as emissions trading. As long as there is no available means of investment in CO_2 emission reducing equipment and design, this may be a viable option. To this end, we believe that a scheme based on a levy on fuel will not be the prevailing long-term solution driving emission reductions, but can only serve as a first step. • Shipping is truly a global industry and any form of regulation of CO_2 emissions from international shipping should be based on concerted global action rather than unilateral initiatives at global, regional or national level.	

	. Crucial for the IMO to maintain leadership. Firstly due to the natural starting point of IMO regulation, by means of which the principle of *no more favourable treatment* encompasses the global community and is imposed on all flag States not following the rules. Secondly, because it significantly minimizes the risk of untenable special arrangements for individual flag States. Thirdly, due to the fact, that work on the establishment of liable and binding greenhouse gas targets for the international shipping industry, has already been on the agenda of the organization for a considerable time. . If the IMO, despite its efforts, do not provide such leadership this might give rise for other international, regional or local bodies to take initiatives. . Paramount that a coherent and comprehensive future IMO framework should be: a) effectively contributing to the reduction of the total global greenhouse gas emissions b) binding and equally applicable to all flag States in order to avoid evasion c) cost-effective d) limit – or at least – effectively minimize competitive distortion e) based on sustainable environmental development without penalizing global trade and growth f) target based and not prescribing specific methods g) promoting and facilitating technical innovation and R&D in the shipping sector h) accommodating to frontrunners in the field of energy efficiency i) practical, transparent, fraud free and fairly easy to administer.	

JAPAN: ***Principles of dealing with GHG emissions from international shipping (Option A)***		
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**CO-COORDINATOR QUESTIONS/ COMMENTS**
An incentive scheme is advised for the framework dealing with GHG emissions from international shipping, and the principles of the scheme should contain operational effectiveness of the methods, avoidance of market-distorting methods and avoidance of growth retardation in the international shipping.	• The international framework dealing with GHG emissions from international shipping should be an incentive scheme and there should be three basic elements as the principle of the scheme: a) Operational effectiveness of the methods: The methods aiming actual reduction in GHG emission from the international shipping and effective implementation of the legal framework should be a top priority. b) Avoidance of market-distorting methods: The single framework participated by all Member States should be developed in the international shipping which is doing their business in a world-wide single market. c) Avoidance of growth retardation in the international shipping: Healthy economic growth should not be hindered, as the economy of the international shipping only depends on the transport demand and no substitute for ships is available in terms of such low amount of GHG emissions per tonne-kilometre of transport in comparison to other mode.	
NORWAY		
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**CO-COORDINATOR QUESTIONS/ COMMENTS**
It should be made clear that the aim of the work of the MEPC on greenhouse gases is founded in Assembly resolution A.963(23), where the *MEPC is urged to undertake further work to identify and develop the necessary mechanisms needed to achieve limitation or reduction of greenhouse gas (GHG) emissions from ships*. It is Norway's view that the CG's work should include assessments of how the mechanisms considered may contribute to limitation or reduction of greenhouse gas emissions. We refer to earlier submissions and reports from Correspondence Groups, *inter alia*, documents MEPC 48/4/1, MEPC 49/4, where some reduction mechanisms have been suggested and assessed. As a	• In general the industry has continuously developed and implemented technical and operational measures in order to improve the cost effectiveness of shipping, not least to develop more energy efficient ship and ship systems to reduce the fuel cost, thereby also reducing the fuel consumption and CO_2-emissions. • Important driving mechanisms are the cost of fuel, and increasing fuel cost, or cost of emitting CO_2, will provide incentives for further investment in and implementation of new technology and operational measures resulting in reduced CO_2-emission.	

starting point, we see that both technical, operational and market based measures are feasible to apply for addressing the GHG emissions from ships. In analysing any proposed mechanisms it is of interest to identify whether: . it will have an effect on the design of new buildings? . it address technical improvements of existing ships? . it address the operation of new and existing ships? A fundamental element in the consideration of all mechanisms is to define the roles of authorities, especially for control and enforcement mechanisms.	. There is a significant potential for such reductions, but many measures are not economical today with the current cost of fossil fuel. . Issues that must be discussed and solved before any emissions reduction mechanism could be implemented: a) Roles and responsibilities of authorities and the Organization b) Participating entities (ship operator, ship owner) c) Coverage of the scheme (which ships should be included, based on DWT, routes, etc.) d) Data availability and accessibility (CO_2-emissions per voyage, etc.) e) The need for a cap on total CO_2-emissions, the level of such a cap (based on projected emissions or emissions in a base-year?) f) The need for baseline(s) g) Guidelines for monitoring and reporting of CO_2-emissions h) Verification i) Enforcement - how to ensure compliance (including penalty if non-compliance) j) Adjustment of the scheme (e.g., related to emission growth)	

UNITED STATES		
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**CO-COORDINATOR QUESTIONS/ COMMENTS**
It is the view of the United States that the best way for IMO to continue its leading role in reducing greenhouse gas (GHG) emissions from international shipping is to develop global solutions through operational and technological improvements, information exchanges, and voluntary approaches. This focus allows for shipping and the world economy to continue to grow, but in a manner that ensures reduced greenhouse gas emissions.	. US recognizes both the importance of taking action to address global climate change and IMO's leading role in addressing greenhouse gas emissions from the maritime sector. . US concurs with the view expressed by MEPC that "*IMO should maintain its leading position to avoid unilateral action either on a global, regional or national level. MEPC should continue to take the lead in developing GHG strategies and mechanisms for international shipping and co-operate closely with other relevant UN bodies*". . Operational and technological improvements for the maritime sector available today can provide immediate and tangible GHG emissions reductions across the globe, while future improvements promise even further reductions. . Voluntary measures such as partnerships, labelling and standards, and some market-based measures also offer real potential for reduction of maritime GHG emissions. . Information exchanges provide an easy mechanism for disseminating practical means to reduce emissions and save fuel. . These solutions bring reduced GHG emissions, but also lead to increased economic growth and a more sustainable shipping industry. . Shipping is the most greenhouse gas efficient way of transporting goods, and actions to reduce GHG emissions from international shipping should take this into account.	

	. A top-down, binding cap and trade programme for the maritime sector will most likely not be based on consensus from a wide range of maritime powers. . As such, and to be consistent with IMO's non-discriminatory nature, we should encourage global action that leads to global solutions while also engendering multiple benefits. . US recognizes that there are a variety of options to reduce greenhouse gas emissions from international shipping aside from mandatory cap and trade programmes.	

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ANNEX 3

TECHNICAL MEASURES

DENMARK *(LONGER-TERM)*			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGES**
The feasibility of a CO_2 index for newbuildings: Establishing an index for new-buildings, and if possible existing ships, should be subject to further investigation in order to deal with CO_2 emissions.	▪ At present special consideration should be given to a CO_2 index for newbuildings. In this context, any indexing method will have to include measurements on board. Little hope should be affixed to set a trustworthy index by means of theoretical assessments only. ▪ Any CO_2 indexing method for newbuildings should comply with the following basic requirements: a) Simple to deploy – i.e., minimum consequences for standard sea trial programmes. b) Consistent – no debating of obtained results. c) Based on a generally accepted methodology. ▪ The stipulation of a methodology will have to take into consideration previous work of recognized expert groups. ▪ Furthermore, the following principles should apply for a CO_2 index: a) It should apply the assumption that CO_2 emission equals the specific fuel consumption multiplied with a factor, which – if no additional emission reducing means have been installed – is a constant, independent of engine and fuel type for standard engines and fuel grades.		

	b) For the majority of ships, a CO_2 index can therefore be obtained by measuring the specific fuel consumption at a standard set of predefined speeds and loading conditions, although further refinement of these calculations may require compensation factors for current/waves/wind to be applied during trials. c) It should be accepted to directly measure the actual CO_2 emissions at the same predefined speeds and loading conditions for ships which are running on non-standard fuels (e.g., natural gas) or where the owner claims that dedicated emission reducing measures have been installed.		
FRIENDS OF THE EARTH INTERNATIONAL: ***Technical measures effective in reducing ships GHG emissions (SHORT-LONGER TERM)***			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGES**
Technical measures including ship design, power plant and machinery efficiencies and choice of fuels offer options that can reduce CO_2 from ships by as much as 30 percent total, in combination[1]. This submission summarizes some of these options and others including new technology, alternative fuels, and shoreside power. However, FOEI strongly asserts that a "multi-instrumental" approach is the best way forward to reducing GHGs from ships, combining operational, technical, and market-based measures as well as policies, regulations and other mechanisms, which will reinforce each other and result in a more effective and	▪ Technical measures include: optimized hull shape, choice of propeller, efficient power plants, switching from HFO to MDO (tailpipe) and in-engine improvements such as fuel injection. All should be considered in developing an international programme to reduce GHGs from ships. ▪ Several new technologies for reducing fuel use in ships have been developed since the IMO 2000 GHG Study that should be considered when developing an international programme for reducing GHGs from ships, e.g.:	▪ Technical measures alone have the potential to reduce CO_2 emissions from new ships by up to 30% and in existing ships by up to 20% (IMO 2000 GHG Study).	▪ **Japan:** is of the view that estimated reductions by 30% of new shipbuilding and 20% of existing ships (indicated in the IMO GHG Study, 2000) are optimistic. After the report was issued, a number of measures for environmental protection, which would increase GHG emission, such as AFS Convention, Sea Water Ballast Management Convention and MARPOL NOx reductions, have been established, or are under development. In addition, measures for existing ships includes plans that lack in universality, such as usage of LNG fuel.

[1] Study of Greenhouse Gas Emissions from Ships, International Maritime Organization, 2000.

efficient policy. This document was produced by a coalition of environmental NGOs.[2]	a) Renewable wind power can be harnessed by OGVs with sails and kites being designed for commercial shipping. Sky Sails claims a range of 10-50% reductions in fuel use with its kite system[3]; the Kite Ship Company is also developing sail configurations for ships[4]. A case was made for wind power for ships in a study on the BeauForce Kite system[5] and wind power was cited by the IPCC a "promising" and "even cost-effective" measure in the short-term for reducing GHGs from ships.[6] b) At MEPC 56, an air cavity system that reduces ship hull friction was highlighted that can reduce use of fuel and resulting GHGs[7]. c) Use of alternatives to marine fuels could also achieve significant reductions in GHGs: use of natural gas (20% reductions); biodiesel produced from feedstock that is sustainable and does not cause other environmental harm such as deforestation, destruction of wetlands, or water shortages. Other biomass fuels and fuel cells for auxiliary power are additional options for reducing GHGs from ships. According to the IPCC, the direct use of natural gas in		▪ **UK:** technologies, such as sails and kites, are not yet mature, however goal based standards can provide the financial incentive for these technologies to develop further and be marketed commercially. Technological answers are also usually ship or route specific and there is no one answer that can be adopted for all shipping at the present time, therefore any solution should be technology or method neutral. ▪ **Canada:** Renewable wind power may be more feasible for short sea shipping. There are technical considerations including adding an additional level of complexity/maintenance/cost to ships for possible marginal cost savings. There also may be some time/delivery penalties associated with wind technology. This needs to be further investigated. – Biofuels are a possibility but advice is required by the engine manufacturers and also serious consideration with respect to supply. Also, special lube oils may be required for these new fuels which may result in higher cost and large R&D investments. – With respect to shore-side power, there are 3 cost elements involved:

2 Friends of the Earth-US, Bellona Foundation, European Environmental Bureau, European Federation for Transport and Environment, North Sea Foundation, Clean Air Task Force, Seas at Risk and Swedish NGO Secretariat on Acid Rain.
3 http://www.skysails.info/index.php?L=1
4 http://www.kiteship.com/
5 http://www.lr.tudelft.nl/live/pagina.jsp?id=8f339bfe-e114-436f-a707-eab1a5ccdac2&lang=en
6 IPP Fourth Assessment Report, Working Group III, Mitigation of Climate Change, 5.3.4.10, Pg 48
7 http://www.dkgroup.eu/

	high-temperature fuel cells employed in large ships and the use of natural gas-derived hydrogen in fuel cells installed in small ships allows for a GHG emissions reduction of 20-40%.[8] d) While the IMO so far has avoided consideration of use of shoreside power for ships as a means to reduce ship emissions, it is a promising technology that should not be ignored. Also called cold-ironing, ship electrification and Alternative Marine Power, this technology offers the potential to cut greenhouse gas emissions from ships at the dock by 50%.[9] The reductions will vary depending on the power source for the electricity and emissions profile of other shoreside generation. The first critical step would be to complete the process of establishing international standards for ship plug-ins and port facilities. The turn-around time in port and corresponding energy use can account for 4-15% of total energy use per trip for ships. As much as 30% of ship emissions generated during a port call is generated during hotelling. Equipping ships and ports to utilize shore power could offer significant CO_2 reductions particularly in heavy shipping corridors. ***Relevant examples provided in submission. See also links below.***[10,11]		retrofitting existing ships, ensuring that there are ports available with shore power hook up, ensuring that the fittings are universal to allow any ship to hook up, and also ensuring that the power source being supplied isn't contributing more towards air pollution than the source for which it's replacing. Consideration also needs to be taken for the ability of the local utility company to supply sufficient supply of electricity to meet intermittent demand. – Cost/benefit analysis required to establish the payback period for such investments. – Many of these technologies may only be feasible on a case-by-case basis where the investment is warranted.

8 Ibid, 5.3.4.20

9 Service Contract on Ship Emissions, Task 2A – shoreside electricity, European Commission, Entec, 2005

10 http://www.nykline.co.jp/engliSH/news/2007/0426_1/index.htm

11 China Shipping (Group) Company, Evergreen America Corp.., Mitsui OSK (MOL), Nippon Yusen Kaisha (NYK Line), Orient Overseas Container Line (OOCL) P&O Nedlloyd and Yang Ming Line

	▪ In order to facilitate the penetration of these technologies in the market further action needs to be taken by the regulator. A legislative framework to ensure that new ships are equipped with the most efficient engines is needed. ▪ Market-based instruments should also be implemented in a way that ships using more efficient technologies, and consequently have a lower impact on climate, benefit from correct price signals.		
JAPAN: ***To provide an external verification scheme for CO_2 Index (Option B) (LONGER-TERM)***			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGES**
An external verification scheme for CO_2 Index shall be provided and the only CO_2 Index verified through this scheme shall be enabled to use in each individual reduction measure. This option is used for every "technical", "operational" and "market-based" measure.	▪ The Interim Guideline for Voluntary Ship CO_2 Emission Indexing for Use in Trial clearly describes the need for "external verification scheme" in section 6, as follows: a) Section 6: If only internal verification of reports are applied initially, measuring and reporting systems should be developed to allow effective external verification at a later stage. It should be considered stating, for the benefit of external stakeholders, why a report has not been independently verified and the company's future intentions in this regard. ▪ There are so many calculation mistakes and different interpretations in CO_2 Index calculation that thorough internal verification by each private ship operators is required. E.g.,: there are a lot of cases that multiply distance and cargo by the total amount during the period instead of calculating by each voyage and summing it up. In this case, the index would be	▪ **UK:** In order to promote the uptake of such new technologies, the IMO could consider how to incentivize the installation of green technology on the industry. To be totally effective the environmental indexing of ships at a global level needs to be considered to provide a level playing field, and a global recognition standard for each port State and flag State to recognize and reward appropriately.	

	incorrectly calculated. In addition, there are different interpretations on how to treat the cargo when voyaging with ballast. ▪ In evaluating all of the future reduction options, whether voluntary or mandatory, external verification of the CO_2 Index will be needed. ▪ Japan will provide an external verification scheme for CO_2 Index and enable only the CO_2 Index verified through this scheme to be used in each individual reduction measure.		
JAPAN: *Estimation for CO_2 Index of new-build ship using real test mode (Option C) (SHORT-TERM)*			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGES**
We have already utilized a lot of effective GHG reduction technology, such as improvement of a propeller additives and optimization of a ship shape. However, these technologies are not used widely for all type of ships. In order to promote these technologies to shipowners and stakeholders, some evaluated designing tools should be developed. For the development of this tool, test mode for every ship-type will be needed. Every technology for GHG reduction should be evaluated in this test mode.	▪ At least the six months' voyage data will be needed for calculating CO_2 Index. So it is impossible to provide initial CO_2 Index for every new-build ship at construction. ▪ On the other hand, many technical options for GHG reduction have been developed, but not been used widely. ▪ In order to promote wide use for these technologies, the evaluation tool which can predict GHG reductions will be required. ▪ For setting up the test modes, it is important to take average operation into consideration for every ship type and ship size categories, such as voyage length, sea conditions and average loading factor. ▪ Also the database evaluated GHG reduction rate of individual technology under these test modes should be created. ▪ These modes are more complex than E3 mode for Diesel engines and should be based on real operation mode.	▪ Using this measure, a ship-owner and a stakeholder can easily select the better GHG reduction technology at construction. ▪ **UK:** In order to promote the uptake of such new technologies, the IMO could consider how to incentivize the installation of green technology on the industry. To be totally effective the environmental indexing of ships at a global level needs to be considered to provide a level playing field, and a global recognition standard for each port State and flag State to recognize and reward appropriately.	

	▪ Evaluation of individual GHG reduction technology should be reviewed and verified the same as operational CO_2 Index.		
THE NETHERLANDS *(SHORT-LONGER TERM)*			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGES**
Presently the Netherlands can only submit an initial document with global input concerning the three aspects technical, operational and market-based measures. This document contains some preliminary ideas; therefore a more in-depth input will be given in the 2nd phase.	▪ Technical measures can be divided in several categories, namely measures for existing ships and measures for new ships and existing and new technologies. ▪ With so-called existing technologies the following measures are available: a) existing ships[12]: optimalization of hull and/or propeller, fuel: switching from HFO to MDO and improvements of engines. b) new ships[12]: optimized hull shape, choice of propeller, fuel: MDO instead of HFO, efficiency optimalization, monitoring of the machinery. ▪ New technologies are available to reduce GHGs, not only for new ships but also for existing ships, such as: a) use of wind energy by sails/kites[13]; b) use alternative fuels, such as natural gas and bio diesel; c) use of shore side power; d) friction reducing systems, such as air lubrication[14].	▪ **UK:** In order to promote the uptake of such new technologies, the IMO could consider how to incentivize the installation of green technology on the industry. To be totally effective the environmental indexing of ships at a global level needs to be considered to provide a level playing field, and a global recognition standard for each port State and flag State to recognize and reward appropriately.	▪ **UK:** technologies, such as sails and kites, are not yet mature, however goal based standards can provide the financial incentive for these technologies to develop further and be marketed commercially. Technological answers are also usually ship or route specific and the UK feel there is no one answer that can be adopted for all shipping at the present time, therefore any solution should be technology or method neutral.

12 See also IMO 2000 Study on GHG Emissions from Ships (MEPC 45/8
13 http://www.skysails.info/index.php?L=1
14 Project PELS – Project energy-saving by air lubricated ships http://www.senternovem.nl/mmfiles/Project_Energiebesparende_Luchtgesmeerde_Schepen_PELS_EETK20003_tcm24-188414.pdf

	e) use of an 'Econometer', an instrument that indicates the optimal speed of a ship with respect to fuel consumption f) inclusion of an energy-performance-standard in the design-requirements of IMO: a standard with respect to maximum fuel consumption per tonne-mile. The indexing system developed by IMO (expressing the ships efficiency in terms of CO_2-emissions per unit transport work in tonne-mile) can be helpful with respect to this[15].(***See also market-based measures: Harbour Dues***). ▪ It is clear that there is a difference in the effectiveness of the measures for existing and new ships, especially as existing ships have to adapt their existing systems which (technically) cannot always be optimized.		
NORWAY *(SHORT-LONGER TERM)*			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGE**
It should be made clear that the aim of the work of the MEPC on greenhouse gases is founded in Assembly resolution A.963(23), where the *MEPC is urged to undertake further work to identify and develop the necessary mechanisms needed to achieve limitation or reduction of greenhouse gas (GHG) emissions from ships.* It is Norway's view that the CGs work should include assessments of how the mechanisms considered may contribute to limitation or reduction of greenhouse gas emissions. We refer to earlier submissions and reports from Correspondence Groups, *inter alia*, documents MEPC 48/4/1, MEPC 49/4, where some reduction mechanisms have been suggested	▪ In general the industry has continuously developed and implemented technical and operational measures in order to improve the cost effectiveness of shipping, not least to develop more energy efficient ship and ship systems to reduce the fuel cost, thereby also reducing the fuel consumption and CO_2 -emissions. ▪ Important driving mechanisms are the cost of fuel, and increasing fuel cost, or cost of emitting CO_2, will provide incentives for further investment in and implementation of new technology and operational measures resulting in reduced CO_2-emission.	▪ Significant potential for such reductions.	▪ Many measures are not economical today with the current cost of fossil fuel.

[15] MEPC/Circ.471 'Interim Guidelines for Voluntary Ship CO2 Emission Indexing for Use in Trials', 29 July 2005

and assessed. As a starting point, we see that both technical, operational and market based measures are feasible to apply for addressing the GHG-emissions from ships. In analysing any proposed mechanisms it is of interest to identify whether: ▪ The mechanism will have an effect on the design of new buildings ▪ Will it address technical improvements of existing ships ▪ Will it address the operation of new and existing ships? A fundamental element in the consideration of all mechanisms is to define the roles of authorities, especially for control and enforcement mechanisms.	***Energy Efficiency Design and Management Plan*** ▪ Ships are required to develop a tool for energy efficient design and operation of ships: an Energy Efficiency Design and Management Plan. ▪ The purpose is to identify the elements leading to energy efficiency optimized design, modification and operation of ships. ▪ The plan could include: a) Identification of the index b) Define Optimized operation (speed, fuel) c) Reporting on actual operation d) Elements consider relative to design and modifications e) Ship maintenance ▪ The Management plan should be updated on a regular basis. ***Regulate installed power relative to cargo carrying capacity*** ▪ This measure could ensuring a more energy efficient fleet in the future and prevent a fleet structure with large emissions.		
UNITED KINGDOM *(SHORT TERM)*			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGE**
Submission contains general comments on technical measures to address GHGs from international shipping. International legislation solutions based on technological methods need to focus on goal-based standards and is technology neutral. Technological methods should also not shift the problem of pollution from one ecosystem and to another.	**Technological methods should also not shift the problem of pollution from one ecosystem and to another** ▪ The **shift to distillates or cold ironing** will only produce a benefit if the net produced CO_2, and alternative pollution cost elsewhere is reduced. Eg: using alternate energy sources as sources for cold ironing - the problem with moving towards distillates		▪ **Technologies, such as sails and kites**, are not yet mature, however goal-based standards can provide the financial incentive for these technologies to develop further and be marketed commercially. Technological answers are also usually ship or route specific and the UK feel there is no one answer that can be adopted for all shipping at the present time, therefore

	will also have an increased on the amount of oil that will have to be refined and an increase of the other cuts of fuel, which could skew other markets and GHG emission reduction schemes. ▪ In order to promote uptake of new technologies, the IMO could consider how to incentivize the installation of green technology on the industry. To be totally effective the environmental indexing of ships at a global level needs to be considered to provide a level playing field, and a global recognition standard for each port State and flag State to recognize and reward appropriately. ▪ In the long run the formation of criteria or regulations for the entire life of a ship can be developed to ensure that the design, construction, operation and recycling of ships is undertaken with the reduction of GHG emissions in mind. ▪ An awareness of cross-legislational issues is imperative, especially where new legislation will increase the energy needed to be generated on board a ship. Eg: new developments in SO_x abatement, bio-fouling, anti-fouling and ballast water treatment.		any solution should be technology or method neutral.

UNITED STATES *(SHORT-LONGER TERM)*			
EXECUTIVE SUMMARY	**DESIGN/OTHER DETAIL**	**ADVANTAGES**	**DISADVANTAGE**
It is the view of the United States that the best way for IMO to continue its leading role in reducing greenhouse gas (GHG) emissions from international shipping is to develop global solutions through operational and technological improvements, information exchanges, and voluntary approaches. This focus allows for shipping and the world economy to continue to grow, but in a manner that ensures reduced greenhouse gas emissions. The United States recognizes that there are a variety of options to reduce greenhouse gas emissions from international shipping aside from mandatory cap and trade programmes. In this correspondence group and in the lead up to MEPC 59, the United States plans to identify and further develop many of these options with an eye towards making recommendations to the 2009 IMO Assembly. The United States is committed to working with any country or organization to further develop these and other appropriate solutions.	▪ Increased energy efficiency at sea and in port offers dramatic GHG emissions reductions. Some organizations are using incentive-based schemes to leverage operational improvements and lower their fuel costs by optimizing engine, hull, and propeller efficiencies, and reduce associated maintenance costs. ▪ Alternative fuels provide a means to reduce GHG emissions in the maritime sector. The U.S. has ongoing experience with biofuels in the maritime sector including through our Clean Ports USA initiative. We are working to develop next generation alternative fuels. ▪ Renewable energy such as solar and wind energy can be harnessed at sea to complement diesel as primary power source. ▪ Fuel cells show promise for auxiliary power sources, and there could also be potential GHG benefits of increased distillate fuel usage.	▪ Can provide immediate and tangible GHG emissions reductions across the globe, while future improvements promise even further reductions.	