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PREVENTION OF AIR POLLUTION FROM SHIPS

Received submissions by the co-ordinators of the Intersessional Correspondence Group on Greenhouse Gas Related Issues

Submitted by Australia and The Netherlands

SUMMARY

Executive summary:	This information document contains all original submissions received by the co-ordinators of the intersessional Correspondence Group on Greenhouse Gases Related Issues
Action to be taken:	Paragraph 2
Related document:	MEPC 57/4/5

Introduction

1 Document MEPC 57/4/5, report of the intersessional Correspondence Group on Greenhouse Gas (GHG) Related Issues (GHG CG), is based on input received from the GHG CG members. Due to the comprehensive nature of this input, it was not always possible to reflect the same level of detail in the draft report and its annexes. Therefore, to be as transparent as possible, all received input has been made available to MEPC 57 through this information document. Only the original submissions are included in this document. These submissions formed the basis of the initial drafts of the report. Specific textual comments made on the drafts themselves are not included in this information document, as these comments have already been used in preparing the report and its annexes. This information document has been compiled in order of date received.

Action requested of the Committee

2 The Committee is invited to note the contents of this document and its annex.

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ANNEX

PHASE 1

EUROPEAN COMMISSION

1 Voluntary commitments (Summary from CE Delft Study)

Executive summary

Voluntary commitments as a policy to reduce GHG emissions from ships have severe disadvantages. Currently there is no organisation that would be willing to enter into a voluntary commitment. Furthermore, a voluntary agreement is not expected to have a significant impact on greenhouse gas emissions. Neither can there be high expectations of its efficiency. Voluntary agreements may serve a purpose as ancillary to other instruments, but not as a main instrument in climate policy for maritime transport.

Introduction

Voluntary commitments are agreements between economic actors and governments to reach a certain environmental goal. The design of a voluntary commitment involves the following choices, which are dealt with in this section: 1) The economic actor(s) involved in the commitment, 2) The basic parameter of the commitment and 3) The carrot and stick involved.

Economic actors involved

The conclusion was that ship operators are in the best position to reduce greenhouse gas emissions, since they have direct control over operational measures and both direct and indirect control over technical measures to reduce emissions. As a second best alternative, ship builders can influence the fuel efficiency of new ships. These two actors are also best suited to enter into a voluntary agreement. Agreements with other actors will be less effective than agreements with these actors, although other actors may be engaged in an agreement in order to facilitate its implementation[1].

Alternatively, governments may enter into an agreement with ports, for example to differentiate their harbour dues according to CO_2-index, or to give a rebate to ships with an index below a certain limit value.

Basic parameter of the commitment

A large number of basic parameters are conceivable. The most commitments would involve parameters that are directly related to climate impacts, greenhouse gas emissions or fuel

[1] Consider, for example, an agreement with shipowners and operators to reduce the average CO_2-index of their fleet. Such an agreement may be more effective when a shippers agree simultaneously to require that their cargo is transported in ships that have calculated their CO_2-index or that have an index below a certain limit value.

consumption[2]. The goals can either be absolute or relative. This leads to the following taxonomy of basic parameters (see Table 7).

Table 1 Taxonomy of basic parameters for voluntary agreements

	Absolute	**Relative**
Climate impacts	Cap on climate impacts	Climate index
GHG emissions	Cap on GHG emissions	CO_2-equivalent index
Fuel consumption	Cap on CO_2-emissions	CO_2-index

Absolute reductions are in general very hard to achieve in voluntary agreements[3]. In the case of an absolute cap on CO_2-emissions, ship operators would have to pledge to reduce their total fuel consumption. In the case of strong demand for maritime transport, this would be an impossible pledge, since it would imply that a ship operator would voluntarily reduce his profits. The fact that voluntary agreements have by nature a limited means of enforcement would make this disadvantage even larger.

This leaves open the option of relative parameters. Of the three possible relative parameters in Table 7, only the CO_2-index has a well developed calculation method that has been agreed upon internationally. All the other options would imply amending or replacing the CO_2-index, something which might take a long time. Therefore, we conclude that the only possible basic parameter would be the IMO CO_2-index. However, Marintek (2006) shows that the CO_2-index can only be partly controlled by ship-owners and operators: they have no control over the business cycle, which is the major determinant for the load factor of a ship.

Apart from these basic parameters, which are directly related to GHG emissions, other basic parameters are conceivable, such as monitoring and reporting, or R&D. Voluntary agreements on these basic parameters will only influence GHG emissions indirectly and are therefore not considered here in detail.

Scope for voluntary agreements in the shipping sector

As part of this project, CE Delft consulted various organisations on the prospect of a voluntary commitment. These organisations included the European Community of Shipowners' Associations, the BSR Clean Cargo Group, and the European Shippers Council[4]. From these meetings, it became clear that most of these organisations supported the goal to reduce greenhouse gas emissions. Several organisations stated that they or their members continuously worked towards reducing greenhouse gas emissions, since this implies reducing fuel consumption for which a clear business rationale exists.

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[2] Other basic parameters may include operational practices such as weather routing, or infrastructure supply and use such as shore electricity. All these parameters would cover only a small fraction of the climate impacts of maritime transport. Therefore, unless large reductions are foreseeable, these are not first best choices as basic parameters.

[3] Examples exist of voluntary agreements to reduce absolute emissions, such as the UK greenhouse gas trading system. However, in this system, companies pledged to reduce their emissions by a certain amount that was more or less foreseen in their business as usual scenarios. Actual reductions have been larger than pledged reductions in some cases, due to increased attention for fuel or energy efficiency. However, the environmental effectiveness of such voluntary agreements is likely to be very limited.

[4] Alas, the BSR Clean Cargo Group did not respond to CE Delfts questionnaire or engage in a dialogue.

On the basis of the discussions, it is CE Delfts judgment that none of these organisations can be expected to enter into a voluntary agreement to reduce greenhouse gas emissions. Shippers do not always have control over the mode of transport, and ship-owners' organisations cannot enter into commitments on behalf of their members. Furthermore, in any voluntary commitment in shipping, free riding may be a problem, and this may cause a distortion of the market and evasion. Therefore, from a regulatory point of view, legislation or regulation may be preferable to voluntary agreements.

Conclusion

A voluntary agreement is not expected to be effective, neither can there be high expectations of its efficiency. Voluntary agreements may serve a purpose as ancillary to other instruments, but not as a main instrument in climate policy for maritime transport. Furthermore, in shipping there seems to be no obvious partner for a voluntary commitment.

2 Requirement for ship operators to use the IMO CO_2-index and report results annually

Executive Summary

A requirement to report the CO_2-index value is feasible and within the realm of EU policy, despite its ***limited effects*** *this policy is still considered to be worthwhile. The requirement can be limited to EU flagged ships, without fear for evasion. The effectiveness of this option per se is limited, but it could serve as a basis for more effective policies. It would generate representative data on the CO_2-index of the fleet, and could be used to increase knowledge and understanding of the CO_2-index, regarding how it depends on technical, operational and economic factors. Furthermore, ship owners or operators may use the data, once available, as a management tool to critically monitor and analyse their ships fuel consumption performance.*

Introduction

In this option, ship operators (or other entities) are required to determine the CO_2-index of their ship, and report the results annually to Member State Administrations and/or the European Commission. Unlike the other options discussed in this report, this option is not aimed directly at achieving greenhouse gas emission reductions, since there will be no explicit incentives to improve the index, and the index will not be regulated. This option would raise awareness in the sector and improve data availability and understanding of the CO_2-index. Furthermore, the CO_2-index may serve as a management information tool for ship operators who would be able to compare CO_2-indexes of their ships, possibly compare them with the industry average, and take action to improve the index of their ships. This would have to be done on a voluntary basis. Finally, when a CO_2-index would be recorded and reported regularly for all ships, this could be the basis for more effective policy measures, as was intended when the CO_2-index was developed[5].

[5] IMO Assembly resolution A.963(23) on *IMO Policies and Practices Related to Reduction of Greenhouse Gas Emissions from Ships* was adopted by the twenty-third session of the Assembly in 2004. It urged the MEPC to identify and develop the mechanism or mechanisms needed to achieve the limitation or reduction of GHG emissions from international shipping. Specifically, it requested, among other things, the development of a CO_2-index and the 'evaluation of technical, operational and market based solutions', which could be based on a CO_2-index. It has not been the intention of resolution A.963(23) that the GHG policy should stop when a CO_2-index would have been in place.

Design of the option

When designing this option, the following choices have to be made: a) Who will be required to report the index (i.e., the shipowner, the operator, EU-flagged ships only, all ships entering EU waters or ports, ...)? How often (i.e., when) should the index be reported? b) Who will be responsible for the collection of the reports, enforcement and compliance?

Reporting entity, scope of the scheme

A requirement to calculate the CO_2-index and report annually could be implemented for all ships within the jurisdiction of certain states. EU-flagged ships would therefore be a logical and legally relatively unproblematic scope of this option. The drawback would be the discriminatory nature of the measure, but since this option only covers a reporting requirement, this would not lead to a competitive disadvantage of EU-flagged ships. Extending the option to all ships entering EU waters or all ships entering EU ports would probably raise legal issues, since this would require ship operators to calculate and report the CO_2-index also for operations outside EU jurisdictions. These legal issues will be discussed further below.

From a practical point of view, extending the scope to all ships entering EU waters or EU ports would mean that all these ships, even those that visit the EU rarely, will have to report their CO_2-index (and the data behind it) when they enter EU waters or ports. This implies that they have had to record their fuel consumption and transport work in the previous year, on a continuous basis. It might be reasonable to ask this of ships that regularly enter EU waters or ports (as it will also be asked of EU-flagged ships). However, it would be out of proportion for ships that rarely travel to or from the EU. It can also be argued that the CO_2-index of these (non-EU flagged) ships would then be based mostly on trips outside of the EU waters, resulting in an extension of the scope of the measure to an almost global scale.

To determine the CO_2-index of a ship, a range of data need to be reported for each trip, including details about departure and arrival ports and dates, distances sailed, fuel consumption and cargo or passengers on board. Ship operators or owners are the only party that currently monitor these data. As discussed in section 30.1, ship operators or owners also have, to some extent, control over emissions since they can take both operational and technical measures to reduce them. Reporting the index data might encourage these parties to analyse the index data of the ships they own or operate, and use the results as a management tool. We therefore conclude that both the shipping companies and the ship owners could be feasible reporting entities.

Reporting frequency

We recommend that the EU should follow that guideline, and require annual reporting (for example, per calendar year). This would minimize the administrative burden and cost imposed on the reporting entity.

Effectiveness

As mentioned above, this option may not affect CO_2-emissions from international shipping. In the long term, though, it may facilitate implementation of other, more effective measures. It can therefore be argued that it would not be fair to judge this option on its operational effectiveness in the short and medium term. Instead, we suggest judging this option on its own merits, i.e. we shall discuss whether and how its implementation could form a basis for further actions/applications.

As stated earlier, the operational effectiveness of this measure depends on the willingness of shippers and ship owners to use these data as a management tool, since the policy itself does not provide an incentive to reduce GHG emissions.

Lack of data on fuel efficiency in shipping is currently a significant bottleneck in the development of policy measures aimed at CO_2 reduction in shipping. This policy option can be a precursor to more stringent policy measures. In the future, the CO_2-index might provide the possibility to implement market based policy instruments in shipping, or perhaps even to set fuel efficiency standards.

Monitoring, enforcement and compliance

This policy options requires ship owners or shippers to provide data about fuel type and consumption and transport work per voyage. These data are typically readily available, and provide the basis for the calculation of the index.

Conclusion

This option is feasible and within the realm of EU policy. The effectiveness of this option per se is limited, but it could serve as a basis for more effective policies. It would generate representative data on the CO_2-index of the fleet, and could be used to increase knowledge and understanding of the CO_2-index, regarding how it depends on technical, operational and economic factors. This understanding seems to be a prerequisite to decide on using the index for regulation (option 3) or market based policy instruments based on this index, such as described in option 5. Furthermore, ship owners or operators may use the data, once available, as a management tool to critically monitor and analyse their ships fuel consumption performance.

3 Requirement for ships to meet a unitary CO_2-index limit or target

Executive summary

*A **requirement to meet a unitary CO_2-index value** could have a large environmental effectiveness and be an effective ways to address the climate impact of shipping. However, it is not clear at this stage that a limit value of the CO_2-index can be assigned to vessels that would present an incentive to all vessels to reduce emissions, and would do so in all phases of the business cycle.*

Introduction

The main bottleneck of designing this option is the difficulty of setting a fair and efficient limit or target. The index was also found to depend strongly on factors out of control of these parties, such as transport demand and market conditions. Furthermore, when comparing different ships, factors such as ship size and type, and type of cargo strongly determine the value of the ships CO_2-index. The CO_2-index thus varies strongly between different types of ships. Marintek concludes the following:

a) There are fundamental problems with setting a baseline for the CO_2-index of ships. For example:

i. Smaller ships will always be at a disadvantage, compared with larger ships.

ii. In times of lower market demand (either globally, or on specific routes or return voyages), the CO_2-index will increase since the cargo will be transported. Ship owners or shippers have only very limited possibilities to influence these developments.

b) In order to further analyse the possibilities of a baseline, more data are needed, that properly represent the different ship types, sizes and trade variations.

Based on the data results to date, it can be concluded that the limit or target should at least be dependent on ship size and on the type of cargo. However, the impact of different operational and technical variables on the CO_2-index must be better understood. This might be feasible once more data are available. In addition, however, market conditions (e.g., of a specific good or region) are also a determining factor in the CO_2-index. For example, the load factor may be all-important. Although vessel operators can influence this to some extent, given the low price elasticity of demand for maritime transport it cannot be expected that they can significantly impact the current imbalances in global maritime trade. Due to the high demand for goods from China, many vessels return empty to pick up a new load in China. Such empty trips in particular, and world trade in general, may to a large extent determine the value of the CO_2-index.

This might pose a more difficult and fundamental problem, since we do not expect it to be practically feasible to vary the limit with these developments at well. The result will be that in 'good' years, shippers will have no problem meeting the CO_2-index limit or target, whereas in 'bad' years, they may have no means to achieve them (unless they do not operate at all, or lower their transport price to uneconomic levels). They will thus be punished for developments out of their control. This might be a fundamental hurdle for this policy option. We therefore recommend further investigation of this effect.

Only when a requirement to meet an unitary CO_2-index limit could be introduced on a non-discriminatory basis, i.e., applying to all ships regardless of their flag, the option would have a significant environmental effect. If this would not be possible, it could have repercussions for the environmental effectiveness, since a requirement to meet a CO_2-index limit for EU-flagged ships is likely to distort the competitive market and lead to flagging out of ships. Clearly, if the flagging out would occur on a large scale, the environmental effectiveness of this policy option would be limited.

<u>Effectiveness</u>

Both the feasibility as well as the operational effectiveness of this option will depend on the following issues, each of which will need to be carefully addressed in designing this option:

a) The consequences of not meeting the limit or target.

b) The level of the limit or target (in gram CO_2/tonne mile).

c) The number of ship classes distinguished:

i. One limit or target could apply to all vessels, but we expect it would be far more feasible and effective to set different limits or targets for a relatively limited number of ship categories[6], for a more detailed subdivision of ships, or even per ship.

d) Whether the requirement would apply to EU-flagged ships or to EU-based operators only, or to all ships to/from EU ports irrespective of their nationality in order to avoid discrimination and economic distortions (see above).

e) How to deal with the cyclical nature of the maritime sector. At the top of the cycle, ships sail with full loads (which reduces the CO_2-index) at high speeds (which increases the CO_2-index). At the bottom of the business cycle, the load and speed decrease.

As mentioned above, the main technical hurdle to this option in our opinion relates to points b, c and e above. There is currently insufficient knowledge on the CO_2-index of the different types of ships, and on the effects of economic developments. Such knowledge is required to determine a) the feasibility and desirability of setting a CO_2-index limit or target, b) to what extent different targets are required for different vessel types, and c), ultimately, to decide on a limit or target system.

Once a CO_2-index limit or target is set, this policy option might be an effective means to reduce CO_2-emissions. In order to meet the target, ship operators can reduce the index of a ship by various operational means, such as increasing load factor, improving transport efficiency, reducing speed, etc. This will have a direct impact on CO_2-emissions. Furthermore, when a new ship or engine is bought, it will give owners an incentive to pay attention to the fuel efficiency (in addition to fuel cost).

Typically, a limit or target will only affect those operators or ship owners that fail to meet the limit. Once the limit is met, there is no incentive to further improve the performance. The measure will thus be effective if the limit or target (and the non-compliance penalty) is set at a level at which the ships with relative low fuel efficiency are encouraged to improve their performance. It is currently too early to estimate the potential effect. Note that there is a risk that the effectiveness of this option will be reduced due to evasion (discussed below) of the policy by flagging out, in case it is limited to ships with EU-flags or operators.

Monitoring, enforcement and compliance

Monitoring and checking of compliance will be in line with the previous option. Since in this option, a penalty is imposed on ships that do not comply with the limit or target, there will be a stronger need for enforcement and compliance.

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[6] Such as the 19 main categories used in Lloyd's Register, distinguished by LMIU Code. It may be expected that ship size and ship age influence its performance.

Conclusion

It is too early to determine the feasibility of this policy measure. The limit or target should at least be differentiated to ship size and load type, but further data gathering and analyses is required before a definite conclusion can be drawn. Furthermore, it is not yet clear how global market developments affect the index. And finally, questions remain with regard to the legality of the option itself and the necessary enforcement actions.

The effectiveness of this policy option is strongly dependent on the limit or target, and the details of the system. Furthermore, the effectiveness may be reduced if evasion occurs, in case the system is limited to EU-flagged ships or EU-based operators. Such a limitation may also lead to economic distortions. However, provided that the policy measure could be introduced on a non-discriminatory basis and that a sensible target can be set, this option could be an effective means to reduce CO_2-emissions, since it promotes both technical and can.

4 Inclusion of a mandatory CO_2 element in port infrastructure charging

Executive summary

*A **differentiation of harbour dues** has a large environmental effectiveness and could be effective ways to address the climate impact of shipping. However, it is not clear at this stage that a limit value of the CO_2-index can be assigned to vessels that would present an incentive to all vessels to reduce emissions, and would do so in all phases of the business cycle. Likewise, it is not clear at this stage that a basis for differentiation of harbour dues can be found that would not distort the competitive market between ports and would incentivize vessels to reduce emissions.*

Introduction

Ship operators pay harbour dues to port authorities for the use of the harbour (although under some charter contracts they may pass on the costs to the charterer). Harbour dues are one of the few charges paid by ship operators to authorities and possibly the only charge that is paid by all ships visiting certain ports, regardless of their flag. Harbours have a large autonomy in establishing their dues. As a result, dues differ both in level and in basis. Most harbours levy harbour dues on the basis of gross tonnage of a ship. In addition, some harbours levy dues on the basis of the amount of cargo loaded or discharged. Other harbours charge vessels on the basis of their volume. In principle, harbour dues could be differentiated in order to provide incentives to reduce CO_2-emissions. The incentive could either be targeted at increasing the fuel efficiency of a vessel through improved performance or though implementing technical measures. In all cases, the differentiation of harbour dues would increase the return on the investment in fuel-efficiency measures.

The main advantage of using differentiated harbour dues as a policy instrument would be that the institutional arrangements for the payment of harbour dues and enforcement are already in place. Differentiated harbour dues have proven to be an effective policy measure in Sweden to reduce NO_x emissions of ships (NERA, 2005). A disadvantage of a differentiation of harbour dues is that it could distort the competitive market of ports. There are indications that the price elasticity of demand varies greatly between ports. Setting the level of harbour dues is currently the prerogative of port authorities. When dues would be differentiated, this section assumes that the differentiation is mandatory for all EU ports, and that EU legislation prescribes both the level of differentiation and the basis of the differentiation. This would reduce the autonomy of port authorities in setting their dues.

Design of differentiated harbour dues has two main design elements: the basis for the differentiation and the level of differentiation. Both will be discussed subsequently

The **basis** for the differentiation could be a technical standard, a performance indicator or a management system. Most of the current differentiation schemes are based either on performance indicators (Swedish harbour and fairway dues) or on management systems (Green Award) (NERA, 2005). A performance indicator would show that a ship is sailing efficiently, emitting less CO_2 than average. The main advantage of a performance indicator would be that it would allow ship operators to meet the standard by both operational and technical measures. Ship operators could, for example choose to bring down their emissions by sailing slower or by installing better propulsion systems, and make the trade-off that suits their company best.

Alternatives to using the IMO CO_2-index are conceivable. A CO_2-index for the last trip, for example, would have the advantage that it would give a very direct incentive to increase the load factor or sail efficiently on the trip to an EU harbour. Furthermore, it would directly penalise a ship operator or charterer or shipper who decides to sail with a ship that is not fully loaded or who sails at maximum speed. A disadvantage would be, however, that the index may be unpredictable due to external circumstances such as weather.

Another possible performance standard could be an environmental management standard, such as ISO 14000 or the Green Award Certificate. However, these standards are not (or not primarily) aimed at increasing fuel efficiency. At most, they aim to provide management tools to increase their fuel efficiency. Therefore, such standards would not necessarily result in lower emissions.

The **level** of the differentiation could either be relative or absolute. A relative differentiation would have the effect that in some ports the financial incentive would be much smaller than in other ports. This could incentivise ship operators to send the most efficient ships to the harbours with the highest rebate, and thus maximise profits by a simple rerouteing of vessels without taking measures that would reduce greenhouse gas emissions. This shows that a charge that is differentiated by a per centage of the harbour dues will provide a different incentive in different ports. The incentive will be much smaller in London and Hamburg than in Rotterdam and Le Havre.

An absolute differentiation (e.g., a reduction of € 1,000 for the cleanest ships within a certain type/size class) would have the advantage that the financial incentive for shipowners and operators to improve their efficiency would not differ from port to port. Since many ships do not sail regular routes, their operators do not know in advance how many times they will visit a certain port in the near future. They may, however, make a more reliable calculation with regard to how often their vessels will visit EU ports. This would allow them to make a more accurate business case for an investment in fuel efficient technology.

Apart from the question whether the differentiation would need to be absolute or relative, there is the question how large the financial incentive would have to be to provide an effective incentive to ship owners and operators. Ideally, the financial incentive would be just enough to give ship operators an acceptable return on their investment in those fuel efficient technologies, management and operational practices that are cost efficient from a wider economic perspective.

In general, many technical measures (such as improved propulsion systems or propeller design) would require up-front investments but have negative operational costs: ships would use less fuel. In these cases, investment subsidies would probably be more efficient than differentiated harbour dues. Operational measures, such as slow steaming of crew training, would have low investments but positive operating costs. These measures could in principle be used to calculate the level of the differentiation.

Conclusion

Differentiated harbour dues could in principle be introduced to reduce greenhouse gas emissions of maritime transport. The main advantages of this policy instrument are: i) The institutions for charging port dues are in place and ii) The instrument is efficient, since it incentivises ship owners and operators to take measures to reduce emissions.

However, there are some disadvantages: i) The introduction of an EU-wide scheme of differentiated harbour dues would require limiting the autonomy that port authorities currently have in setting their charges. This could have implications for the economic viability of ports. ii) A differentiation of harbour dues would most likely change the competitive market for ports.

When implementing a differentiation of harbour dues, the following challenges would have to be met:

a) First, care should be taken to connect the differentiation in harbour dues closely to the environmental impact one wants to control. It is not yet clear how this could be done. The IMO CO_2-index would only be feasible if a large number of classes would be defined, and even then, the result could very well be a that fuel-efficient ships would visit EU harbours whereas less fuel efficient ships would be operated in other parts of the world. This would have no environmental benefit.

b) Second, in designing the instrument of differentiated harbour dues, further attention should be paid to determining the optimal level of differentiation, taking the variety of harbours, ships and shipping business models into account.

5 Future inclusion of refrigerant gases from shipping in an EU regulation and/or an indexing system parallel to the CO_2-index

Executive summary

The ***inclusion of refrigerant gases in an EU regulation*** *would have limited environmental effectiveness, but is still recommended to implement as it would open up very cost effective options to reduce emissions.*

Introduction

Refrigerant gases have a considerable global warming potential (up to several thousands of times the global warming potential of CO_2), although their total contribution to global warming seems to be decreasing rapidly as a consequence of the Montreal Protocol (IPCC, 2005[7]).

[7] IPCC, 2005: Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons.

Emissions of these gases from shipping are significant, though there is quite some uncertainty regarding their magnitude. The IPCC guidelines suggest using an annual emission factor for leakages of 17% of on-board refrigerant gases[8]. However, the results of inspections by the Dutch government between 1996 and 2001 have shown much higher refrigerant leaks and thus emissions: on average, 50% annual refrigerant leakage for trawlers and merchant ships, and 80% for cutters[9]. The UNEP estimates that emissions from refrigerated containers and reefers amount to approximately 10%/y[10]. For comparison, the average annual emission rate of refrigerant gases from land-based installations is taken to be 4.5% in the Netherlands. Shipping may thus contribute significantly to total emissions of these gases.

The relatively high leakage rates of refrigeration equipment in marine vessels are partly attributed to the harsh environmental conditions at sea, such as the corrosive salt-laden and wet atmosphere, vibrations and torque. Furthermore, poor maintenance, the failure to detect leaks, the age and complexity of equipment, the technology used and lack of enforcement also contribute to these high leak rates (Klinkenberg, 2005).

Climate impact of refrigerants in maritime shipping

A recent inventory of global refrigerant gas emissions (IPCC, 2005) estimates that about 8.3 ktonne of refrigerants were used in maritime transport and fishing vessels (0.78% of the total global use), with an annual leakage rate estimated to be about 2.8 ktonne (1.1% of the total emissions). Expressed in Mtonne CO_2 eq, global refrigerant emissions of the maritime transport sector are about 9.5-10.6 Mtonne CO_2 eq (CE Delft, 2006a).

European data are not available. However, some member states have estimated refrigerant emissions of ships registered in their state. When analysing the data from ships under Dutch flag, annual emissions are about 350 tonnes. Based on German data, ships with German flag emit approximately 37 ktonne CO_2 eq per year. These emissions are very small compared to CO_2-emissions of maritime transport and land based GHG emissions.

Therefore, we conclude that even though the relative refrigerant emissions are high in the maritime sector, these emissions are only minor in terms of CO_2 eq.

Feasibility of policy options

An inclusion of refrigerant gases in the CO_2-index would in principle be possible. The leakage of refrigerant gases would have to be recorded, multiplied with the global warming potential and added to the CO_2-emissions. It makes some sense to include refrigerant gases in the CO_2-index, since like fuel consumption, emissions of refrigerant gases are likely to increase with the amount of cargo on board and the distance sailed. For fishing vessels, the inclusion may require a workable definition of the amount of cargo, since this obviously varies during as trip of a fishing vessel.

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8 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories.

9 'Enforcement of chlorofluorocarbons regulations on maritime vessels', A. Klingenberg, VROM Inspectorate, Seventh International Conference on Environmental Compliance and Enforcement, 2005.

10 2002 Report of the refrigeration, air conditioning and heat pumps technical options committee, UNEP, 2003.

Irrespective of the exact reporting requirements, we expect potential problems with quality control of the data (and evasion), because the ships involved in international trade will be able to buy their refrigerant gases in countries where monitoring and reporting of these sales are less stringent than in the EU.

The other option would be to include shipping refrigerant emissions in the EU regulations on refrigerant gases. This option would be in line with refrigerant policies in other sectors.

In 2000, the EU has issued Regulation No 2037/2000, which regulates the phase out of production and use of substances that deplete the ozone layer. It is not completely clear, though, whether this regulation also applies to maritime shipping, since the geographical scope of the EC Treaty is in principle limited to the territories of EC Member States (pursuant to Article 299 of the EC Treaty). Accordingly, the general rule is that secondary EC law is limited to the territories of the Member States, except where provided otherwise. Apart from an arrangement on the use of halons in fire-fighting systems, Regulation No.2037/2000 does not contain explicit provisions on its geographical scope or its applicability to seagoing ships in its entirety. Also, the object and purpose of the Regulation do not give reason to assume that its scope logically extends beyond the territories and to seagoing ships. It therefore follows that the general rule applies according to which the scope is limited to the territories of the Member States and not to seagoing ships. There are some arguments that contradict this view but also important arguments that support it. On balance, the argument that Regulation 2037/2000 is not applicable to seagoing ships seems the better one[11].

In 2005, the EU has agreed on a directive for stationary applications and vehicle air conditioning. The use of refrigerants in maritime shipping is not regulated in these proposals. However, the proposal does include the statement that the Commission shall publish a report by 2007 on, among other topics, refrigeration systems contained in transport modes other than motor vehicles. Research by the Dutch Environmental Inspection (Klinkenberg, 2005) suggests that operational measures and improved maintenance of equipment might reduce emissions considerably. For example formal maintenance systems can be introduced, crew members can be trained and made aware of the problem, leak detection systems may be improved. Furthermore, newly constructed ships could be required to install indirect rather than direct refrigeration systems, to replace synthetic refrigerants with natural alternatives, and to apply the principles of Life Cycle Engineering within the design of refrigeration installations.

Conclusion

The climate impact of leakage of refrigerant gases is probably small. However, there are probably many cost-effective options for reducing this leakage. We suggest that a reduction of leakage should be pursued, but not as a main or major element of GHG policy for maritime transport.

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11 Personal communication with Mr. E.J. Molenaar, University Utrecht Faculty of Law.

6 Inclusion of CO_2 emission from shipping in the EU Emissions Trading Scheme

Executive summary

*The most promising option evaluated is the **inclusion of CO_2-emissions from shipping in ETS**. Under this policy, ship operators would have to surrender EU allowances for CO_2-emissions on their voyage to EU ports. This policy would have a large environmental effectiveness, would be feasible to enforce and feasible to implement, provided that a number of design issues can be solved. The legal basis for implementation would also require further study.*

<u>Scope of the scheme</u>

The scheme could in principle apply to many different combinations of operators, type of vessels and geographical scope. We have decided to take a non-discriminatory approach with regard to the operators that are to be included. This means that whether emissions from a vessel are subject to the scheme does not depend on the country in which the operator is based, the country in which the shipper is based, or the flag under which the vessels is operated. At this stage of the project, such a non-discriminatory approach appears feasible from a legal perspective. The main advantage of this approach is that no competitive distortions will occur between operators when competing for the same shipment. Moreover, the emissions covered under the scheme will thus be maximized.

With regard to the type of vessels, we will assume that the scheme will hold for all vessels above a certain threshold, which would have to be further defined in a more elaborate design study. The threshold is intended to reduce the administrative burden for ships that emit a small amount of CO_2. An objective threshold based on the gross tonnage or deadweight tonnage may be best.

The geographical scope of the scheme can be determined in two manners. First, it can relate to where (in a strict geographical sense) emissions take place. The 200-mile zone or the EMEP region could demarcate such a scope. Alternatively, the ‘geographical’ scope of the scheme could relate to the route of the vessel. Route groups that could be distinguished are for example routes between two EU ports, routes leaving from EU ports and routes arriving at EU ports.

Both types of schemes (route-based and one based on where emissions take place) have pros and cons. In general, a route-based scheme may give rise to evasive behaviour where vessels may prefer to go to non-EU 25 ports instead. A vessel could for example call at Kalingrad (Russia) instead of a Polish or Lithuanian port nearby. Freight could then further be transported by road or rail to its final destination. Other non-EU 25 countries where this might occur are Norway, Turkey, Croatia, Bulgaria, Romania, Serbia and Montenegro and Albania. Only the latter two could pose significant problems, since the former are either EEA Member States, which have to implement EU ETS directives, or candidate or accession countries, which in time will need to implement the Acquis Communautaire.

If only the last and next port are of importance for the definition of a route, ships from, e.g., the East coast of South America may decide to call at a North African port before calling at an EU port.

Alternatively, a scheme based on geographical area may also give rise to evasive behaviour. Depending on the costs associated with emissions, ships may decide to make a detour around the area included. This may give rise to additional emissions. The impact will depend on the precise definition of the geographical area.

There is one more argument to may have to be taken into account in the choice between a geographically defined area and a route-based scheme. This argument relates to monitoring. If the scope depends on where exactly emissions take place, monitoring of fuel use needs to be related to the location of a vessel. Instead, if the scope is route-based, data is only required on the total amount of fuel during the trip. This may be less complicated.

We now go over the options for both a geographically defined scheme and a route-based scheme. A geographically based scheme, e.g., 12-mile zone might cause legal problems since they might violate the right of innocent passage and would have limited effectiveness. Without study we discard these options.

A route-based scheme could be based on: a) All voyages between EU ports, b) All voyages from EU ports, c) All voyages arriving at EU ports or d) All voyages to and from EU ports.

Geographical scopes including emissions on voyages from EU port may not be feasible, since ships may change their destination while at sea. The same ship may not visit an EU port again while owned or operated by the same person or company.

A route-base scheme would probably be less problematic from a legal point of view; it would at least not violate the right of innocent passage. It may, however, be difficult to define a voyage under a route based scheme including all voyages ending at EU ports. For example, assume a vessel departing from a non-EU port and calling at another non-EU before arriving at an EU port. Clearly, the emissions of the second stage of the trip would be included. But how should the emissions during the first stage of the trip be treated? That is, should only the emissions from the trip from the last non-EU port to the EU port be included? This would limit the scope of the scheme and therefore its environmental effectiveness. However, the inclusion of all emissions from the first port of departure may be possible in this example, but not in case of a liner service sailing in circles and visiting a number of ports.

A second design element relates to **who would be the most appropriate entity** to assign responsibility for surrendering allowances to. Important considerations with respect for a choice for an entity are: a) Who has the most control over abatement measures? b) Who is best equipped to report emission data? and c) Is enforcement of compliance possible? The access to operational emission abatement measures is very important if the policy is to be effective within, say, 10 years. The reason is the long lifetime of vessels and engines.

We conclude that the operator of the ship is the most logical choice for the trading entity. First, because it would guarantee emission reduction is achieved effectively. Because the operator has direct control over most of the operational abatement options, he can decide with measures would most cost-effectively reduce emissions. If any other entity would be elected, it cannot be ensured that incentives for emission reductions would be passed on efficiently.

Moreover, the operator is most suited to monitor and report emissions from the vessel. After all, the ship operator keeps records of his fuel consumption for his own administration and in many cases to bill his clients. If any other entity would be selected, more parties would be involved in monitoring and reporting emissions, increasing the administrative costs.

The data reported by the ship operators could be verified by making use of average emission factors and combining these with information on the trips made by a particular vessel. This data is collected by Lloyds. Enforcement by Member States could be based on the same procedure as enforcement of payments of harbour dues by harbour authorities. In both cases, the ultimate penalty could be detention of a ship.

The third design element to be discussed is the **climate unit** that may be used. In the current EU, ETS allowances for the emissions of CO_2 are traded. However, the Directive leaves room for the inclusion of other gases.

Allocation and distribution of allowances

In order to be able to participate in ETS, the sector would have to be allocated emission allowances and these would have to be distributed amongst ship owners or operators.

Allocation in shipping can be based on a historical or business as usual baseline, at least if the geographical scope would be intra-EU routes. Data on the amount of emissions in a historical year can be calculated from the Entec database or an update, although it would be advisable to calibrate the database by requiring a representative number of vessels to report emissions in a specific year. After all, the Entec database uses activity data, and this method for calculating emissions generally provides a much higher figure than calculations based on fuel sales. A business as usual scenario for shipping can be based on an analysis of historical data on imports and exports and passenger transport by ferries.

The distribution of allowances cannot be based on grandfathering, at least not for operators engaged in tramp shipping. The reason is that ships from tramp operators may not visit EU ports regularly. If they would happen to make only a few calls at EU ports in the year used for grandfathering, and many calls in a later year, they would need to buy many allowances. On the other hand, a competitor who happened to make many calls at EU ports in the baseline year but only very few thereafter, would receive a large windfall profit. Thus grandfathering allowances would distort the competitive market in the sense that it would penalise growth of transport to the EU by ship operators and reward a decrease of transport, and much more so than ETS does in the current trading sectors, because of the volatility of transport of some firms.

For operators engaged in liner shipping, the situation may be different, since their share of business in the EU may be more predictable. However, in order not to distort the competitive market, it would not be advisable to design a different allocation and distribution method for liner shipping.

Distribution of allowances on the basis of a benchmark (CO_2-emissions per tonne mile, say) would share some of the disadvantages of grandfathering. Furthermore, as Marintek (2006) has shown, it may be hard to design a benchmark that does not discriminate against certain ship classes or sizes. Auctioning allowances would not suffer from the same drawbacks. It would, however, place a considerable extra burden on shipping companies. This could even distort the competitive market for transport if other modes would not face similar burdens.

Scope for evasion

The scope for evasion depends on the geographical scope of the scheme. If only emissions of voyages between EU ports would be included in the scheme, evasion could take place by making an extra call at a port outside the EU. This could be profitable in the Mediterranean, where an extra stop in an Albanian, North African or Middle Eastern port can be made with little extra delay on some voyages. Also in the Baltic Sea, an extra call at a Russian port would be conceivable. If all emissions on voyages to EU ports would be included in the scheme, other possibilities for evasion would be opened. There could be an incentive to make an extra stop at a port just outside the EU. For example, a ship departing from Asia, may be inclined to call at a North African port so to substantially reduce the amount of emissions for which it can be made responsible.

Evasion would reduce the environmental effectiveness of the policy measure. Measures to reduce the scope for evasion should be studied further.

Conclusion

Based on the brief analysis above, an inclusion of shipping in ETS seems possible under a design that would have a route based scope, either for intra EU routes or all arriving vessels. The trading entity would have to be the ship operator and the climate unit could be CO_2 only. An inclusion of shipping in ETS could be effective if evasion can be limited. It would clearly be in the realm of EU policy to include EU-flagged ships on intra EU routes. Whether or not more extensive scopes are indeed possible would need further legal analysis.

GERMANY

1 Sectoral Responsibility based on Ship Activity

Under this option, ship operators, shipping companies or ships are burdened with sector-wide GHG emissions. Responsible entities need to acquire the necessary number of certificates to cover their GHG emissions. Importing port states monitor compliance with the authorities under the UNCLOS port State control.

There are two basic options to assess GHG emissions for individual ships:

a) A GHG indexing/reporting scheme for each ship is established. Each ship receives a ship activity based GHG index [g CO_2/ km]. Overall GHG emissions are calculated by multiplying the GHG index with the distance travelled.

b) The absolute amount of fuel used based on the information contained in the bunker fuel delivery notes is used.

After calling at berth the absolute amount of CO_2-emissions for the distance falling under the scheme will be calculated. The subsequent step is to monitor compliance, i.e., to control whether the corresponding amount of certificates was provided by the responsible entity.

Limitation and reduction of GHG emissions is achieved through an absolute emission cap. Based on base year emissions, an emission target for the trading years is established (e.g., no-net increase, % reductions, etc.).

GHG emission certificates can be distributed in varies ways, including auctioning, benchmarking, grandfathering. Auctioning of portions of the certificates would create additional incentives for emission reductions and could facilitate distribution of allowances by avoiding distortion in competition. If the GHG emission target cannot be reached within the sector itself, additional certificates need to be obtained. The system could be designed in two ways:

a) Additional certificates may be purchased from other sectors.

b) Additional certificates can only be generated by investing in transport projects that reduce GHG emissions in developing countries (similar as the CDM mechanism).

This option encourages ship operators and shipping companies to transport freight more efficiently. The focus on ship activity allows ship operators to transport more freight under equal allowances by increasing utilization, reducing empty trips, etc. Furthermore, ship operators can reduce the number of required certificates when showing proof of a reduction in GHG emissions per distance sailed through their GHG reporting.

A similar approach was recently published in a study under the title "Linking CO_2 Emissions from International Shipping to the EU ETS" for a regional scheme which can be extended to a global scheme. The study also includes further details on how a global scheme for international shipping emissions can be designed.

2 Technical considerations concerning GHG emissions of international transport

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Introduction

To prevent or at least mitigate the negative impacts of global warming any reasonable effort should be taken to reduce especially the emissions of CO_2. In the post-Kyoto regime after 2012 international transport should also be included in the international regime. Any solution should not derogate international trade, especially with developing nations that want to improve their welfare. The following paper deals with difficulties to integrate international shipping into future emission reduction schemes and drafts a possible solution that could be applied for international transport as a sector but also for the shipping industry sector alone.

Background

In compliance with the United Nations Framework Convention on Climate Change (UNFCC) the Assembly of the Marine Environmental Protection Committee (MEPC) of the International Maritime Organisation (IMO) has adopted a resolution /1/1 by which the MEPC is urged to develop mechanisms to reduce GHG emissions from shipping. Several member states of IMO then performed scientific analyses (e.g., /2/) on the basis of available design values. Operational data were not available yet. These analyses revealed significant differences between the ship types and even within the same ship type a remarkable scattering between ships of the same size. Common result for all ship types was that emissions per transport work decrease with increasing ship size (Figures 1 and 2).

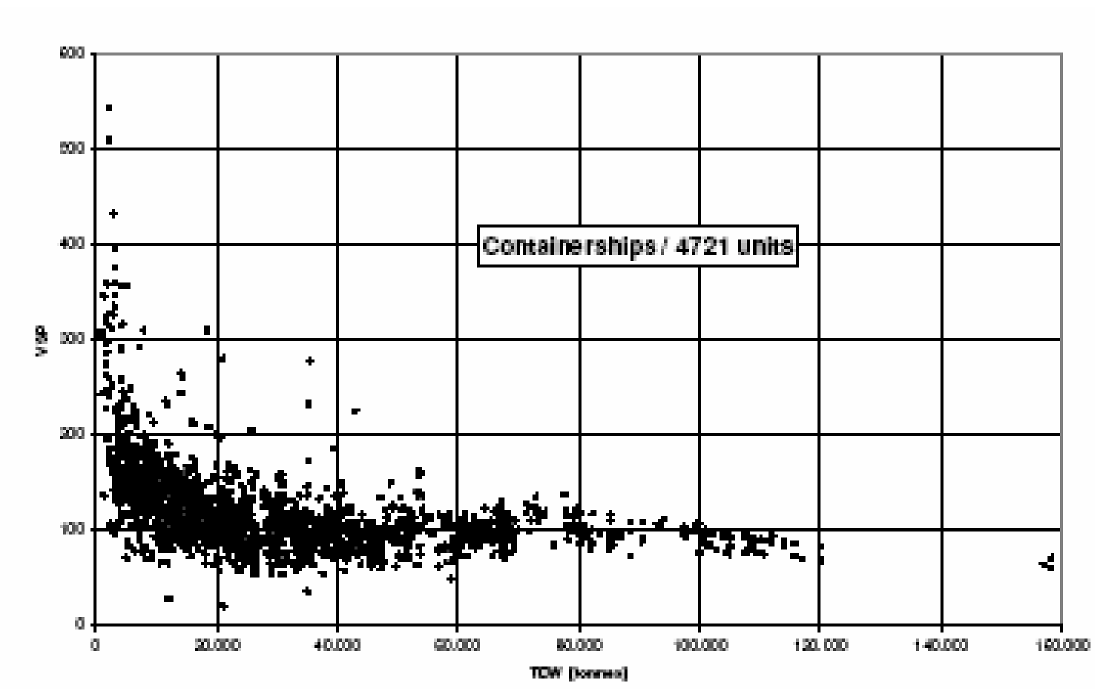

Figure 1 – Specific Value Vsp for container ships

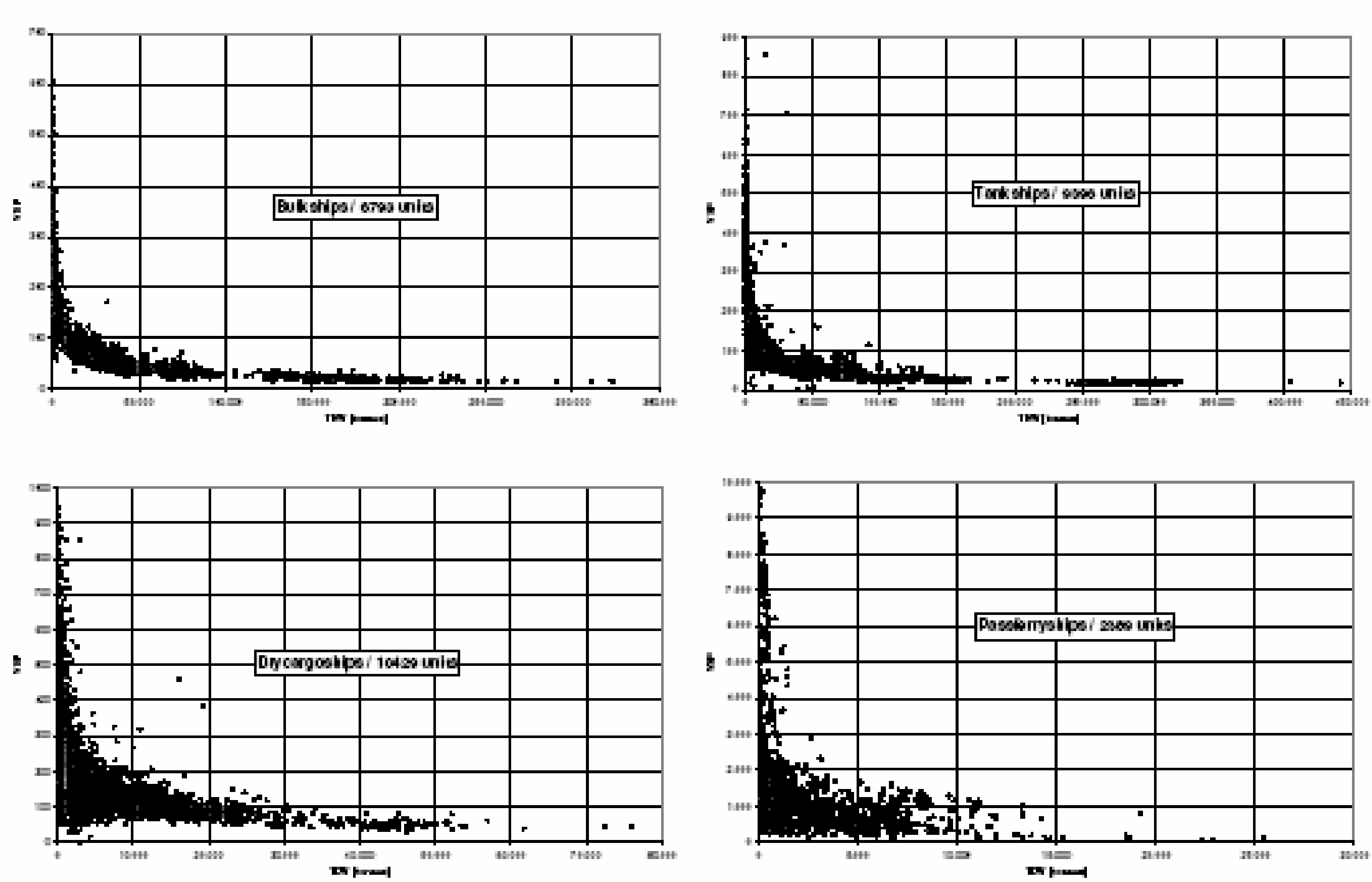

Figure 2 – Comparison of ship type

The analysis of the above results in Figures 1 and 2 show:

. A common baseline for all ships and ship types seems not to be realistic because of their different characteristics

. Even within the same type of ship a formula for the baseline depending on ship size is not suitable and would lead to unpredictable distortion of competition

. Since fuel costs are important for the operational cost of a ship the differences between the specific values are the result of operational and economic considerations

MEPC/Circ.471 (/3/) gives a definition of the CO_2-index for ships that could be applied for test purposes with different definitions of unit of cargo transported with different ship types. These equations were applied for trials and the results were reported in a special workshop to MEPC 53/4/. The results underlined the differences between ship types and ship sizes, however they indicated that reductions of emissions should be possible with improved operation and optimized fleet management. Details for container ships and Baltic Sea ferries are reported and discussed in /5/.

To date land transport, aviation and navigation are treated and discussed separately, while the EU discussions are concentrating on aviation. The environmental (CO_2) indexing of ships will be discussed at MEPC within an agreed time schedule /6, 7/, considering technical, operational and market-based methods for dealing with GHG emissions (action 1(d) of resolution A.963(23)) at MEPC 59, July 2009.

Attempt to find a common solution for the transport sector

The table below describes the causality chain of transport. Only goods that are wanted at the place of their destination will be transported. That means, in consequence, that the customer causes the transport and the related emissions. Of course the single customer can not be made responsible for the emissions because he has no influence on the selection of transport modes, ships, etc. The shipper or importer orders the transport, however, he usually has also no influence how the transport is arranged. This task is performed by the Logistics Company. Since they decide about the modes of transport, they have the possibility to optimise the transport chain with regard to the minimum possible emissions and so they should be made responsible. This seems to be the solution closest to the Polluter Pays Principle.

Player	Action
Customer	Wants goods
Shipper	Satisfies requirement
Logistics Company	Arranges transport
Mix of transport modes	Performs transport

When considering solutions for the reduction of transport emissions any proposal should achieve:

- Reduction of emissions or at least reduction of increase
- No unwanted restrictions in international flow of goods in the global market
- Cost effectiveness of mitigation
- No unwanted change in conditions of competition
- Minimum bureaucracy
- The solution should be neutral to
  - Fleets
  - Region and location
  - Logistics
- The solution should offer possibilities to:
  - Include shipping into Emission trading systems
  - Apply local and/or regional incentive or fee systems
- The solution should enable Emission Trading Systems that include either:
  - The shipping sector alone, or
  - The transport sector as a whole, or
  - Include the shipping or transport sector into existing Emission Trading systems.

Description of the proposed system

From the above it can be concluded that the emission in the first instance should be allocated to the importing nations. However, a differentiation between transport of goods and transport of persons seems to be necessary. With transport of goods the logistics company decides which mode of transport will be chosen. That means the decision is made in the country of arrival. Travelling people decide for themselves, therefore the decision is made in the country of first departure.

When allocating the transport emissions to the importing state, in which the goods are required, the Polluter Pays Principle is followed as closely as possible.

The standards for the assessment of a ship's emission performance could be set by IMO, amending the guideline according to experiences during the trial period (CO_2-index) /3/. The responsibility for the enforcement would lie with the Flag State of the vessel certifying and regularly updating the special index value of the ship. Compliance with the procedure could be checked during the inspections in the regime of port State control.

The regime could be as follows:

To each individual ship an index according to its own emission performance would be assigned. Based on the IMO-proposal for the ship's index a calculation program for use on board and approved by the flag state will calculate the index based on the amount of cargo units transported, the fuel consumption and the emission factor of the fuel used, and the distance sailed for each voyage leg with different amount of cargo. The data should be put into the program after arrival in port, so that the fuel consumption at berth will also be included to the assessment. Based on the indexes for the individual legs a mean value is calculated for one year of operation to reduce the influence of bad weather, high sea states, ice etc.. This value will be updated each year on the basis of the actual performance, should be certified by the Authority and will be valid for the next year of operation.

This index value could then be used in different systems as indicated above:

. Port fees; fairway fees or similar

. Incentive systems

. Emission Trading Systems for ships, the transport sector, existing Emission Trading Systems extended to the transport sector

. Database for publication of ships' indices

. Development of calculation procedure for initial Index for New Buildings (first value).

The indexes of the ships should be published for the information on the interested industry and as basis for the arrangement of ecological transport. The expected result for ships would be that ships with a low index value will attract more cargo, thus reducing their index to the individual optimum. The index values of ships that are not so CO_2-efficient will increase over time by reduced amount of cargo, thus reducing their economy. Furthermore there will be a strong intention to build new ships with the technologically and economically lowest CO_2-index as possible. This means that the proposed system has the inherent potential for self sustained improvement. Thereby good ships become more and more attractive and less efficient ships will become unattractive and will eventually be pushed out of the market.

Full advantage could be gained from this approach if all means of transport would be equipped with such an index. For a mass market as, e.g., for trucks, this could be a value valid for a special type of truck. In an introductory period emissions caused by the import volume of the participating states should be monitored. Then deliberations could start to set emission limits and to allocate allowable emissions to the importing nations (UNFCCC). The importing nations distribute their allowable transport emissions under national control to logistics companies that decide on the composition of transport modes in a specific transport task. These emissions could then be included in the existing emission trading systems. The verification of spent emission allowances could be based on the existing freight documents with information about the amount of cargo shipped, the distance of the transport and the CO_2-index of the vessel in question.

If the index should be used as basis for port and/or fairway fees, a fair comparison of ship types and ship sizes is required. A way forward could be to plot all indexes of one ship type into one graph as function of ship size in cargo units (TEU, tons, m^3, etc.). The calculated regression curve represents the mean value as function of ship size. All ships with an index higher as the corresponding value of the regression curve would have to pay higher fees, ships with an index below would get rebates (similar to the approach with the Swedish Fairway dues). The different regression curves for the ship types could be a basis for the comparison of ship types and should be updated on a regular basis.

Advantages

When considering the information in /2/ it becomes obvious that a reasonable definition of baselines for ship's emissions will need lengthy discussions and may end in a very complicated system. This can be minimized by such an indexing system with individual values for ships. In the full implementation of the system the logistics company in a special transport task requires means of transport for:

a) a specific type of cargo

b) on a specific route and

c) in a specific time frame.

Only a relatively small selection of ships will fulfil these requirements. Out of this selection the logistics company will choose the ship with minimum emissions, because that will help to optimize their performance and competitiveness. The system could equally be applied to all flags regardless whether a flag state has ratified the IMO indexing instrument or not. Furthermore the indexing could be agreed by the majority of IMO Member States.

The importing Nations who cause transport are responsible for the emissions and their reduction (Polluter Pays Principle) while the use of international IMO standards and regulations guarantees comparability when ships are classified individually by their CO_2-index. The IMO standard of equal treatment of all ships is maintained.

Since the system is based on the import of goods it could be implemented regionally and stepwise with the first region requiring the CO_2-index of the ship as a prerequisite to be allowed to import cargo via its ports. The burden would lie on **all** importing nations not only on the port states. The information necessary for the calculation of the index should be available on board and/or in the offices of the ship operator and could therefore also be calculated retrospectively.

From the present state of development of the proposal it seems to be possible to extend the system from ships only to other modes of transport and to include the international transport into the existing national Emission Trading Systems without additional structures. And finally there should be no differences in the treatment of national and international legs in the whole transport chain. If other modes of transport would be included an incentive for a modal shift towards more environmentally friendly modes of transport could be the result (e.g., from road to sea).

Disadvantages

If the allowable emissions would be included into an Emission Trading System the transport cost could increase and thus negatively influence international exchange of goods and improvement of welfare of developing countries.

This would also be the case for emission dependent port and/fairway fees. This solution might also change the competition between ports with resulting influence on the local socio economic conditions in ports and their hinterland. That means the traffic could be relocated with unwanted results in total emissions.

Expected Results

In a completely implemented system for all transport modes the logistics company wants to ship largest amount of goods with minimum emissions since this will result in their best operational results. Therefore they will select the optimum mix of transport modes for their requirements. This will result in environmental competition between the transport modes and between carriers of the same type and size. In a system only including maritime transport there will be environmental competition between carriers of same ship type and size.

The equation for the calculation of the CO_2-index results in a lower value for ships with high transport work, i.e., with best utilization of transport capacity. That means that ships that attract more cargo will improve their index. This will in the long term result in a continuous improvement of emission characteristics, since ships with a good index will attract more cargo, thus further reducing the index. This cargo is withdrawn from other ships that consequently will have a higher index value. Therefore the system will generate a profit driven incentive to improve environmental performance and a tendency to order new buildings with low CO_2-index.

Open questions

There are some questions to be solved including:

. How to treat transboundary land based traffic after unloading of the ship (e.g., Rotterdam to Luxemburg, Austria, etc.) Proposal: allocate ship's emissions to the finally receiving state. Same allocation of other transport modes, perhaps with no individual index for a truck or railway but using a design based index for small units depending on, e.g., type of truck (similar to fuel consumption of cars).

. To minimize administrative effort, is there a minimum size of Logistics Company for allocation? How to treat the smaller ones?

. The MEPC Circular does not yet include the fact that when a ship is full, she is full. That means for instance that the ship can not be made responsible for the content of the container (full, empty, feathers, rugs, iron, etc.) The solution should be generalized for all types of ship, depending on their cargo characteristics.

. To date unclear is a possible solution for ships with mixed cargo (trains, trucks, cars, passengers). However, this would mostly apply to ferries that operate in regular service and an individual approach could be conceivable.

. How to treat transboundary land based traffic after unloading of the ship? Is development /improvement of existing systems feasible?

Conclusions

Environmental efficiency

. The calculation of the CO_2-index and the allocation of allowances to logistics companies will in the long term result in a continuous improvement of emission characteristics of ships.

. If the system is only applied to ships the shipping sector contributes its share to reduce the greenhouse gas emissions effectively.

. If other modes of transport would be included an incentive for modal shifts (e.g., from road to sea) could result in the best achievable emission reductions in the transport sector.

Economic efficiency

. The system could be extended to other modes of cargo transport. The international transport by ships could be included into the existing national Emission Trading Systems without additional structures.

. In a completely implemented system for all transport modes the logistics company wants to ship largest amount of goods with minimum emissions since this will bring them the maximum profit.

. Profit-driven incentive improves sustainable environmental performance.

. If the allowable emissions would be included into an Emission Trading System the transport cost could increase and thus could negatively influence international exchange of goods and improvement of welfare of developing countries.

Fairness

. The importing Nations who cause transports are responsible for the emissions and their reduction (Polluter Pays Principle).

. The use of international IMO standards and regulations guarantees comparability when ships are classified individually by their CO_2-index.

. In a completely implemented system for all modes of transport both national and international legs in international transport contribute to emission reduction.

Political practicability

. An equal treatment of all ships independent of flag is maintained by an IMO regulation that requires a ship to have a certified CO_2-index.

. International IMO standards and regulations guarantee comparability of ships of same type and comparable size by means of the CO_2-index.

. Regional (EU) and stepwise implementation possible since the system is based on import of goods.

References

1) Resolution A.963(23), "IMO policies and practices related to the reduction of greenhouse gas emissions from ships", 5 December 2003, Annex I

2) MEPC 51/INF.2: "Statistical investigation of containership design with regard to emission indexing", 22 December 2003, Annex II

3) MEPC/Circ.471: "Interim guidelines for voluntary ship CO_2-emission indexing for use in trials", 29 July 2005, Annex III

4) MEPC 53/WP.3: "Report of the One-day Technical Workshop on GHG Indexing Scheme held at IMO Headquarters on Friday, 15 July 2005", Annex IV

5) Krapp, R.: "Assessment of Fuel Efficiency in Operation", Green Ship Technology Conference, Hamburg 2006, Annex V

6) MEPC 55/4, "Report of the Working Group on Air Pollution (Part 2)", 18 April 2006, Annex VI

7) MEPC 55/23, "Report of the marine environment protection committee on its fifty-fifth session", annex 9, "Work plan to identify and develop the mechanisms needed to achieve the limitation or reduction of CO_2-emissions from international shipping", 16 October 2006

FRIENDS OF THE EARTH INTERNATIONAL

1 Market-based measures combined with other emissions reductions initiatives

Executive summary

FOEI strongly asserts that a "multi-instrumental" approach is the best way to reduce GHGs from ships, combining operational, technical, and market-based measures (MBIs) with policies, regulations and other mechanisms, which will re-enforce each other and result in a more effective and efficient policy. This document was produced by a coalition of environmental NGOs.[12]

Introduction

The contribution of maritime transport to climate change is significant. Carbon dioxide (CO_2) emissions from the international shipping sector as a whole exceed annual total greenhouse gas emissions from most of the nations listed in the Kyoto protocol as Annex I countries (Kyoto Protocol 1997). While shipping moves cargo more efficiently than goods transport modes, GHG emissions from maritime transport now exceeds that of commercial aviation and has been estimated to generate from 1.5% to as much as 5% of worldwide CO_2-emissions, depending on the base year and calculation method.

1 World shipping activity and energy use are on track to double from 2002 by about 2030, according to Corbett, et al (2007)[13] . Growth rates are not likely to be reduced without significant changes in freight transportation behaviour and/or changes in shipboard technology. Results also show that ocean shipping has become less energy efficient. These facts must be considered if the IMO is to achieve its objective of limiting or reducing the contribution of maritime transport to climate change by 2012, compared to 1990 levels.

2 MBIs, if rigorously designed and implemented, can be a powerful tool for reducing GHGs from shipping because they can internalize external costs into transport prices; provide an incentive to operate ships with lower emissions; reward better operation of ships and investment in new technologies; and foster innovation. MBIs can also correct market failures.

3 Market-based options to consider for reducing GHGs from shipping should include: (1) Marine Fuel Taxes; (2) Emissions Trading (3) En-route emission charges; (4) Differentiated Port Charges; (5) Environmental Indexing.

4 MBIs can also be manipulated and fail to achieve real emissions reductions if not properly designed and implemented. For example, recent experiences with the first phase of the European Unions' Emission Trading System for the industrial sector encountered a number of shortfalls due to over-allocation of emissions allowances, failures to reward

[12] 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.
[13] See BLG 11/INF.3.

cleaner technologies and actually allowed for a 4.3% increase in CO_2 for EU 15 emissions between 2005 and 2007 compared to base years[14].

5 MBIs also have the potential to create unintended consequences, such as exposing environmental justice communities near ports, coastlines or even hundreds of miles inland to higher levels of shipping emissions if allowances and offsets are not carefully balanced.[15] For this reason, any offsets in an emissions trading scheme should be restricted by geographic or quantitative limits.

6 The IMO GHG study identified a number of market-based measures that have the potential to reduce greenhouse gas emissions.[16] One of the primary findings was that "voluntary agreements were not found to be a viable approach to obtain significant GHG emissions [reductions] from international shipping" (page 20). Considering the current climate-change crisis, FOEI agrees that any international GHG-reduction for ships must be based on schemes with accountability that can be measured and monitored for results.

7 What's urgently needed are initiatives that will trigger large reductions in CO_2-emissions from ships and reduce the cost of cutting CO_2-emissions. Low-level taxes or lax emissions trading schemes may lead to short-term perspectives when planning investments (due to discount rates and net present values) and have very little effect on long-term structural change and technological innovation. A system that *only* reduces emissions where they can be obtained at lowest cost today (and that may be outside the shipping sector, depending on tax levels and fuel prices), without addressing the need for long term structural change are not sufficient or acceptable. An emissions trading scheme alone will not be enough to seriously reduce the environmental impact of the sector.

8 A **marine fuel tax** may be among the most effective MBIs. Applied globally, it would encourage fuel efficiencies among all vessel types, new and old, and could also encourage slower speeds and improved efficiencies at ports. It is likely to be much easier to administer and monitor than an emissions trading system. The administration cost is likely to be lower for a tax-on-fuel-system than emissions trading. The tax could be used a funding element in a carbon reduction scheme as proposed by Norway (MEPC 56/4/9).

9 If a fuel tax is truly global, covering all ports, the easiest system would be a tax related to fuel purchases. Alternative emission allocations are only relevant when there are (significant amounts of) fuel sales able to avoid the tax. Of the alternatives discussed, taxing the importation or exportation of goods or taxing a ship when visiting regulated ports seems to be the most relevant.

10 **En-route emissions** charges and differentiated port charges that reward ships that meet emissions reductions standards is another approach that may be viable, such as the Swedish Fairways dues program. This could involve implementation of **environmental indexing** where each ship's emissions would be measured and then rewarded when reduced.

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14 Climate Action Network Europe "National Allocation Plans 2005-7: Do They Deliver?: Key Lessons for Phase II of the EU ETS, Summary for policy-makers, April 2006.

15 See http://www.climatechange.ca.gov/policies/market_advisory.html, Chapter 2.4 and http://www.arb.ca.gov/cc/ejac/ejac.htm

16 IMO Study on Greenhouse Gas Emissions From Ships, 2000, Marintek, Corbett, *et. al*.

11 Until a global scheme for ships is decided, nations and/or groups of nations may wish to wish to start to implement GHG reduction programs and to report their decisions and experiences to IMO. Then, the IMO's role would be to review various state options in these areas; to encourage a common approach among the various states; and finally propose a global approach.

2 Vessel speed reductions and operational measures

Executive Summary

Vessel speed reductions, weather routeing, and improved efficiencies in logistics and voyage planning are several operational approaches for immediately reducing the growing volume of GHGs from shipping. This submission focuses on vessel speed reductions. 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 re-enforce each other and result in a more effective and efficient policy. This document was produced by a coalition of environmental NGOs.[17]

Vessel Speed Reductions

1 A fleetwide 10 per cent speed reduction would result in a 23 per cent decrease in CO_2, according to the 2000 IMO Study of Greenhouse Gas Emissions from Ships. In fact, a reduction in vessel speed was identified as the single measure that results in the highest reductions of CO_2. Reducing vessel speeds would also result in beneficial reductions in criteria air pollutants and could help reduce ship strikes of whales and prevent shoreline erosion in channels and harbours.

2 Several vessel speed reduction programs that can serve as models for an international regime are already in place that have achieved significant reductions in emissions from ships with high compliance and without disrupting global trade.

3 In May 2001, a Memorandum of Understanding (MoU) between the Ports of Los Angeles and Long Beach (POLA/POLB), the United States Environmental Protection Agency, California Air Resources Board (ARB), the South Coast Air Quality Management District, the Pacific Merchant Shipping Association, and the Marine Exchange of Southern California was signed and later extended to today. This MoU specifically requests OGVs to voluntarily reduce their speed to 12 knots at a distance of 20 nautical miles from the POLA/POLB.[18]

4 The estimated reductions were 1 ton per day of NOx with compliance rate of 45 to 65 per cent. Now the Port of Long Beach offers reduced dockage fees for compliance, achieving an 80 per cent compliance rate and reductions of 4 to 5 tons per day of NOx.

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17 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.

18 See: *http://www.portoflosangeles.org/Press/REL_VSRProgram.pdf*

5 As part of its efforts under the Diesel Risk Reduction Plan, Goods Movement Emissions Reduction Plan, and Assembly Bill 32 – Greenhouse Gas Initiative, the ARB staff is evaluating the need to develop a mandated ocean-going vessel (OGV) speed reduction programme.

6 With a mandated program of reducing speeds to 12 knots within 24 nautical miles, assuming MDO in auxiliary engines and HFO in main engines, ARB estimates a 31 per cent reduction in CO_2 or 90 tons per day at the Port of Long Beach. They are evaluating 40 nm, 100 nm distances relative to emissions, cost, human exposure, and effectiveness. A Technical Assessment is due late 2007.[19]

7 On the St. Lawrence River in Quebec, Canada, commercial vessels slow down to an average of 12 knots (14 knots downstream, 10 knots upstream) in a program designed primarily to reduce shore erosion.[20] The measure involves reducing speeds in five river sectors covering 30 km.

8 Slowing speeds has not evidently caused ship operational problems in the areas where they have been implemented. However, the IMO study noted that operational issues could arise when ships run at less than optimal speeds for long periods of time. The authors suggest that for ships permanently operating at slower speeds potential problems could be solved by engine modifications and/or de-rating.

9 An international program to reduce vessel speeds could include mandatory speed reductions either in specified zones, such as within 200 miles of any coastline, and or globally. A phased-in program could slow speeds over a period of time to allow the goods movement system to adjust to slightly longer shipping times between ports. In any case, it should apply to all party nations and flags.

10 Small speed reductions of as little as 1 knot combined with a 25 per cent decrease in turn-around time at port can afford important GHG reductions in the range of 1 to 4 per cent, according to the IMO 2000 study.

11 Setting international speed limits for ships could help modify the trend toward higher installed power and energy use by container, cargo and cruise ships that, along with growth, are fueling increases in GHGs from the shipping sector. High-speed ferries should also be considered in this context.

12 Existing research shows that speed reduction measures could be an immediate cost effective way to reduce emissions from ships. However, these options can be further evaluated to determine the best way towards an international vessel speed reduction program. This research should proceed without prejudice to trials or existing schemes around the globe, to evaluate technical, feasibility, economic and trade issues with implementing a global program. This could be addressed under the framework of the update of the IMO 2000 GHG study; and perhaps in conjunction with government agencies already engaged on this issue.

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[19] See*: http://www.arb.ca.gov/ports/marinevess/vsr/docs/pres07122007.pdf*

[20] *See http://www.st-laurent.org/ressources/fichiers/ACommVdesnav.pdf*
http://www.slv2000.qc.ca/bibliotheque/lefleuve/vol11no9/volume11_9_accueil_a.htm

The finding in the IMO GHG study that voluntary programs are not effective for reducing GHGs from ships should be considered.

13 **Other operational measures to consider:** weather routeing[21], improved efficiency of logistics and voyage planning, fuel economy standards for ships, optimal ship and engine operation. Some shipping lines are already implementing efficiency measures, such as Maersk.[22]

14 There is a need to consider the need for a combination of several operational measures – speed reductions, weather routeings and voyage planning – in order to ensure that fuel consumption and emissions from ships are minimized in every trip. For example, there is a need to further work on the managements and planning of ship voyages in order to avoid that ships are travelling at high (inefficient) speeds in certain parts of their trips and stopped, queuing or sailing at sub-optimal speeds in network bottlenecks or ports.

15 Increasing the efficiency of logistics for shipping could mean a considerable lowering of CO_2-emissions. Nowadays, in many cases ships run at high speed to the port of destination and then have to wait for days or even weeks to get their cargo loaded or unloaded. If ports would give ships a timeslot – just as happens in aviation, ships could be operated at economic speed and shorten the waiting time.

3 Technical measures effective in reducing ships GHG emissions

Executive summary

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 per cent total, in combination[23]. 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 efficient policy. This document was produced by a coalition of environmental NGOs.[24]

<u>Introduction</u>

1 Technical measures alone have the potential to reduce carbon dioxide emissions from new ships by up to 30 per cent and in existing ships by up to 20 per cent, according the IMO 2000 Study on Greenhouse Gas Emissions from Ships.

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21 See http://www.weather.navy.mil/paoweb/starsams.ppt
22 See ttp://www.maerskline.com/link/?page=brochure&path=/about_us/environment/efficient_transportation
23 Study of Greenhouse Gas Emissions from Ships, International Maritime Organization, 2000.
24 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.

2 These include optimised hull shape, choice of propeller, efficient power plants, switching from HFO to MDO (tailpipe) and in-engine improvements such as fuel injection. These are discussed at length in the study. All should be considered in developing an international programme to reduce GHGs from ships.

3 New technologies. Several new technologies for reducing fuel use in ships have been developed since the IMO study that should be considered when developing an international program for reducing GHGs from ships:

4 Renewable wind power can be harnessed by OGVs with sails and kites being designed for commercial shipping. There are many examples of applications that lead to significant emission reductions: Sky Sails claims a range of 10 to 50 per cent reductions in fuel use with its kite system[25]; the Kite Ship company is also developing sail configurations for ships[26]. A case was made for wind power for ships in a study on the BeauForce Kite system[27] and wind power was cited by the Intergovernmental Panel on Climate Change as a "promising" and "even cost-effective" measure in the short-term for reducing GHGs from ships.[28]

5 At MEPC 56, an air cavity system that reduces ship hull friction was highlighted that can reduce use of fuel and resulting GHGs[29].

6 Alternative fuels and fuel cells: Use of alternatives to marine fuels could also achieve significant reductions in GHGs: use of natural gas (20 per cent 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 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 to 40 per cent.[30]

7 Shoreside power 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 per cent.[31] The reductions will vary depending on the power source for the electricity and emissions profile of other shoreside generation.

8 The first critical step would be to complete the process of establishing international standards for ship plug-ins and port facilities.

9 The turn-around time in port and corresponding energy use can account for 4 to 15 per cent of total energy use per trip for ships, according to IMO study. As much as

25 http://www.skysails.info/index.php?L=1
26 http://www.kiteship.com/
27 http://www.lr.tudelft.nl/live/pagina.jsp?id=8f339bfe-e114-436f-a707-eab1a5ccdac2&lang=en
28 IPP Fourth Assessment Report, Working Group III, Mtitigation of Climate Change, 5.3.4.10, Pg 48
29 http://www.dkgroup.eu/
30 *Ibid*, 5.3.4.20
31 Service Contract on Ship Emissions, Task 2A – shoreside electricity, European Commission, Entec, 2005

30 per cent of ship emissions generated during a port call is generated during hoteling. Equipping ships and ports to utilize shore power could offer significant CO_2 reductions particularly in heavy shipping corridors.

10 Several ports and fleets along the West Coast of North America already installing or plan to install shoreside electricity for ships including the Ports of Los Angeles and Long Beach, Seattle, San Francisco, and Juneau, AK. In Europe, the Port of Gothenburg, Sweden; and Amsterdam, Netherlands, have ongoing programmes.

11 The California Air Resources Board is developing a new regulation to require a percentage of ship calls per terminal to plug-in to shoreside power to be phased in over time.

12 The NYK Line recently announced that 38 of its existing and new vessels would be equipped to plug- in by 2009[32]. Many other shipping companies have shore-power programs including 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.

13 The Port of Oakland, CA, recently completed a "proof of concept" for shoreside power using an on-dock diesel generator operated on natural gas that achieves 42 per cent reductions in CO_2 compared to an on-board auxiliary engine running on marine distillate (out the tailpipe).

14 In the previous paragraphs it has been shown that there is a number of technology options available in the market and under development that allow a significant cut in GHG emissions from ships. It is important that IMO recognizes the progress that has been made in this field and encourage States and stakeholders to continue supporting R&D in this field.

15 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. Moreover, 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.

[32] http://www.nykline.co.jp/engliSH/news/2007/0426_1/index.htm

JAPAN

1 Option A: Principles of dealing with GHG emissions from international shipping

Category of methods

Technical, operational and market-based (common principle in any methods)

Executive summary

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.

Principles of dealing with GHG emissions from international shipping

Japan is of the opinion that 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.

1. 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.

2. 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.

3. 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.

2 Option B: To provide an external verification scheme for CO_2-index

Category of methods

Technical, operational and market-based

Executive summary

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.

To provide an external verification scheme for CO_2-index

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.

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.

Actually, there are so many calculation mistakes and different interpretations in CO_2-index calculation thorough internal verification by each private ship operators. In evaluation of all the future reduction options, whether it is voluntary or mandate, the external verification for CO_2-index will be needed.

Consequently, we will provide an external verification scheme for CO_2-index and enable the only CO_2-index verified through this scheme to use in each individual reduction measure.

3 Option C: Estimation for CO_2-index of newbuild ship using real test mode

Category of methods

Technical

Executive summary

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 evaluated in this test mode.

Estimation for CO_2-index of newbuild ship using real 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 newbuild ship at construction. On the other hand, many technical options for GHG reduction has been developed but not been used widely. In order to promote wide use for these technologies, the evaluation tool which can predict the GHG reduction 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. A shipowner and a stakeholder can easily select the better GHG reduction technology at construction.

These modes are more complex than E3 mode for Diesel engines and should be based on real operation mode. Moreover, evaluation of individual GHG reduction technology should be reviewed and verified same as operational CO_2-index.

4 Option D: Traffic control / fleet managements on reduction of GHG emission

Category of methods

Operational

Executive summary

With developing E-Navigation, the traffic control/fleet managements achievable of the efficient shipping operation would be globally established, and policies of traffic control/fleet managements on reduction of the amount of GHG emission from ships could be considered in the future.

Mechanisms for dealing with GHG emissions from international shipping

For the international aviation sector, it has already announced that EU introduces ATM (a common programme for Greener Air Traffic Management) from 2009 to their area, and the large amount of GHG reduction will be expectable. Considering that there are many vessels waiting for the voyage through bottlenecks of sea-lane, such as some port with geographical complex, canals and straights, the GHG reduction by the slowdown cruising speed according to shortening waiting time for these bottleneck will be possible using same ATM over a wide sea areas.

We think E-Navigation would be used as one of above the efficient shipping operational scheme. IMO/NAV has considered the strategies of safety operation in the future, making use of information technology under the item of E-Navigation. Some concepts in E-Navigation include the ideas of support and control of ships from coastal side.

With developing these ideas, the traffic control/fleet managements achievable of the efficient shipping operation would be globally established, and policies of traffic control/fleet managements on reduction of the amount of GHG emission from ships could be considered in the future.

E-Navigation at the moment has considered the strategy, and thought the efficient shipping operation by traffic control/fleet managements would be long-range approach.

5 Option E: Disclosing CO_2-index

Category of methods

Market-based

Executive summary

This is an additional option to Option B. By disclosing CO_2-index assigned to a ship, shippers become able to choose the operator who has ships with a better CO_2-index. Voluntary promotion and natural prevalence of ships with less CO_2-emission is expected in this option. This mechanism would be similar to EQUASIS.

Mechanisms for dealing with GHG emissions from international shipping

Taking into account great interests on the climate change in the market, shippers will willingly choose the operator whose ships have better CO_2-emission, if they become able to reach information on CO_2-emissions. CO_2-index must be a good benchmark to them. Voluntary promotion and natural prevalence of ships with less CO_2-emission is expected by disclosing CO_2-index assigned to a ship.

If an operator wants to disclose ship's CO_2-index in order to promote its own ships, the scheme is as follows.

By using Option B submitted by Japan, it is possible to render assignment of CO_2-index to each ship. Calculation and verification by a third party is included in the assignment of CO_2-index. Further to Option B, the flag State needs to be reported. All data collected by the flag States is to be sent to IMO, or other appropriate organization decided by IMO, and to be open to the public on-line access like EQUASIS. The information should be obtained by any interested parties including shippers.

6 Option F: Rating of the performance of ships with regard to GHG emissions and giving incentive based on the rating

Category of methods

Market-based

Executive summary

Rating of the performance of ships with regard to GHG emissions and giving incentive based on the rating promote the prevalence of less GHG emission ships.

Mechanisms for dealing with GHG emissions from international shipping

On request by shipping companies, the performance of their new ships with regard to GHG emissions shall be rated using the evaluation tool of option C.

On request by shipping companies, the performance of their existing ships with regard to GHG emissions shall be rated based on actual operational records of the ship.

If incentives are given based on these rating, it is expected that operators shall increase the share of less CO_2 emission ships in their own or operate ships.

Consequently, the prevalence of less GHG emission ships will be promoted and the reduction of GHG emissions from international shipping is expected.

7 Option G: Rating of the performance of operators with regard to GHG emissions and giving incentive based on the rating

Category of methods

Market-based

Executive summary

Rating of the performance of operators with regard to GHG emissions and giving incentive based on the rating encourage operators to take an action for procurement, charter, and operation of less GHG emission ships.

Mechanisms for dealing with GHG emissions from international shipping

We will develop an evaluation tool with which we will be able to evaluate totally "The ratio of mass GHG emissions per unit of cargo transport work" of an operator.

On request by operators, the performance of operators with regard to "The ratio of mass GHG emissions per unit of cargo transport work" will be rated using the evaluation tool of 1 based on the actual mass of transported cargo and fuel consumption.

If incentives are given based on these rating, it is expected that operators shall take an action for procurement, charter, and operation of less GHG emission ships.

Consequently, the prevalence of less GHG emission ships will be promoted and the reduction of GHG emissions from international shipping is expected.

8 Option H: Measure sets a GHG reduction target calculated from the projected future increase in GHG emissions and emissions reductions required for each ship

Category of methods

Market-based

Executive summary

Setting a target of reduction of GHG emissions calculated from the amount of increase in GHG emissions in the future, the amount of required emission reduction is assigned to each *ship. Operators have an effort to reduce emissions assigned to their ships. Additionally, the operators might buy emission credit as one of the ways to achieve the target for each ship.*

Mechanisms for dealing with GHG emissions from international shipping

Estimate increases in GHG emissions in the future without reduction measures

Set a target of reduction of GHG emissions increases. This target isn't reduction of total of GHG emissions but reduction of increases of it.

Calculate the amount of required annual GHG emission reductions from the target of reduction of GHG emissions.

The amount of required GHG emission reductions are assigned to each ship with considering the number of increase ships in the future.

Operators which have these ships make efforts to achieve the ships' assigned redaction of GHG emissions. Operators have an external verification to prove ship's assigned redaction of GHG emissions.

The operators might buy the emissions credits as one of the ways to achieve the target for each ship. IMO sets up mechanism for setting the exchange rate between emission credit and emissions from ships.

9 Option I: Expansion of CDM scheme to international marine sector

Category of methods

Market-based

Executive summary

If Parities in UNFCCC or CDM executive board would accept the extension of CDM to GHG emitted from International maritime, the Stakeholder in Annex I countries will pay more attention for this matter and they will make investments in GHG reduction from international maritime. In this extended CDM, their investments can be approved as emission credits from "international marine sector" as same as from "non-Annex I countries".

Mechanisms for dealing with GHG emissions from international shipping

At last MEPC session, we re-recognized that there would be huge difficulties to set the total CAP to each country for GHG emission from international maritime. However, the land source in non Annex I countries without any CAP can provide emission credits in Kyoto mechanisms.

CDM is one of three market-based mechanisms which can be used in Kyoto Protocol. In this mechanism, a stakeholder in Annex I countries can make a GHG reduction project in non-Annex I countries, which have no caps, and they will get the emission credit as CER

(Certified Emission Reduction). This mechanism does not need GHG emission cap or allocation for the sector.

At this moment, the CDM executive board under UNFCCC thinks that it is not eligible to include international maritime in CDM scheme, as follows.

> *The Board agreed to confirm that the project activities/parts of project activities resulting in emission reductions from reduced consumption of bunker fuels (e.g., fuel saving on account of shortening of the shipping route on international waters) are not eligible under the CDM.* (From WP for 25th CDM executive board [EB25 Rep, paragraph 58])

The potential and possibility for reduction GHG(s) in international maritime is so huge. With collaboration with land-sources, we can get the reductions in shifting international land transportation to marine transportation or use of on-land electricity at port instead of D/G.

IMO should claim to Parities in UNFCCC and CDM executive board that all the GHG emission from the international maritime would be regards as the emission from non-Annex I country without any cap. And IMO should works on a CDM executive board to make it possible to build the reduction project using CDM from international maritime.

In the extended CDM, it is desirable for the IMO secretariat to take charge of the role of host administration. And also IMO should specify some class societies as DNA (Designate National Authority). In each application for project, more strict external verification will be needed for comparison between emission with and without reduction project. After this external verification, this reduction could be validated as CER under usual procedure in CDM.

UNITED STATES

Executive summary

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.

Introduction

The United States 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. The United States 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, labeling 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 program 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.

Possible Solutions

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 programs. 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 list below represents an initial brainstorm of possible solutions. The United States is committed to working with any country or organization to further develop these and other appropriate solutions.

Operational Improvements

Providing onshore power to ships while in port: Cold ironing could lead to decreased GHG emissions and reductions in air pollutants and there is ongoing work in the United States in this area. It should be noted that ISO and IEC (at the request of IMO) are working toward developing international standards for onshore power to ships.

Using freight routeing energy and emissions modelling: in combination with short sea shipping methodologies and voyage planning to optimize routeing could lead to sizeable GHG reductions by reducing vessel wait times. Better logistics planning is an important yet often overlooked component in reducing GHG emissions in the entire transportation system and across the whole transportation supply chain.

Energy conservation while at sea: provides a means for shippers and ship owners to reduce fuel consumption and GHG emissions. Some organizations are using incentive-based schemes to get improvements and lower their fuel costs.

Operational improvements at port terminals: also can reduce GHG emissions. Use of more efficient terminal equipment and methodologies for intermodal transfers is one example. Peak spreading programs, such as the "Pier Pass/Off Peak" program of incentives for cargo owners to move cargo at night and weekends to reduce truck traffic and port congestion during peak hours, also offer efficiencies that can reduce GHG.

Technical Improvements

Increased energy efficiency both at sea and in port: offers perhaps the most dramatic reductions in reducing greenhouse gas emissions. 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 sources: such as solar and wind energy can be harnessed at sea to complement diesel fuel as the primary power source.

Fuel cells: show promise for auxiliary power sources, and there could also be potential GHG benefits of increased distillate fuel usage.

Voluntary Measures, Labelling and Standards, and Partnerships

The United States has considerable experience and success with voluntary partnerships such as the SmartWay Transportation Program (http://www.epa.gov/smartway) and the National Clean Diesel Campaign (www.epa.gov/cleandiesel) run by the United States Environmental Protection Agency. These and other partnerships could be a model for a potential international partnership designed to reduce maritime emissions.

IMO could develop a green label which is awarded to shippers that meet certain criteria. The green label would provide companies with a competitive advantage as they would be consuming less fuel. There is a Green Flags program in some ports on the west coast of the United States which have experience in this.

Information Exchanges/Outreach

Developing best practices: could provide an easy and practical means for shippers and ship-owners to increase fuel efficiency and decrease their emissions. For example, the International Association of Ports and Harbors is developing a Tool Box for Port Clean Air Programs that provides international examples of best practices for maritime operations.

Working to improve data on global GHG emissions from shipping: is important as there is no current comprehensive and reliable data set on global GHG emissions from international shipping. Better data is imperative as we work towards developing policy solutions.

AUSTRALIA

Executive summary

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.

Background

A number of reports commissioned in recent years indicate that GHG emissions from international shipping comprise around 2 per cent of global emissions. Australia acknowledges that the shipping sector has a role to play in reducing GHG emissions.

It is 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 proactive, 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 recognise and harness the range of policy measures that member States can adopt and deploy to reduce GHG emissions, and facilitate cooperation across a range of actions with climate-friendly outcomes. Australia thus 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, which are introduced on the basis of mutual agreement by affected parties only.

Australia considers 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

Australia considers that 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 cooperation 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.

THE NETHERLANDS

Executive summary

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.

I Technical measures

Input

1. **Technical measures** can be divided in several categories, namely measures for existing ships and measures for new ships and existing and new technologies.

2. With so-called existing technologies the following measures are available:

   a) existing ships[33]: optimalisation of hull and/or propeller, fuel: switching from HFO to MDO and improvements of engines.

   b) New ships[1]: optimised hull shape, choice of propeller, fuel: MDO instead of HFO, efficiency optimalisation, monitoring of the machinery.

3. Also 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[34];

   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[35].

   e) use of an 'Econometer', an instrument that indicates the optimal speed of a ship with respect to fuel consumption.

   f) to include 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[36].

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[33] See also IMO 2000 Study on GHG Emissions from Ships (MEPC 45/8).
[34] http://www.skysails.info/index.php?L=1.
[35] Project PELS – Project energy-saving by air lubricated ships http://www.senternovem.nl/mmfiles/Project_Energiebesparende_Luchtgesmeerde_Schepen_PELS_EETK20003_tcm24-188414.pdf.
[36] MEPC/Circ.471 'Interim Guidelines for Voluntary Ship CO_2 Emission Indexing for Use in Trials', 29 July 2005.

(See also market-based measures: Harbour Dues).

4. Its 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 not always (technically) can be optimised.

II Operational measures

Input

1. **Operational measures**[37] can be integrally used for as well existing ships as for new ships. Although in some areas the operational measures can be optimized if a ship is also technically adapted for such measures (e.g., reduced time in port through optimized ship design concerning cargo handling, such as the so-called open-top containership).

2. The following operational measures can be of positive influence on GHG emission, such as:

   a) speed reduction;

   b) optimalization of use of engine(s) by:

      i) better revolutions per minute (rpm) control;

      ii) optimalization of propeller pitch control;

      iii) optimalization use of rudder (e.g., minimalization of rudder angle to maintain course).

   c) optimizing loading conditions by:

      i) optimizing trim;

      ii) minimum use of ballast.

   d) reduction of turn around time by:

   i) optimizing cargo handling operations;

   ii) optimizing berthing, mooring and anchoring operations.

3. Many of the operational measures can be made more effectively by optimizing the planning, as well for fleet-, ship as routeing planning.

4. General ‘feeling’ is that most of the operational measures, as a stand-alone measure, have a marginal influence on the emission of GHG. Except speed reduction which will have a large influence on the reduction.

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37 See also IMO 2000 Study on GHG Emissions from Ships (MEPC 45/8).

III Market based measures

Input

1. **General:** Reduction of emissions of greenhouse gases, among which CO_2, is a very important element of the environmental policy. The Netherlands' government aim – under certain conditions – at substantial reductions. This calls for efforts of all sectors, including the maritime sector.

2. **Market based measures:**

   a) *Harbour dues*: Introduction of a system of differentiation of harbour dues – using the Polluter Pays Principle – based on amongst emissions of greenhouse gases of seagoing ships. Netherlands is currently carrying out a study concerning this measure[38].

***Note:** to make a system of differentiated harbour dues an indexing system is necessary – which in nature actually is a technical measure.*

   b) *Emission Trading System* (ETS): although an ETS has in potential merits in reducing GHG, as long the extension of ETS to shipping – unless other emission reduction measures are more effective – does not weaken the current system.

   c) Adjusting the Green Award system: a voluntary certificate-system where ships with a high quality and environmental performance get reduction on harbour dues and get other premiums (reduction on the tariffs of pilots, boatmen, etc.)[39]. This system is already in use in 48 ports in Europe, South Africa and New Zealand. The present GA-system can be adjusted to include CO_2-emissions.

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[38] Research: "Ontwikkelen beoordelingsinstrument voor luchtemissie prestatie van zeeschepen"(Development of an assessment tool for air emissions of seagoing vessels).

[39] see http://www.greenaward.org/defaulthome.htm

CANADA

Executive summary

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 cooperate on an international level towards a common goal.

Canada welcomes the formation of a Correspondence Group on greenhouse gas emissions as a forum for discussing and compiling possible approaches on technical, operational and market-based measures to address GHG emissions from ships. We also look forward to participating as members of the Correspondence Group.

We believe IMO remains the appropriate United Nations body to develop environmental goals with respect to shipping and to work with Parties to translate these goals into effective action.

It is 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:

. 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;

. Foster the necessary research and development to provide more environmentally efficient engine and ship designs in a timely manner;

. 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

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 Tokyo 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.

PHASE 2

DENMARK

Executive summary

This paper provides outlines of the Danish Government viewpoints on the issue of greenhouse gas emissions – first and foremost CO_2 – from international shipping. Also, it provides for an overview of the basic principles, to be applied in any future regulation regarding CO_2-emissions from international shipping. Taking into account various inputs from phase 1 of the CG GHG, the imminent need for both short term economic and market based measures as well as long term sustainable technical solutions, it furthermore outlines a scheme in order to enable international shipping to contribute effectively to the reduction of total global emissions quanta. Denmark is contemplating a submission to the MEPC 57 to be held in March 2008 along the lines introduced in this document.

General viewpoints and fundamental principles for future regulation

Given the envisaged accelerated growth rates throughout international shipping in the years to come, along with the fact that shipping has always endeavoured to optimize its fuel consumption for commercial reasons, Denmark still considers CO_2-emissions from international shipping as a significant challenge that needs to be addressed without further delay.

It appears most unlikely that any one magical solution will emerge, adequately capturing all relevant concerns. This calls for both short term economic and market based measures as well as sustainable long term technical and operational solutions, which will enable international shipping to contribute effectively to the reduction of global emissions and cater to a combination of elements.

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.

As it is, Denmark regards the IMO as the appropriate UN body to develop global and binding greenhouse gas goals for international shipping.

Denmark finds it crucial for the IMO to maintain leadership and continue its efforts to address the impact of greenhouse gas from international shipping. 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.

However, 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.

In order to achieve the overall objective, Denmark finds it paramount, that any future regulation should be based on the fundamental principles stated hereafter. A coherent and comprehensive future IMO framework should be:

. effectively contributing to the reduction of the total global greenhouse gas emissions,

. binding and equally applicable to all flag states in order to avoid evasion,

. cost-effective,

. limit – or at least – effectively minimize competitive distortion,

. based on sustainable environmental development without penalizing global trade and growth,

. target based and not prescribing specific methods,

. promoting and facilitating technical innovation and R&D in the shipping sector,

. accommodating to front runners in the field of energy efficiency,

. practical, transparent, fraud free and fairly easy to administer.

<u>Outline of a future scheme on CO_2-emissions from shipping</u>

The proposed scheme contains the following basic elements:

. A levy on all fuel delivered worldwide for shipping.

. Deployment of new binding technical regulation dictating performance criteria for newbuildings based on a CO_2-index.

. An IMO controlled body to:

  - provide advice with regard to the levy levels subject to consideration and, if appropriate, adoption at the relevant level in the IMO

  - collect the levy

- advice on gradually stricter and ever more binding maximum emission levels for newbuildings which become subject to consideration and, if appropriate, adoption at the relevant level in the IMO

- deploy the collected funds, primarily in order to buy CO_2 emission allowances or credits in other industries/the market

- ensure smooth, transparent and fraud free workability of the regulation.

By and large the proposed scheme is based on cap-charge-trade model originally introduced by Norway in MEPC 56/4/9, as subsequently outlined by Norway and others by means of a hybrid mechanism in the CG GHG.

Choosing the entities to which the levy should apply

A number of criteria should be fulfilled when choosing the entities subject to the levy. The most obvious criteria would be practicability, traceability and verification stability. At present, there may be merit in further considering the fuel delivering company and the shipowner.

According to the indications available to us, the fuel delivering company would be able to keep track of the quantity delivered to ships, given the fact that these companies currently track sales to marine vessels, due to the fact that most countries do not apply the same tax to local and international vessels. Moreover, the number of companies is limited, which would facilitate the verification process.

Applying the levy to the shipowner has the advantage of a higher level of consistency with the principle of "polluter pays". Furthermore, through bunker delivery notes, shipowners keep track of the bunkers purchased and hence would be able to account for the fuel consumption of both national maritime transport and international transport.

Naturally, various details will require further discussion, additionally to the elements outlined in this paper, one of these subjects for consideration being whether there should be a differentiated charge for various engine types, products or scope of product application. In general, however, it is our estimate that a fuel levy proportional to the CO_2 emission impact of the fuel itself would provide for the simplest and most transparent scheme.

Thought should also be given to collection/administration/expenditures, as these processes would have to be transparent and simple. Also, implementation and development of improved control schemes would potentially have to take place.

All things considered, the key objective when choosing the liable entity, must be the reliable verification of whether of all fuel for international shipping, independent of origin is captured by the system.

The feasibility of a CO_2-index for newbuildings

Establishing an index for newbuildings, 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, Denmark is convinced, that 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.

Denmark finds that any CO_2-indexing method for newbuildings should comply with the following basic requirements:

. Simple to deploy – i.e., minimum consequences for standard sea trial programs.

. Consistent – no debating of obtained results.

. Based on a generally accepted methodology.

Naturally, 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:

. 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.

. 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.

. 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.

More work would be needed to decide how to include the above measurements into sea trial programs to limit additional costs and to ensure consistent measurements. In future work Denmark will consider the following elements regarding a future CO_2-index.

. an overview of existing CO_2-index proposals/systems, incl. evaluation of operational experience (where available) and description of strengths and weaknesses,

. an evaluation of alternative CO_2-indexing options, e.g., index based on design/sea trial, operational consumption data and combinations of such, and

. an outline of a workable CO_2-index scheme(s) for shipping.

JAPAN

- Response to co-coordinator questions.
- Questions and comment on four summary tables.

Response to co-ordinator questions

Table title	Title of proposal	Section	Pertinent part	Co-ordinator question	Response
OPERATIONAL MEASURES	To provide an external verification scheme for CO_2-index (Option B)	Design/ other detail	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???).	Please see section highlighted in yellow below. We have made an attempt to interpret your meaning, but grateful for clarification.	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 incorrectly calculated very small. In addition, there are different interpretations on how to treat the cargo when voyaging with ballast.
MARKET-BASED MEASURES	Mechanisms for dealing with GHG emissions from international shipping (Option H)	Executive summary	Measure sets a GHG reduction target calculated from the (projected??) future increase in GHG emissions and emissions reductions required for each ship.	Do you mean projected future increase in GHG emissions?	Yes. Thanks for clarification.

General Comments

As for submitted general comments, there are wide varieties of directions of what points IMO would take care. We would suggest co-coordinator to classify them according to type/direction of comments for members understanding.

Concerning proposals for technical measures, operational measures and market-based measures, we would like to recommend co-coordinator to prepare a matrix that indicates activity for implementation of three measures according to time span, such as 10 years, 20 years and 30 years. Such matrix could be a useful basis for the consideration of strategy.

Questions and comment on four summary tables

Table title	Country	Title of proposal	Questions/ comments
GENERAL COMMENTS	**CHINA**	-	As international shipping is operated in a world-wide single market, it should be address under a common international rule. GHG reduction is a matter that should be achieved under the corporation of all countries concerning international shipping.
TECHNICAL MEASURES	**FRIENDS OF THE EARTH INTERNATIONAL**	-	Japan is of view that estimated reduction by 30% of new shipbuilding and 20% of existing ships, which are indicated in the IMO GHG study in 2000, are rather optimistic numbers. 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 next MARPOL NOx reductions, have been established, or been under development. In addition, the measures for existing ships includes plans that lack in universality such as usage of LNG.

Table title	Country	Title of proposal	questions/comment
MARKET-BASED MEASURES	**UNITED STATES**	A green label which is awarded to shippers	"Green label" for top runner program is a measure that has been introduced in Japan in other sector such as automobile, electric household appliances. It successfully improved efficiency of those machines. Based on such experiences, US proposal seems to be practical with high possibility to success. However, a verification scheme by third party to keep transparency would be indispensable for measure like "green label". This is why Japan has proposed "To provide an external verification scheme for CO_2-index (Option B)". Here is the URL for the Features of top runner program. http://www.eccj.or.jp/top_runner/chapter2_1.html And also, this is the Efficiency improvement result of some products, such as gasoline passenger. The initial expectation is 23.0%, which was set based on the R&D proceeding of GHG reduction technologies by the external advisory committee. And all of the manufacturers, including Toyota and Honda have tried to specify the number from 1995 until 2010 and some model have already reached 22.0% in 2004. http://www.eccj.or.jp/top_runner/chapter2_4.html
	EUROPEAN UNION	Inclusion of mandatory CO_2 element in port infrastructure charging	All proposals seem to be based on a premise to put a global CAP or allocations to each country. As Japan has commented on "principles of dealing with GHG emissions from international shipping" of "general comments", method to reduce GHG should have avoidance of market-distorting methods and growth retardation in the international shipping. Based on this principle, a mechanism that contains global CAP or allocation should not be introduced.
	GERMANY	Considerations how to address GHG emissions from international shipping	
	NORWAY	Include international shipping in a global cap & trade emission trading system	

UNITED KINGDOM

1 Technology Measures

Although the United Kingdom realize that there are ways to technically reduce CO_2-emissions from shipping, we feel that any international legislation solution based on technological methods needs to focus on goal based standards and is technology neutral. We also believe that technological methods should not shift the problem of pollution away from one ecosystem and remove it to another. For example 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. For example – using alternate energy sources as sources for cold ironing. The problem with moving towards distillates 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 greenhouse gas emission reduction schemes.

We also feel that other 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 United Kingdom 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.

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 recognise and reward appropriately.

Additionally the United Kingdom feel that 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 also imperative, especially where new legislation will increase the energy needed to be generated on board a ship. For example new developments in SO_x abatement, biofouling, antifouling and ballast water treatment.

2 Operational measures

The UK are interested in exploring some of the issues raised in this sector further as it has been suggested that significant emission reductions can be gained from amending operational practices. However, the nature of the present economy and the “just in time” supply chain will potentially undermine any development of these measures. Specifically the UK has comment on the following technologies being proposed.

CO_2-indexing could be a method to compare vessels on a like to like basis and be a precursor to a carbon trading scheme, however there are still arguments over how indexing should cover the amount of cargo moved, the time it takes to move this cargo, the distance the cargo is moved, routeing issues, loading rates, operating in ballast/with empty containers and weather delays (amongst others).

Vessel Speeds – this is primarily an issue between producers and consumers with a ship having to make commercially competitive decisions to gain trade. Speed is usually weather dependant and does not always necessarily correlate with fuel use or CO_2-emissions. Two vessels can be going at the same speed but due to loading rates, fuel amounts, weather, hull fouling and amount of ballast can be using significantly different fuel amounts and producing different emissions. However, if capping speed proves to reduce CO_2 levels significantly then by developing such a cap based on optimal engine levels, will produce a quick win that could be phased in over time to allow the global economy to adapt. This may reduce the pressure on the industry to immediately engage in Emission Trading and buy time for a trading scheme to be developed fully. Further research may be necessary on this issue.

There are other efficiencies that can be met through routeing, loading and operational practices which can and should be investigated. Therefore, the United Kingdom would like to see further development of the Energy Efficiency Design and Management Plan as suggested by Norway in the technical measures paper, to incorporate logistics as well as energy efficiency on board ship.

3 Market Based Measures

The United Kingdom are open to all market based measures, however there are some principles that we feel that should be included in such a scheme for shipping

. It should be global in nature, however if this cannot be achieved then a regional system may be appropriate. Nevertheless any measures should apply equally to all ships regardless of flag or country of origin.

. It should be an enclosed system, so that emissions changes can be traded or offset against real changes elsewhere, either in the industry or with a comparable industry.

. Emissions traded should be on a like for like basis, potentially taking into account the fuel used and the cargo tonnage being carried.

. The emissions cap for the industry should be a base or reference point, for example, the current level of emissions.

. The emissions cap for the industry could be auctioned off or it could be allocated for free amongst existing firms, for example, on the basis of their fuel use and the cargo tonnage being carried. However this should not penalise new entrants into the industry.

. Allocation could also be linked to other environmental initiatives that a ship has undertaken – a clean ship could actually use more CO_2 but benefit the environment more.

. Further investigation on the base level of CO_2 for the industry is needed, especially as it is expected to increase. Is the level to be capped? Is it to be maintained, increased (at a rate lower than the expected increase in shipping) or is it to be reduced? What will the implication on the global economy of each of these measures? Typically, in other industries with growing carbon emissions, the industry allocation is capped at a base level and growth in carbon emissions is achieved by buying credits from industries or companies that are reducing their emissions below their base level.

Options suggested in the paper include:

. Marine Fuel Taxes and En-route Emissions Charging:

Taxes and emissions charging would hit the word fleet equally, however fiscal issues are often left to the individual flag states and port states and it is questionable whether a worldwide scheme could be set up. Where would the money be used? One option is that it should be re-invested in the industry to improve technology and efficiencies on board ship, which could be difficult as geographically the distribution of bunker supply and flag state tonnage do not correlate.

. Emissions Trading:

Please see the principles highlighted above.

. Differentiated Port Dues

This has proved difficult at the regional level, let alone the global level. This is because not all ports can automatically give a reduction in port dues because they are private companies unless a new global/regional/local environmental charge or tax is levied. Differentiated Port Dues become a very commercially sensitive issue, especially when ports are competing against each other in smaller regions and enclosed seas. In the field of waste delivery in North West Europe reductions in fees are becoming an increasingly difficult issue to resolve as in this case the fees charged to the ship in most cases are charged at cost and therefore the port could be losing money if they discount. However, this could work as an incentive if global guidelines are developed that all ports can adhere and there is a global index for either CO_2 or environmental performance that can be recognised by the all ports/port States.

. Environmental indexing

This is an important concept if any incentive measure is going to be put into place globally. It offers a level playing field and a "badge" or independent assessment, which can be recognised by the different charging or fiscal systems around the world. However, it could be very difficult to put into place due to the need to incorporate extensive and complicated issues. The CO_2-index could be a precursor to such a system, which could be expanded at intervals to include other relevant and more complicated environmental issues.

Response to discussion questions

General

What assessment criteria should be used in evaluating measures?

The overall net reduction of CO_2 into the environment – that is not moving the problem elsewhere. Any assessment has to recognise the proportionate nature of the action, potentially in tonnes of CO_2 reduced, and their feasibility. Any measures effect on the global economy should also be analysed.

Operational

Will measure have an effect on the design of new buildings? Will measure address technical improvements on existing ships? Will measure address the operation of new and existing ships?

Any acceptable measure should be technology neutral and could include design, construction, operational and technological options for both new and existing ships.

CO_2-index and reporting

Who will be required to report the index?

Shipowners should report the index based on clear guidelines and formulae developed by the IMO.

How often should it be reported?

Reporting should be phased in over 2 years, with reporting every year to the Maritime Administration and then on to IMO. If the index is simple (i.e., segregating ships into 5 or 10 categories) then the collection and reporting will be easy and give a direct indication of improvements on board a ship.

Who should be responsible for the collection of the reports, enforcements and compliance?

The Maritime Administration based on guidelines created by IMO.

Market-based Emissions trading schemes

To which entity would the measures apply?

The measures should apply to each ship over a certain tonnage.

What units would be used for trading?

Emissions will likely to be unitised in terms of tonnes of CO_2. At the present time data is collected on fuel bunkers sold which does not give any information on the amount and position of emissions, but does provide a way of measuring carbon bought to be turned into GHG.

The United Kingdom would like to see the trading scheme either limited to the shipping industry, or at a minimum within transport industries. In the first case simple tonnes of CO_2 could be traded to provide a level playing field within the shipping industry, however, what caps are apportioned to each vessel could be difficult to quantify.

When trading between industries, the amount of cargo transported could be bought into the equation. It could be argued that a tonne of carbon is more efficiently used on a ship than on a road, since it might transport more cargo per tonne carbon. Therefore, 1 tonne of CO_2 from a ship carrying 200 containers should not be equivalised with 1 tonne of CO_2 from a lorry carrying one container, otherwise, cargo movement could be skewed towards less efficient transport methods. However, in the present carbon trading schemes, the markets define the price of carbon, irrespective of the economic benefit that carbon has had. We should be encouraging shipping over other modes where it is an effective substitute (where you could use a ship, a lorry, a train or a plane to transport the same thing to the same place, we should encourage the ship). The economically efficient way to do this is through getting the relative carbon caps right of different modes, not trying to influence the price of carbon emitted by different forms of transport.

What current data is available and is it sufficient for these measures?

There is very little information on the CO_2-emissions from shipping and that that is available is uncertain – most comes from bunkers sold and does not take into account efficiency improvements in new engines. If emissions were to be capped at a certain date, then we have to be certain that the correct information is available for that date. The longer we go back in time the more difficult this is as records are not kept by the industry for long periods and acquisitions and mergers complicate the issue further.

What use can be made of the IMO's existing/completed work on the indexing of emissions from ships?

This is a good start – however the United Kingdom thinks it could be made more user-friendly and actually provide more detailed guidance to the industry. It could also be developed further to place the vessels in categories (see reporting section), which would promote internal incentivisation in the industry and be a basis for indexing and emissions trading in the future.

What methodology could be used for the calculation of CO_2-emissions for the organizations running the scheme?

Monitoring CO_2-emissions on ships is essential for a fair emissions trading scheme. Other calculations tend to bring in to many variables that can cause confusion and be used to skew any scheme.

For a trading approach, how would the baseline be calculated?

As information does not exist on CO_2-emissions, and that that does exist may not be in the form that we need, then can we consider capping at present day levels? This would depend on which unit is being used to cap and therefore traded. If the two are not related then the capping system is worthless.

Which vessels should be included in the scheme?

Ships on any voyage over 400 GT to bring it in line with other IMO Conventions.

How will any overall sustainability and environmental impacts or any abatement systems be addressed? How will the different technologies be tested?

This could be reflected in the allocated cap for each vessel – vessels with a better CO_2 or environmental index could have a higher cap, whilst those with a lesser one (i.e., the vessel emits more pollution) should have a lower cap. Abatement technologies, methods and systems should only be included if it can be proved that the abatement measure does not cost more in terms of CO_2-emissions. It would be down to the manufacturer/ship owner to prove this through an independent assessment – preferably through class.

How could penalties for non-assessment be enforced?

Should this read "How could penalties for non-compliance be enforced?" Enforcement would need legislation and an amendment to Annex VI. By penalizing the vessel in further years – i.e., reduction in the allocation or cap for that vessel could be an effective measure.

FRIENDS OF THE EARTH INTERNATIONAL

Emissions of nitrogen oxides and black carbon from international shipping

Executive summary

International shipping emissions of black carbon and nitrogen oxides are significant climate forcing agents and must be included in the IMO's evaluation of GHG-related issues. This document was produced by a coalition of environmental NGOs.[40]

Related Documents: *MEPC 56/4/8, MEPC 47/4/3*

Introduction

As indicated by FOEI in an initial submission to this Correspondence Group ("Market-based Measures Combined with other Emissions Reductions Initiatives Have the Potential to Control GHG Emissions from International Shipping"), carbon dioxide (CO_2) emissions from international shipping are a significant contributor to global climate change. However, CO_2 is not the only important GHG. Black carbon and nitrogen oxides are also important climate-forcing agents, and must be included in the IMO's evaluation of shipping's contribution to climate changes and development of appropriate measures to reduce that contribution.

1 The State of California and a coalition of environmental non-governmental organizations recently petitioned the U. S. Environmental Protection Agency to regulate greenhouse gas emissions from ships including nitrogen oxides and black carbon.[41] The petition is quoted in the following paragraphs 3 to 15.

2 Nitrogen Oxides and Nitrous Oxide Nitrogen oxides consist of a family of several compounds containing nitrogen and oxygen in varying amounts.[42] Nitrogen oxides play a role in climate change through two primary means: (1) nitrogen oxides react with other substances to form the greenhouse gas ozone, and (2) nitrous oxide is itself a highly potent and long-lived greenhouse gas. Moreover, nitrogen oxide pollution represents an additional burden on oceanic pH levels by lowering pH and increasing acidity.

3 Contribution to global climate change emissions of nitrogen oxides contribute to global climate change by influencing the atmospheric concentration of ozone, which the IPCC has

[40] 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.

[41] See petition at http://www.oceana.org/fileadmin/oceana/uploads/Climate_Change/Marine_GHG_Petition_FINAL.pdf

[42] EPA, Technical Bulletin: Nitrogen Oxides (NO_x): Why and How They Are Controlled, (1999) at 1-2, EPA-456/F-99-006R, available at http://www.epa.gov/ttn/catc/dir1/fnoxdoc.pdf

determined is the third most damaging greenhouse gas, after carbon dioxide and methane.[43] As nitrogen oxides react with volatile organic compounds, they create ozone in the lower layer of the atmosphere, called the troposphere.[44] Through the production of tropospheric ozone, nitrogen oxide emissions contribute to the warming of the surface-troposphere system.[45]

4 Nitrogen oxides have also been found to contribute to ocean acidification, thereby amplifying one of the many deleterious impacts of climate change.[46] Approximately one third of all nitrogen oxide emissions end up in the oceans.[47] The impact of these emissions on acidification is intensely felt in specific, vulnerable areas. In some areas it can be as high as 10 to 50 per cent of the impact of carbon dioxide.[48] The hardest hit areas are likely to be those directly around the release site, so these emissions are especially significant in and around coastal waters.[49]

5 Nitrous oxide behaves very similarly to carbon dioxide in that it both directly traps heat in the atmosphere and remains in existence for many decades once emitted.[50] However, nitrous oxide is far more potent, with a global warming potential 298 times that of carbon dioxide over 100 years.[51] According to the IPCC, the concentration of nitrous oxide in the atmosphere in 2005 was 319 parts per billion (ppb), approximately 18 per cent higher than its pre-industrial level.[52] Moreover, data from ice cores indicate that in the 11,500 years before the Industrial Revolution, the level of nitrous oxide in the atmosphere varied by less than about ten ppb.[53]

6 Emissions from Marine Engines and Vessels Ships are beyond doubt a significant source of nitrogen oxide emissions. Ships contribute as much as 30 per cent of the world's nitrogen oxide emissions, an estimated 27.8 million tons per year.[54] In the United States, the EPA has already determined that marine engines and other non-road engines and vehicles are a "major source" of nitrogen oxides. Recent EPA estimates show nitrogen oxide emissions from ships make up 9.1 per cent of all U.S. mobile source nitrogen oxide emissions and 5.2 per cent of U.S. nitrogen oxide emissions from all sources (figures include NO_x emissions from all categories of marine engines). Moreover, based on national fuel consumption statistics, EPA estimates that ships in the United States emitted approximately 2000 metric tons (2205 short tons) of nitrous oxide in 2005.[55]

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43 Denman, K.L., et al. Couplings Between Changes in the Climate System and Biogeochemistry, (2007), at 544. In: WORKING GROUP I SUMMARY, supra note 6. ("The dominant impact of NO_x emissions on the climate is through the formation of tropospheric ozone, the third largest single contributor to positive radiative forcing").

44 EPA, NO_x – How Nitrogen Oxides Affect the Way We Live and Breathe, (1998), available at http://www.epa.gov/air/urbanair/nox/noxfldr.pdf

45 Denman, supra note 31, at 544 ("The dominant impact of NO_x emissions on the climate is through the formation of tropospheric ozone, the third largest single contributor to positive radiative forcing").

46 Doney, Scott C., *et al.*, Impact of Anthropogenic Atmospheric Nitrogen and Sulfur Deposition on Ocean Acidification and the Inorganic Carbon System, (2007), PNAS Vol. 104:14580-14585, at 14580.

47 Id.

48 Id.

49 Id.

50 E.g., Technical Summary at 27 (discussing the radiative forcing effect of N_2O); Id. at 23-24 (discussing the long atmospheric lifetimes of CO_2, CH_4, and N_2O).

51 Id. at 33, Table TS.2.

52 Id. at 27.

53 Id.

54 FOEI, supra note 21, at 3.

55 EPA Inventory, supra note 10, at 3-31, Tablse 3-24.

7 The contribution of ships to nitrogen oxide emissions is also projected to grow substantially in the coming decades. One EPA study forecasts that nitrogen oxide emissions from ocean-going ships in the United States waters will increase by almost 300 per cent above 1996 levels by 2030.[56] At the international level, emissions of nitrogen oxides from ships are projected to nearly double by 2050 and to increase their share of total nitrogen oxide emissions relative to other sources as well.[57]

8 These gases have a significant impact on the global climate, both through the formation of ozone and as nitrous oxide. Thus, given the large quantity of nitrogen oxides that ships emit, it is not surprising that marine engines' emissions of these pollutants play a significant role in climate change. In fact, nitrogen oxide emissions from ships are believed to have a net warming effect potentially equivalent to the warming effect from ship carbon dioxide emissions.[58]

9 Black Carbon Contribution to Global Climate Change A product of inefficient combustion, black carbon, also known as soot, consists of microscopic solid particles of incompletely burned organic matter.[59] As explained further below, black carbon is a potent warmer, exerting effects on the global climate both while suspended in the atmosphere and when deposited on snow and ice. Global warming potentials for black carbon range from 500 to 2240.[60,61,62] The most pernicious characteristic of black carbon from a climatic perspective is its dark color and correspondingly low albedo, or reflectivity. Because of this dark coloring, black carbon absorbs heat from sunlight.[63]

10 When suspended in the air, black carbon warms by trapping heat in the top of the atmosphere.[64] The IPCC estimates that atmospheric black carbon exerts a positive radiative forcing effect of +0.2 W/m^2.[65] This direct warming leads to feedback effects which magnify the global warming contribution of black carbon.[66] For example, as black carbon particles absorb sunlight, they warm the air around them, decreasing the relative humidity of the air and thus the liquid water content of other particles suspended in the air.[67] The drying out of these other particles reduces *their* reflectivity, and as they absorb more sunlight the air warms even more.[68] Further, the water evaporated from such particles remains in the air as water vapor, which is itself a greenhouse gas.[69]

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56 EPA, Final Regulatory Support Document: Control of Emissions from New Marine Compression – Ignition Engines at or Above 30 litres per Cylinder, (Jan. 2003), EPA420-R-03-004, at 4-14, Table 4.3-1.

57 ICCT, supra note 18, at 35, figs. 11 & 12.

58 Id. at 34.

59 See W. Chameides and M. Bergin, Soot Takes Center Stage, 297 SCIENCE 2214 (Sept. 27, 2002), (explaining that "BC is produced through incomplete combustion of biomass, coal, and diesel fuel").

60 Hansen, J., Mki. Sato, P. Kharecha, G. Russell, D.W. Lea, and M. Siddall, 2007: Climate change and trace gases. Phil. Trans. Royal. Soc. A, 365, 1925-1954, doi:10.1098/rsta.2007.2052.

61 Bond, T. and Haolin, Sun, "Can Reducing Black Carbon Emissions Counteract Global Warming?" ES&T, August 2005. p. 5921

62 Jacobson, Mark Z, .Effects of Black Carbon and Other Non-Kyoto Pollutants on Climate, presented to the California Air Resources Board, September 6, 2007

63 Chameides and Bergin, supra note 47, at 2214 (noting that while "greenhouse gases warm by absorbing infrared or terrestrial radiation," "BC warms by absorbing sunlight").

64 M. Shekar Reddy and Olivier Boucher, Climate Impact of Black Carbon Emitted from Energy Consumption in the World's Regions, 34 GEOPHYSICAL RESEARCH LETTERS L11802 (2006) at 1 (stating that "Black carbon (BC) exerts a positive forcing at the top of the atmosphere").

65 Technical Summary, supra note 9, at 29.

66 Jacobson, supra note 48, at 6-8 (discussing twelve ways in which suspended BC affects climate).

67 Id. at 6.

68 Id.

69 Id. at 7.

11 When deposited out of the air onto a lighter surface, the darker black carbon causes the surface to absorb more of the sun's energy. Thus, when deposited on snow or ice, black carbon can reduce the snow's reflectivity and accelerate the melting process.[70] As when suspended in the atmosphere, black carbon's deposition onto ice and snow creates positive feedback effects that lead to even greater warming. For example, as snow and ice around them melt away, the deposited black carbon particles can become even more concentrated on and near the surface, further reducing the reflectivity of the remaining snow and ice.[71] Thus, although the IPCC estimates the radiative forcing effect of black carbon deposition on snow and ice to be +0.1 W/m^2, it acknowledges that the radiative forcing metric may not accurately capture the climatic impacts of black carbon deposition on snow and ice. In the words of the IPCC, "the 'efficacy' may be higher" for black carbon radiative forcing, as it produces a temperature response 1.7 times greater than an equivalent radiative forcing due to carbon dioxide.[72]

12 Because it can accelerate the melting of snow and ice, black carbon may play a particularly important role in Arctic climate change.[73] Moreover, the radiative forcing of suspended black carbon particles may be amplified at the poles, where there is more light reflected from the Earth's surface, and thus more light available for the black carbon particles to absorb.[74] Because the Arctic has warmed at around twice the rate of the rest of the world over the last 100 years,[75] controlling and reducing black carbon emissions is particularly important.

13 The impacts of black carbon are not limited to the Arctic, however. Black carbon may be responsible for seven per cent of the observed global warming.[76] Thus, the overall contribution of black carbon to global warming may be substantial.

14 Emissions from Marine Engines and Vessels Marine engines account for a significant share of black carbon emissions. Black carbon is a component of the particulate matter emitted from ships and other engines. In fact, approximately 66 per cent of anthropogenic black carbon emissions come from the burning of fossil fuels.[77] Ships emit between 50,000 tonnes and 132,000 tonnes of black carbon per year. [78]Thus, in 2000, shipping contributed up to 2.8 per cent of global black carbon emissions.[79] Moreover, shipping is responsible for all black carbon

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70 Reddy and Boucher, supra note 50, at 2.

71 Flanner, Mark G., *et al.*, Present-Day Climate Forcing and Response from Black Carbon in Snow, 112 JOURNAL OF GEOPHYSICAL RESEARCH D11202 (2007) at 2.

72 IPCC, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, Forster, P., *et al.* Changes in Atmospheric Constituents and in Radiative Forcing (2007) at 184-85.

73 FOEI, supra note 21, at 3.

74 See Forster, supra note 58, at 163 ("Additionally, the presence of BC in the atmosphere above highly reflective surfaces such as snow and ice, or clouds, may cause a significant positive RF").

75 IPCC, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS, CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, Trenberth, K.E, *et al.* Observations: Surface and Atmospheric Climate Change (2007) at 237.

76 Hansen, J., Mki. Sato, R. Ruedy, L. Nazarenko, A. Lacis, G.A. Schmidt, G. Russell, I. Aleinov, M. Bauer, S. Bauer, N. Bell, B. Cairns, V. Canuto, M. Chandler, Y. Cheng, A. Del Genio, G. Faluvegi, E. Fleming, A. Friend, T. Hall, C. Jackman, M. Kelley, N.Y. Kiang, D. Koch, J. Lean, J. Lerner, K. Lo, S. Menon, R.L. Miller, P. Minnis, T. Novakov, V. Oinas, Ja. Perlwitz, Ju. Perlwitz, D. Rind, A. Romanou, D. Shindell, P. Stone, S. Sun, N. Tausnev, D. Thresher, B. Wielicki, T. Wong, M. Yao, and S. Zhang, 2005: Efficacy of climate forcings. J. Geophys. Res., 110, D18104, doi:10.1029/2005JD005776.

77 Reddy and Boucher, supra note 50, at 1.

78 Bond *et al.*, A technology-based global inventory of black and organic carbon emissions from combustion, J. Geophys. Res., Vol. 109, No. D14, 203, 2004, doi:10.1029/2003JD00369.

79 *Ibid* , Bond.

released over the oceans.[80] Although black carbon from shipping is emitted mainly to the air above the oceans, plumes of black carbon can also travel great distances and deposit on areas far away from the initial emission site. For example, plumes of black carbon from sources in Asia are believed to deposit on snow in the Arctic.[81]

Action requested of the IMO Correspondence Group

IMO should include black carbon and nitrogen oxides in its overall evaluation of greenhouse gas emissions from ships and measures to reduce these emissions.

ICS

When analysing the different propositions on measures to reduce GHG emissions that have arrived through e-mail, there are a few things to take in consideration that we from the industry like to put forward.

As always we emphasize that a holistic viewpoint is essential and it is important to remember that shipping is only one out of many different transport modes and the transport sector has to be considered as a whole when acting in order to reduce Green House Gases.

Transportation at sea is made to fill the demand from the industry and other customers ashore. We can all agree on the fact that the most environmental friendly transport mode is shipping and the more goods we can ship at sea the less will be transported on our roads causing different air emissions and traffic congestion. The more we study information about the development in transport sector, the more worried we get about the land based transport and its effects on the environment.

The International Energy Agency has a report "30 years of energy use in IEA countries" that can be downloaded from their website. We don't know how accurate it is but we think it gives everyone a good idea about which sectors has increased their contribution to GHG the most the last 30 years.

We also found a Swedish report on CO_2-emissions and energy use in transporting goods that is on the internet. Again we can't judge how accurate this report is but it's made of an independent organ "Väg-och Transportforskningsinstitutet" (translated- Road and Transport Research Institute) but the figures gives one some thoughts about where the real problems are.

Shipping has become more and more fuel efficient over the years and in this it has also reduced its CO_2-emissions. The development is still going in the same direction driven mostly by the decrease in operational cost that derives from fuel savings.

By taking measures that increases the cost of transports at sea there is always a risk that the customers choose to use land based traffic instead which will lead to an increase in CO_2-emissions and other problems related to transporting goods on the roads. It is therefore very important to consider the whole transport system when making regulation if they are intended to have a net positive effect on the environment.

[80] Reddy and Boucher, supra note 50, at 1.
[81] Joseph R. McConnell, *et al.*, 20th-Century Industrial Black Carbon Emissions Altered Arctic Climate Forcing, 317 SCIENCE 1381 (2007) 1383.

When considering reduction of speed as a way of reducing GHG emissions, again it is the transport customer that decides how much goods that needs to be shipped and when it should be shipped. A reduction of speed without any other measures will probably lead to problems in port with gathering of goods that waits for shipping, the need for more ships to handle the transports and again no savings of CO_2-emissions.

Regional regulations as CO_2 related harbour fees will most lightly turn transport streams to other areas and the goods will be shipped to its final destination by road or rail causing road congestions and an increase in total CO_2-emissions.

To control the CO_2-emissions from fossil fuels we could consider discussing emission trading which might involve the whole transport sector (and also land based industry if we really want to make a difference). When building up a market based CO_2 emission reduction scheme like suggested in MEPC 56/4/9 it will increase the economic burden only for the sea going transports where we might end up shifting sea transports to land-based traffic instead.

In a market-based trading system involving all emitters, abatement techniques will be implemented where they are most cost effective and this will also give the best total reductions of the CO_2-emissions.

The aim of the work group should be to make a suggestion for action that considers all different angles and gives a holistic solution on the emissions of Green House Gases.

PHASE 3

CHINA

China appreciates the efforts by the coordinators and the valuable inputs by the members of the GHG correspondence group, and would like to make some modifications to the relevant paragraphs of the draft report as follows:

1. To add the text "by some CG members" after "It was acknowledged" in paragraph 14 of the draft report.

2. The view reflected in paragraph 38 of the draft report is only expressed by some CG members, which could be unacceptable to other CG members, therefore we strongly request to delete the paragraph **or** to replace the paragraph by the following new paragraph:

   Taking into account the general principle of "common but differentiated responsibility" established in the UNFCCC and Article 2.2 of the Kyoto Protocol, any measures to be taken by IMO concerning the reduction of GHG emissions from the international shipping shall only apply to Annex 1 Parties to the UNFCCC.

3. We all understand that any activities taken by MEPC or its CG with regard to the reduction of GHG from the international shipping should strictly follow the "Work Plan" adopted by MEPC 55, which clearly set forth the roadmap from MEPC 55 to MEPC 59, therefore, the existing paragraph 39 in the draft report, which is not in line with the timetable in the said "Work Plan", should be replaced by the following new paragraph:

   This report will be submitted to MEPC 57 for consideration according to the "Work Plan to Identify and Develop the Mechanisms Needed to Achieve the Limitation or Reduction of CO_2 Emissions from the International Shipping" adopted by MEPC 55. MEPC might also request the correspondence group to continue its work if deems necessary.

JAPAN

Onshore power

In our study, introduction of onshore power costs over US$ 100 million at each container berth. We should fully take into consideration of cost effectiveness of using onshore power when we discuss whether Contracting Governments should make ship operators use onshore powers at a berth.

At current time, onshore power is introduced in very limited number of ports, and a technical standard for high-voltage onshore power is now being drafted. Many technical issues and safety issues should be further addressed for full-fledged operation of onshore power. Furthermore, we should share best practices regarding actual use of high-voltage onshore power for large container ships and cruise ships.

Inclusion of mandatory CO_2 element in port infrastructure charging

In general, there are various kinds of harbor dues including port entrance due, tonnage due, port service charge, port cleaning Maintenance due, pilotage, towage, dockage and so on. Furthermore, different ports adopt different kinds of harbor dues, and actual taxation method depends heavily upon circumstances surrounding ports. Hence, it is too difficult for port authorities to adopt a single rule for differentiation.

ICS

Technical measures

Optimized hull design

More effective hull designs can only be considered on new ships.

To alter an existing ship will not be economically feasible and is most unlikely to be practically achievable and can due to its complexity have an adverse impact on the CO_2-emissions from the ship. (May alter the ships draft which will create more drag from the water and higher CO_2-emissions.)

Choice of propeller

The ships drive train including the propeller is designed to fit the specific hull design of the ship and it is very difficult to predict if changing the propeller on existing ships will have a positive effect on CO_2-emissions.

The design of an optimal propeller for a specific ship will require considerable design and testing time.

The ship will have to be tried with a new propeller for several months before it is possible to say if there an over all positive effect on the CO_2-emissions has been achieved. If not, a new or the original old propeller will have to be fitted which includes dry docking and that also have its own environmental impacts and the whole procedure has to start from the beginning again.

In-Engine improvements

Improved combustion from in-engine improvements with higher temperatures will increase fuel efficiency and thereby reduce CO_2 in some engines.

This will however increase the NOx emissions as more of the nitrogen in the air will react with the oxygen when combustion temperature is risen.

In-engine improvements are not a viable alternative on all existing engines as some engines already are as efficient as possible considering the balance between fuel consumption and NOx emissions.

It might not be possible to alter some engines at all or even find the necessary manufactured parts that will make them more efficient.

Due to the design of the internal combustion engine, there is a very limited possibility to improve its environmental performance from the levels of today.

Fuel cells

Fuel cells will be more environmental friendly and probably a solution to be used in some ship applications when they are fully developed but as for today they can only be used on a trial basis. The use of fuel cells will require natural gas, hydrogen gas or other fuel in gaseous form. Existing fuel cells are not much more efficient than internal combustion engines. Considerable research and development is still required in this area.

Natural gas

The distribution network of natural gas is still undeveloped. It would be difficult for a ship to rely on a type of fuel that is not available in all of the ports that it calls at.

As the natural gas needs other forms of storage than liquid fuels, it will be difficult to alter existing ships so that they could switch to gas because it will 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 can be more widely used as fuel.

Natural gas could be considered for new ships operating in areas where it is easily available, and after distribution is in place, in the rest of the world.

The distribution system has also to be in place for those fuel cells that uses natural gas.

Biodiesel from feedstock

It will not be sustainable to use farmland for growing crops for fuel production as the feedstock has to be used to feed the people of the earth.

There are many people starving in the world and if the feedstock is used for fuel it will literally take the food out of the mouths of these people and will start a competition for the use of such crops.

Cold ironing

Cold ironing can be used for ships in regular traffic between certain ports where there is a proven advantage in providing shore generated power.

In most cases it will be very difficult for the ports to provide the right form of electricity to the ships. Often ships have different voltage than shore side electricity and sometimes also different frequency.

The port will need a separate transformer for every different voltage and when the electricity has different frequency ashore and on board they will also need a converter. These transformers and converters will have to be adequately rated to handle high currents. Such equipment is large and requires suitable space to house and operate them safely.

When converting electricity to other voltage and frequency there are heat and other losses that reduce the efficiency and if the electricity is produced in a power plant that uses fossil fuel there will still be emissions of CO_2 and other harmful gases which will reduce the advantages using shore power.

Operational measures

Optimal speed

The demands of the transport customers are to have their goods "right on time". Today everybody tries to have as little as possible 'in storage' due to a variety of reasons (e.g., no adequate storage facilities, short "selling lifetime" of products such as computers and mobile phones).

This means that the customers also have their demands on how fast the transport should be and the control of the speed is not in all in the hands of the ship owner.

The demand for transport infrastructure is rising and if there is to be consideration of speed reduction in order to reduce the CO_2-emission one has to factor in the need for more ships to handle the requirement as less goods will be transported in the same time. More ships inevitably mean more emissions.

Logistics

Improved logistics in harbours and from transport companies to ensure that every ship carries the maximum load and has its optimal port time would be a possibility to reduce the GHG emissions from shipping. Reduction of ships waiting times in ports should also be included in measures to be considered by ports and logistic service providers.

Weather forecasts

Accurate weather forecast could give possibilities to ships to alter route in order to avoid severe conditions which could offer a total reduction of CO_2-emissions on specific routes. However a longer voyage could make the ship consume an equal amount of fuel as if it had gone through the bad weather system.

Market based measures

A GHG emission trading system that involves all emitters (eg different transport modes, industry, agricultural) could have a positive effect on CO_2-emissions. If only one sector of the contributors will be forced into a trading system the source of emissions will merely change location and no total reduction will be achieved. It is essential to ensure that a balance is achieved in emission reduction without transferring emissions from one sector to a less environmentally transport mode. It is unsustainable to solve one emission problem by creating another problem. Most important of all is to capitalise on the fact that shipping is the most environmentally sustainable form of transport for world trading requirements that is available.

FINLAND

Technical (short-term) measures

Energy Efficiency Design and Management Plan/ Using a Test Mode for estimating CO_2-index of newbuild ships

Propulsion system manufacturers, ship designers and ship builders should be involved in the design of an energy efficient ship in order to optimize the under water hull form and the propulsion system for best energy efficiency. (The design of a new ship is controlled by the builder and by the manufacturers and the ship designers with whom the builder has made a contract with for hull and propulsion design. The ship owner gets a complete package from the builder with little possibility to affect the design and not without increased cost and prolonged delivery time.)

Use of wind power

Due to wind direction and force the possibilities to use sails and kites will be limited to times when the wind speed is more than 7-10 m/s (ships initial speed) and less than 20 m/s (wind forces above 20 m/s will most likely destroy the sails/kites) and coming from aft of ship (kites) or lesser angles to the sides (sails).

Operational (short-term) measures

Vessel speed reductions

As transports are made to fill transport customers demand, speed reductions will only slow down sea transports. This has the effect that either is the transport customer may choose other means of transport or there has to be more ships to handle the same amount of transports because the goods will stay a longer time at sea. Other means of transport and/or more vessels means more emissions and a reduction of vessel speed can have an adverse effect! This is clearly a speed optimization problem.

Technical (long-term) measures

Use of alternative fuels

The availability of natural gas is still low and can only be used in certain areas until a global distribution system has been developed.

Operational (long-term) measures

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

Due to external factors, like weather conditions, it would be very difficult to meet a CO_2-index limit at all times. Customers demand for transport time and delay on deliveries due to other factors than the operator are to be considered when the choosing the subject for penalties.

Market-based (long-term) measures

Emissions Trading Scheme (ETS)

To get a fair ETS with the aim to reduce the over all CO_2-emissions, other transport modes have to be involved in the trading scheme otherwise evidently some of the transports will move from ship to shore.

Marine Fuel Tax

Seaborne transport competes with rail and road transport and a marine fuel tax can in certain areas give an advantage to the shore based transport modes, which may result in higher total CO_2-emissions from the transport sector.

EUROPEAN COMMISSION

Response to discussion questions

General

What assessment criteria should be used in evaluating measures? E.g., effectiveness in reducing greenhouse gases; technical feasibility; commercial implications; implementation and administration issues; and consistency with broader multilateral initiatives.

Measures should be evaluated on: Level and certainty of reductions to be achieved, cost effectiveness and ease of enforcement.

Operational

Will measure have an effect on the design of newbuildings?

Measures adopted must give a clear signal to influence the design of future vessels, hence mandatory measures are necessary.

Will measure address technical improvements of existing ships?

Many effective measures are applicable to both existing and new vessels.

Will measure address the operation of new and existing ships?

Many effective measures are applicable to both existing and new vessels.

CO_2-index and reporting

Who will be required to report the index?

CO_2-emissions are proportionate to fuel consumption, reporting at the ship level should be linked to existing requirements to carry bunker fuel notes.

Who will be responsible for the collection of the reports, enforcement and compliance?

Possibly incorporate in existing port State control actions.

Emissions trading schemes

To which entity would the measures apply?

The ship itself (each company can then make their own arrangements regarding how they administer the certificates/allowances).

What units would be used for trading?

Tonnes of CO_2 emitted.

What current data is available and is it sufficient for these measures?

Directly related to fuel consumed. Bunker Fuel notes already provide this information.

What use can be made of the IMO's existing/completed work on indexing of emissions from ships?

As the IMO CO_2-index is also related to distance travelled and cargo carried it goes far beyond what is required for reporting CO_2-emissions. The voluntary IMO CO_2-index may indeed be a useful tool for ship operators.

What methodology could be utilized for the calculation of CO_2-emissions for the Organization running the scheme?

Based on verified Bunker Fuel notes carried on every vessel.

How could the penalties of non-compliance be enforced?

Possibly using existing procedures for detaining ships after suitable notice/warning.

NOTE: ***These answers are given in good faith to support the work of the GHG correspondence group. They cannot be considered a formal position of the European Commission or in any way binding.***

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