A Future Regulatory Framework for CO_2 Emissions of Shipping in the Mediterranean Area

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THIS PAPER TRIED TO FIGURE OUT what will be the regulatory framework for CO_2 emissions from ships in the Mediterranean area, both on efforts from EU and IMO. It is certain, indeed, that a few other areas have been regulated already, but CO_2 emissions in the Mediterranean area are above 30% of total maritime emissions in the EU27. The EU under the Kyoto protocol 1997 is committed to reduce its GHG emissions by 8% by 2012 vis-à-vis 1990. The Mediterranean area follows the worldwide pattern which is that human activities of all kinds (industrial, recreational, residential) are found near the coast. The Mediterranean area – due to its littoral states – is expected to advance further in trade and thus climatic conditions are likely to get worse. This paper presents first the regulatory framework for the reduction of GHG emissions from ships analyzing the four regulation systems. The Mediterranean, due to its large ports hosting mother ships soon of 16000 TEU is an area for ships to manifest their economies of scale and economies of density, being also a main importing area. Thus the paper made the working hypothesis that the environmental protection must start from ports including littoral states. As shown, the Mediterranean area must be prepared for the ships destined for it to be banned, unless more energy efficient ships are built under incentives (a global levy scheme on marine bunkers) and indicators like EEOI/EEDI in a Maritime emission trading scheme.

INTRODUCTION

During the last 5 years, there has been growing international concern about maritime air emissions. This concern can be attributed to the fact that the contribution of these emissions to global anthropogenic emissions has significantly increased and is expected to continue rising in future, if no abatement measures are taken now.

In order to offset the negative effect of shipping on the environment, a regulatory policy framework has already been adopted for

maritime emissions, but only for those which are classified as 'local or regional' pollutants. These are only SO_2 and NO_x. An important step for the reduction of SO_2 emissions from ships was the adoption by the contracting nations of the revised Annex VI of MARPOL 73/78 drafted by the International Maritime Organization (IMO 2008c). But this covers only some environmentally sensitive areas such as the Baltic Sea and North Sea, which are designated 'Sulphur Emission Control Areas' or SECAs. Within these areas, the ships are obliged to use fuel oil with low sulphur content[1] or to use SO_2 scrubbers with equivalent emissions reduction.

The effectiveness of this specific measure has already been evident, as the contribution of SO_2 emissions from ships in the SECAs in the European region has decreased, in contrast to the Mediterranean Sea which has not been designated a SECA, although we believe it should be.

Although the international and European communities have made some progress as far as the reduction of local and regional air pollutants from ships is concerned, there is a complete lack of any regulation for maritime CO_2 emissions, in spite of the belief that these have a global impact on climate change. International Aviation and Shipping are the only greenhouse-gas-emitting sectors which are not covered by the Kyoto Protocol (UNFCCC 1998) or the Copenhagen Accord (UNFCCC 2009).

Moreover, these sectors remain unreported due to 'lack of reliable emission data' and 'lack of an agreed approach for defining responsibility by country' (UNFCCC 2005).

It should also be noted that shipping is the most energy-efficient and environmentally-friendly mode of transport, as it carries as much as 90% of world trade by volume but accounts only for 10% of transport sector emissions. Nevertheless, for a number of reasons set out below, we estimate that shipping will be regulated sooner or later for air emissions worldwide, mainly due to: (1) the growing concern

of the international community about the 'deep reduction of global GHG/Green house gas emissions' (UNFCCC 2009), (2) the fact that the contribution of shipping to global GHG emissions has increased, mainly as a result of the lack of regulation of its GHG emissions,[2] and (3) the growth of the international fleet, at least until the end of 2008.
We believe that shipping cannot be left out of future regional or international conventions for the reduction of maritime GHG emissions for much longer (Friedrich et al. 2007).

Responsibility for the regulation of GHG emissions from shipping was given to the International Maritime Organization (IMO) and to the Marine Environment Protection Committee (MEPC). These bodies developed a package of interim and voluntary technical and operational measures to offset GHG emissions from shipping, and also introduced market-based instruments to provide incentives for the shipping industry to comply with these measures (IMO 2003; IMO 2009b).

A significant part of the work of the MEPC for the reduction of maritime GHG emissions was the development of some fundamental principles. These were destined to serve as the basis for a coherent and a comprehensive framework for the regulation of GHG emissions from ships to be introduced in the future by the IMO (2008b). The global effect of CO_2 emissions on climate change, as well as the international character of shipping, indicates that the regulatory framework for the abatement of maritime CO_2 emissions must be implemented globally. This means that sooner or later regulation will directly influence maritime transport in the Mediterranean Area, which is the focus of the research reported in this paper.

AIM OF THE PAPER

This paper examines (a) how a regulatory framework for the reduction of CO_2 emissions from shipping could be developed – based on the fundamental principles of the IMO – and (b) the ways in which this framework would influence maritime transport flows and logistics networks in an environmentally sensitive area such as the Mediterranean Sea, which is surrounded by many coastal nations on three continents. Our interest has been triggered by the fact that the annual CO_2 emissions from shipping in the Mediterranean area were 65 million tons

(Concawe 2007). This represents more than 30% of the total maritime CO_2 emissions in the EU27. In addition, we must pay attention to the geographical and commercial features of this specific area, which make the Mediterranean a particularly interesting region for the investigation of future trends with respect to our international good, namely the environment.

THE GEOGRAPHICAL AND COMMERCIAL CHARACTERISTICS OF THE MEDITERRANEAN AREA

Introduction

The most important step, we believe, for a stabilization of GHG concentrations in the atmosphere, and at a level that would prevent dangerous anthropogenic interference with the climatic system, is the implementation of the Kyoto Protocol (UNFCCC 1998). This can be done through the United Nations Framework Convention on Climate Change (UNFCCC), which sets binding targets and mandatory limits on greenhouse gas emissions (GHG) not only for the 37 industrialized countries, but also for the European community as a whole.

Under the Kyoto Protocol, the European Union has made a commitment to reduce its GHG emissions by 8% by the year 2012 compared with 1990. Although, by 2005 there had been a decrease of 7.9% in the total GHG emissions in European Union, over the same period emissions from the transport sector increased by 26%. This represented 22% of the total GHG emissions of the European Union (European Environment Agency 2008).

We have seen that the increased transport volumes have resulted in the growth of GHG emissions, as this has also required increased energy use in the transport sector. This is a growth, however, which prevents the European Union from achieving its Kyoto Protocol commitment. In order to reduce GHG emissions from the transport sector in the European Union, additional measures need to be taken, we believe.

These additional measures should focus on the coordination and optimal use of different modes of transport according to their energy-efficiency, but also concentrate on improvements in the energy-efficiency of each mode of transport.

Mediterranean Geography/Characteristics

As is well known, the geographical position of the European Union provides an advantage for the further development of maritime transport flows, as it has a coastline in excess of 67,000 kilometres and a network of inland waterways of about 25,000 km, of which 12,000 km are part of the combined transport road network. These conditions facilitate the transport of certain cargoes (mainly wet and dry bulk) by coastal and sea-river vessels (Blonk 1994). The fact that 60% to 70% of the industrial and production centres of the European Union are located within 150 to 200 kilometres from the coast provides a commercial advantage for the further use of maritime transportation in the form of short sea shipping and river transportation.

As mentioned above, maritime transport is by far the most energy-efficient mode of transport, as the transportation of goods and people by sea has lower carbon emissions per ton/passenger-kilometre than other modes of transport.

In spite of this, the increased contribution of shipping to global GHG emissions during recent years, due to the lack of any regulation of GHG emissions by the sector and the growth of the international fleet, have made the adoption of a regulatory framework of maritime GHG emissions an obvious next step. Namely, for year 2005, maximum emissions of NO_x, SO_2 and CO_2 in the Mediterranean area are estimated to have reached 1.45, 0.86 and 64.94 million tons respectively (Concawe 2007). We are almost certain that the inclusion of shipping in a regional or international convention for the reduction of maritime GHG emissions is not far off.

Commercial Aspects of the Mediterranean Sea

As far as the Mediterranean Sea is concerned, it should be noted that it is amongst the world's busiest waterways, as it is the destination of 10% of global shipping by vessel deadweight. It is also a major transit area. Around 10,000 vessels transited the Mediterranean area en-route between non-Mediterranean ports in 2006. This emphasis on shipping in transit in the Mediterranean, in addition to the fact that seaborne trade between states with coastlines on the Mediterranean (Mediterranean Littoral States) is relatively underdeveloped[3] (figure 1),

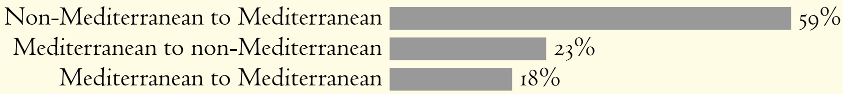

FIGURE 1 Mediterranean littoral states – seaborne trade (tons), 2006

indicates that the density of international shipping traffic in the area will increase.

The most significant change in the overall traffic patterns in the Mediterranean in coming years will be the development of export routes of crude oil from the Caspian Sea. This oil is currently transported predominantly through Black Sea ports, passing on through the Bosporus. We expect as a result an increased density of tanker activity, especially in the Eastern Mediterranean, so as to exceed 20 000 voyages per annum (Lloyd's Marine Intelligence Unit 2008). To this we may add the fact that nearly 80% of vessels in transit through the Mediterranean, between two non-Mediterranean ports, are registered under a non-Mediterranean state flag. We believe that maritime CO_2 emissions in the area should probably be dealt with through an international convention for the reduction of maritime GHG emissions as soon as possible.

A REGULATORY FRAMEWORK FOR THE REDUCTION OF GHG EMISSIONS FROM SHIPS

Introduction

In the light of the mandate given to IMO in the Kyoto Protocol of 1997 to address the limitation or reduction of GHG emissions from ships, the Marine Environment Protection Committee (MEPC) agreed that a coherent and comprehensive future IMO regulatory framework on GHG emissions from ships should be based on the following principles (IMO 2008b):

- It should be effective in the reduction of total global greenhouse gas emissions.
- It should be binding and equally applicable to all flag states in order to avoid evasion.
- It should be cost-effective.

- It should be able to limit, or at least effectively minimize, competitive distortions.
- It should be based on sustainable environmental development without penalizing global trade and its growth.
- It should be based on a goal-based approach and not prescribe specific methods.
- It should be supportive in promoting and facilitating technical innovation and R&D in the entire shipping sector.
- It should accommodate leading technologies in the field of energy efficiency.
- And, finally, it should be practical, transparent, fraud-free and easy to administer.

The basic principles against GHG

Based on the above basic principles for the adoption of an effective regulatory framework for GHG emissions from shipping, various technical and operational measures, as well as market-based instruments, have been developed in order to offset maritime GHG emissions. Considering the variety of measures proposed and the fact that they could not all be analyzed in this paper, our analysis will be restricted to four possible regulation systems with GHG-reduction potential for interna-

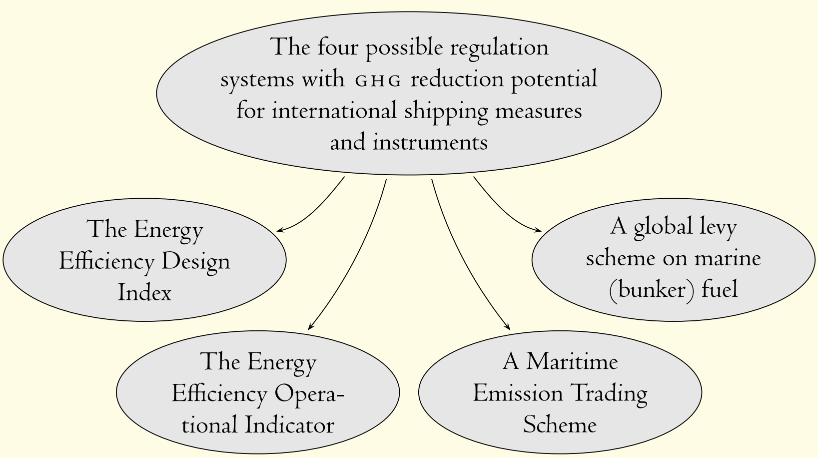

FIGURE 2 The regulation systems for GHG-reduction measures and instruments

tional shipping, as shown in figure 2. We will examine each of the four systems in turn. These are:

1. The Energy Efficiency Design Index (a technical measure).
2. The Energy Efficiency Operational Indicator (an operational measure).
3. A Maritime Emission Trading Scheme (a market-based instrument).
4. A global levy scheme on marine (bunker) fuel (also a market-based instrument).

The Energy Efficiency Design Index

The technical policy options for reducing GHG emissions from shipping, which have been considered by MEPC, aim to improve the energy efficiency of the fleet by changing ship design. These are based on the Energy Efficiency Design Index (EEDI) (IMO 2008a). Improved energy efficiency is achieved when the same amount of useful work is done by using less energy. This means that less fuel is burned and less greenhouse gases are emitted. The development of the EEDI – defined below (1) – is an effort to exploit this option to increase design efficiency.

The EEDI expresses the CO_2 efficiency of a ship in a well defined design condition. Efficiency is, in this context, the ratio between the environmental cost and the benefit for society:

$$\text{EEDI} = \frac{\textit{environmental cost}}{\textit{benefit for society}}, \tag{1}$$

where the 'environmental cost' of shipping is its contribution to global warming through emission of CO_2 from combustion of fossil fuel, and the 'benefit for society' comes from the transportation of vessel's work capacity related to her type, size and design. In general, EEDI has a constant value, which is going to change if design is altered. The unit for the EEDI is grams of CO_2 per capacity-mile, where capacity is an expression of the cargo-carrying capacity relevant to the cargo that the ship is designed to carry. For most ships capacity will be expressed in deadweight tonnage.

The EEDI produces, for each ship, a figure that expresses its design performance. If we collect data on the EEDI for a number of ships within a category, then baselines that express typical efficiencies of these ships can be established. Based on these baselines (CO_2 indices), a mandatory EEDI for new ships can be developed. This would require [47] them to meet a design CO_2 limit on the value of their EEDI that would be set at a level below the baseline (IMO 2008c).

All ships built after a certain date would have to demonstrate that their EEDI was better than the target value for EEDI of new ships, a target which should be specific to the type and size of the ship. Consideration should be given, though, to the way the EEDI will be implemented, as different ship types will need different correction factors. There are also practical issues relating to the way the design index will be verified, so that there should not be a flag state designated for a ship at the design stage. 'Different correction factors' mean that the ship-type-specific parameters of various ship types and sizes should be taken into account before the 'baseline' value of EEDI for these vessels is calculated (IMO 2009a). The verification process of the EEDI value of ships is rather complicated and is divided into two stages: (1) limited to the examination of data of input parameters to see compliance with EEDI required before vessel is constructed, and (2) sea trials for the same target as in one (Sames 2009).

The whole process of implementing EEDI for ships we believe will be assigned on to IACS. Moreover, Classification societies are no doubt the appropriate certification agents in technical maritime safety and environmental matters. One European classification society has already carried-out the first ever EEDI certification for a large containership. This class established a 'technical life' for the vessel, which summarizes the relevant technical data and documents indicating calculations towards final EEDI figure (Sames 2010). The EEDI for new ships would obviously serve as a fuel-efficiency tool at the design stage of ships. This would enable the fuel efficiency of different ship designs, or a specific design, to be evaluated, with different inputs such as design speed, choice of propeller and the use of waste heat recovery systems. It would also make rational comparisons easy to achieve.

It should be noted, however, that most modifications of design, on which the improvement in the value of the EEDI of ships will be based, are primarily suitable for new-buildings. This means that the reductions in GHG emissions that can be achieved by design-based improvements in energy efficiency will be slow, due to the long expected

service life of ships. Moreover, the baselines for the value of the EEDI of ships, based on ship-type-specific parameters, could be initially determined for only 7 different ship types and later possibly extended to other ship types (IMO 2008c). This means that only 81% of the total global maritime GHG emissions would be covered by the EEDI, as this is the amount of emissions corresponding to those seven ship types.

The Energy Efficiency Operational Indicator

Besides the technical policy options for reducing GHG emissions from ships, improved energy efficiency of the fleet can also be achieved at the operational stage by all ships. The MEPC has developed some operational policy options with GHG-reduction potential for international shipping. These aim to improve the operational efficiency of the fleet and are based on the use of the Energy Efficiency Operational Indicator (EEOI) (IMO 2005), defined below (2). The EEOI expresses the CO_2 efficiency (i. e. the fuel efficiency) of a ship. That is to say, the CO_2 emissions per unit of transport work is calculated as follows (in gram CO_2/tonne identical mile):

$$\mathrm{EEOI} = \frac{\sum_i \mathrm{FC}_i \mathrm{C}_{carbon}}{\sum_i m_{cargo,i} \times \mathrm{D}_i}, \tag{2}$$

where (1) FC_i, is the fuel consumption on a voyage or in a period, (2) C_{carbon} is the carbon content of the fuel used, (3) $m_{cargo,i}$ is the total payload carried during a voyage or a period, and (4) D_i is the distance travelled for a voyage or a period. Thus the CO_2 emission index is equal to the ratio of total fuel consumption of a voyage or a period (FC_i) multiplied by the carbon content of the fuel used (C_{carbon}) divided by the total payload carried during a voyage or a period ($m_{cargo,i}$) multiplied by the distance travelled for a voyage or a period. Fuel consumption, FC, is defined as all fuel consumed at sea and in port for a voyage or period, by main and auxiliary engines including boilers and incinerators.

As the amount of CO_2 emitted from a ship is directly related to the consumption of bunker fuel oil, the CO_2 index will provide useful information on a ship's performance with regard to fuel efficiency. This will enable ship owners and operators to evaluate the performance of their fleet with regard to CO_2 emissions. It is obvious that, in contrast to the EEDI, the EEOI changes with operational conditions and it may thus be calculated for each leg of a voyage and reported either as a rolling average or periodically.

In order to promote best practice for fuel-efficient operation of ships, ship owners and operators can establish a Ship Efficiency Management Plan (SEMP). This provides a possible mechanism for monitoring ship and fleet efficiency performance over time and considering possible improvements in a structured fashion. The SEMP provides guidance on the way that the operational efficiency performance of ships can be optimized through technical details (IMO 2008c). These include improved voyage planning, weather routing, just in time arrival of vessels at port, speed optimization and other operational-based measures.

A mandatory requirement for an SEMP would imply that ships would be required to document what is done to manage the operational efficiency of each ship, while the mandatory use of the EEOI for monitoring performance could be part of this policy. Implementation of the EEOI in an established environmental management system should be carried out in line with the implementation of any other chosen indicators. Ships and fleets could then be managed following the main elements of the recognized standards (planning, implementation and operation, checking and corrective action, and management review). The results from monitoring and measurements should be reported to management. A management review may include the review of targets, objectives, and CO_2 index, to establish continued suitability in the light of changing environmental impacts and concerns, regulatory developments, organizational activity changes, and changes in the environment (IMO 2006).

A Maritime Emission Trading Scheme – METS

The MEPC also identified market-based instruments for reducing GHG emissions from shipping, which address maritime emissions of

CO_2 directly. These are in contrast to technical and operational policy options, which aim to improve the design and operational energy efficiency of the fleet. The development of a Maritime Emission Trading Scheme (METS) is one of these market-based policy options (IMO
[50] 2008c).

Emissions' trading represents cooperation between two countries, companies or organizations that have emission reduction commitments. Any company in a country that has reduced its emissions below the determined commitment can sell its surplus units to another company in a country that may find it more difficult to reduce its emissions and meet its reduction commitment. The idea behind an emission trading scheme is that if allowances can be bought and sold by participants in the open market, then the overall cost of compliance with the Kyoto targets will be restricted to a bare minimum (Criqui and Viguier 2000).

In order to operate an emission trading scheme in international shipping, there are two options. International shipping emissions should be included in a national emissions inventory, or they should be included in the Kyoto Protocol, outside the assigned amounts of Annex I parties (under the auspices of the IMO or other body). A number of distinct characteristics of sea transport makes the allocation of shipping emissions to countries more complicated than in other industrial sectors (IMO 2000). We must mention at this point the difficulty that exists in defining those nations from which the sea transport services are generated, given the fact that both sea transport and its emissions in international trade are at the moment outside control. On top, there is the difficulty of determining the vessel's country of ownership, given the fact that the majority of world's cargo-carrying capacity is registered in developing countries... These have not adopted the Kyoto emission reduction targets (Wit, Kampman, and Boon 2004). Because of the existing difficulties in allocating shipping emissions to countries (IMO 2000), and the fact that international shipping should be dealt with in a global perspective because of its international character, the MEPC has adopted the second option regarding the design of an METS. This means that a cap on global maritime emissions should be established, based on historical emissions and on an absolute target for their reduction, based on the findings of the Intergovernmental Panel on Climate Change (2007) as to the global emission reductions needed in order to delay or avoid impact on climate change and ship owners would have to buy emission allowances to cover their emissions.

The METS should be open for trade with other emission trading schemes so that the shipping sector could buy allowances from other sectors, which would reduce their emissions at a lower price compared to the abatement costs in the shipping sector. As the cap would apply to global maritime transport, it seems logical that it should be established by an appropriate international organization.

It is worthwhile to mention that the transaction costs of a METS are relatively high and include large administrative burdens, as maritime emissions have to be monitored first, verified and reported per annum. The entity responsible for monitoring and reporting emissions and allowances will be the ship. This means either the ship operator or the charterer. These report the emissions per annum to the Flag State and give also the relevant amount of allowances. This is a market-based policy option the implementation of which we believe to be assigned to Port State controls. These will write down whether ships have given away the relevant allowances.

However, this option presents problems in practical implementation. The cap on global maritime emissions would have to be negotiated with the parties to the Kyoto Protocol, which would imply rather complicated negotiations. If the cap includes only the ships registered in Annex I countries, there would be an incentive to register ships in non-Annex I countries. We believe that this option would also require difficult negotiations on the distribution of allowances among ship owners.

A Global Levy Scheme on Marine (Bunker) Fuel

Another market-based instrument developed by the MEPC to achieve GHG emission reductions from ships was an international compensation fund (ICF). This is based on a global levy on marine bunkers (IMO 2007a; 2007b; 2008c). Under this scheme, all ships engaged in international voyages would be subjected to a bunker levy established at a given cost per ton of fuel bunkered. The levy should apply to all marine fuels, taking due account of different emission factors. This could either be paid by the ships, or by the suppliers of bunker fuel, or by oil refiners. The levy would be channelled to an International Maritime GHG Emission Fund, and clear guidelines for the specific use of this fund would be set so that it could be used to fund research and development (R&D) in shipping or to fund an IMO technical cooperation programme to improve the efficiency of the world fleet.

A carbon charge on bunker fuels would increase fuel costs of vessels, which are in many cases a large (circa 33%) proportion of shipping costs and therefore play an important role in the decisions of ship builders and owners. Since emissions of CO_2 are directly connected to fuel consumption, carbon charges would give ship owners increased incentives to reduce fuel use and emissions (Chupka 2004). This effect is confirmed by historical data, which show that bunker fuel demand responds to changes in bunker fuel price (IMO 2000). A carbon charge on bunker fuels might reduce bunker demand and associated CO_2 emissions through energy efficiency improvements in ship engines and ship design, changes in operating practices including load factors, routing and sailing speeds and various other measures (OECD 1997). Another response of shippers over higher energy prices tends to be slow steaming. This probably will have an impact on proper 'port calling schedules' (Rodrigue, Comtois, and Slack 2009).

However, there are several obstacles to the implementation of a carbon charge on bunker fuels. First, it would be necessary to reach an agreement between countries on implementing such a charge. Even if a levy scheme involved only a small number of countries, it would be important for them to negotiate a range of issues with non-participating countries. Second, the negotiations would need to address issues such as the point of application of the charge, the question of which party/organization would be responsible for collecting and disbursing the proceeds of the charge, and the question of distributing the revenue among various purposes. And third, unless implemented globally, bunker charges can be readily evaded. If they apply to a limited number of countries only, evasion will depend on the location of ports where bunkers can be tanked free of carbon charge. The incentive to avoid the charge will depend on the level of the charge as a proportion of the cost of fuel.

The European Union (EU) Policy for the Reduction of GHG Emissions from Ships

In addition to the work of the MEPC on the problem of shipping GHG emissions, the EU has on many occasions made it clear that if the IMO cannot reach an agreement on significant reductions of GHG emissions from shipping, then Europe will move ahead with its own measures and act on its own in order to limit GHG emissions from ships travelling in its territorial waters (Marshal 2008).

As mentioned above, emission trading is one of the flexible mechanisms approved by the Kyoto Protocol for the accomplishment of the targets that it set for the industrialized countries involved and by the European community for reducing greenhouse gas emissions (2002/358/EC). In January 2005, the European Union Greenhouse Gas Emission Trading Scheme (EU-ETS), based on Directive 2003/87/EC, commenced operation covering 11,500 energy-intensive installations across the European Union. This represents a figure close to 50% of Europe's emissions of CO_2. International shipping is not included in the EU-ETS because of the difficulty of defining responsibility by country and the fact that it should be dealt with from a global perspective because of its international character.

The inclusion of the shipping sector in the EU-ETS has already been considered by the European Commission, in line with the model used for the inclusion of emissions from aviation in the ETS (Commission of the European Communities 2006). Before taking a position on this matter, though, it is essential to consider some important differences between aviation and maritime transport. A number of circumstances make the allocation of allowances and liability more complicated in the maritime sector than in aviation. Moreover, it is more difficult to access reliable fuel and emissions data for shipping (Kågeson 2007).

In order to link maritime emissions to the ETS, the allocation of allowances and liability could be based on voyages arriving in EU ports, and ships would be liable for their emissions only for journeys ending in a port of the European Union. This model would require the operator to monitor fuel consumption in order to be able to split bunker oil deliveries between voyages to EU ports and to other destinations. However, this principle of allocation might cause a ship on a long distance voyage to call at a port just outside the EU before proceeding to its final destination in order to minimize the CO_2 allowance that would have to be surrendered.

[54] If the IMO is not able in the short term to take the necessary decisions on the introduction of a cap on CO_2 emissions from international shipping, the European Union could introduce a scheme of its own, a European Maritime Emissions Trading Scheme (EMETS), which would operate in the same way as the global Maritime Emissions Trading Scheme presented above (Kågeson 2007).

In the case of a regional regime, however, only ports in the member states and in candidate countries for accession to the EU would then participate. In addition such a scheme would be administered and monitored by an EU agency, created for this particular purpose. A problem with getting the scheme started is the lack of reliable fuel sales statistics, as this information would be needed in order to know the exact quantity of fuel used in ships calling at the ports participating in the scheme.

What a Regulation Framework for CO_2 Emissions from International Ship Traffic in the Mediterranean Area Would Be Like

After a brief analysis of the four possible technical, operational and market-based regulation systems with the potential to reduce CO_2 from international shipping presented above, we now come to the consideration of a future regulatory framework for maritime CO_2 emissions in Europe (EU) and more specifically in the Mediterranean area. As mentioned above, the Mediterranean Sea is among the world's busiest waterways and a major transit route. A significant increase in the overall vessel activity within and through the Mediterranean is expected over the next ten years, with an increase in transits through the area of about 23% and an increase in vessel activity within the area of about 18%.

A predominant feature of maritime transportation in the Mediterranean Sea is the fact that economies of scale have already been developed by forming a Mediterranean maritime network. Here the majority of trade is concentrated in larger vessels deployed at lower levels of frequency. The geographical pattern of the area, with a large percentage of industrial and production centres located within 150 to 200 kilometres of the coast, allows the use of economies of scale in maritime transport, with increased income and reduced costs. In such a maritime network, larger vessels are likely to choose a route that involves fewer port calls in order to accomplish lower average transit times.

We may add here that soon after the crisis at the end of 2008, container transportation adopted slow steaming, reduction in the size of ships used and a reduction in frequency of calls. But this seems to be temporary, as a recovery in container transportation is noted outside Europe. The recovery is expected to be slower in Europe than in India or China, because many member countries have large debts. This may improve emissions, but this would also be temporary. Economies of scale are practised by liner companies here, and vessels are expected to reach 16,000 TEUs or more.

Coming to the implementation of a regulatory framework for maritime CO_2 emissions in the Mediterranean area, any scheme with CO_2-reduction potential for shipping would in practice have to be carried out in Mediterranean ports. Enforcement of this scheme should be flag neutral, through port state control, for foreign flagged vessels, and flag administration for vessels falling under national jurisdiction. This means that Mediterranean Littoral States should all adopt the regulation system for ships so that they would exercise exclusive jurisdiction over their ports. Thus ships calling at their ports would be required to comply with the specific regulatory scheme. The agreement for the implementation of a common regulatory framework for maritime CO_2 emissions is extremely difficult for the Mediterranean area, because it involves states from three different continents and having entirely different economies, as well as different attitudes to environmental issues.

Practically, implementing an METS in the Mediterranean would mean that a failure to surrender allowances matching a ship's emissions would result in the banning of the ship from calling in Mediterranean ports. Under a levy scheme on marine bunker fuel, all sales on bunkers within the Mediterranean area would be taxed at a given cost level per ton of fuel bunkered. A mandatory EEDI or EEOI for ships would require ships to meet, or even exceed, a minimum design or operational efficiency standard in terms of CO_2 emitted per ton-mile sailed. Ships that did not meet this requirement would be banned from Mediterranean ports.

As mentioned above, any regulation system for the abatement of maritime CO_2 emissions should be neutral across all nations and ship categories. This is necessary in order to eliminate the possibility of evasion and leakage of emissions, and to avoid reduced competitiveness of ships complying with regulations. Any regulatory scheme implemented regionally, i. e. only in the Mediterranean area, could easily be avoided by deploying more energy-efficient ships within the Mediterranean and less efficient ships outside the area. This would also lead to unwanted market distortions as ship owners would prefer other maritime routes, where they would not be subject to such stringent regulations regarding the CO_2 emissions from their ships.

A successful regulatory framework for maritime CO_2 emissions in the Mediterranean area would provide strong incentives for ship owners to follow it if it rewarded efficiency and increased the cost of emitting CO_2. The emitters have an incentive to reduce emissions as long as the marginal cost of reducing emissions is larger than the charge/levy that they would otherwise pay. The implementation of a regulatory scheme would be improved if the probability of being caught and the cost of non-compliance are sufficiently large. This requires a reporting, monitoring and verification system that functions well, where ships are able to provide proper documentation to any port state control showing that they follow the regulations.

One of the most important features that a regulatory scheme with CO_2-reduction potential for shipping in the Mediterranean would need is the flexibility to allow adjustments of the scheme itself in response to new information or changes in general policy. Increased overall vessel activity, which is expected in the coming years once the crisis is over, within and through the Mediterranean, will result in further CO_2 emissions from maritime transportation in the area. The regulatory framework adopted should be able to respond to changes in activity reflected in new data.

CONCLUSIONS

In this paper, we have attempted to describe a future regulatory framework for CO_2 emissions from shipping in the Mediterranean Area. This was based on the possible regulation systems with CO_2-reduction potential for international shipping developed by the IMO and the European Union. The special geographical and commercial features of this specific area were also taken into account.

The Mediterranean, as described above, is among world's busiest waterways, surrounded by states situated in three different continents, with an expected further increase in its overall vessel activity in the coming years. This area forms a particularly interesting region and thus we have investigated its future environmental trends and ways in which these trends would influence maritime transport flows and logistics networks in this environmentally sensitive area.

Our conclusions were, however, limited by the inclusion of only four possible technical, operational and market-based regulation systems for the reduction of CO_2 emissions from shipping. We did not cover the whole variety of measures proposed by the IMO, as they could not be developed satisfactorily in a short paper.

We made it clear that any regulatory scheme chosen for the reduction of maritime CO_2 emissions within the Mediterranean would in practice have to be carried out at Mediterranean ports, through port state control for foreign flagged vessels and flag state administration for vessels falling under national jurisdiction.

We have shown that given the large heterogeneity of states surrounding Mediterranean with entirely different economies, as well as attitudes towards environmental issues, difficulties in adopting a common regulatory framework for maritime CO_2 emissions in the area will arise. However, the fact is that economies of scale have already been developed in the area, forming a Mediterranean maritime network in the logistics chain, implying fewer port calls from vessels – in order to achieve lower average transit times – and the use of larger and well-organized ports. A proper reporting, monitoring and verification system for CO_2 emissions should be established.

We have also pointed out that given the growing concern of the international community about the deep reduction of global GHG emissions and the increased contribution of shipping to them, it cannot be expected that shipping can remain outside a regional or international convention for the reduction of maritime GHG emissions.

In addition, we have stressed the fact that CO_2 emissions from shipping in the Mediterranean represent more than 30% of the total maritime CO_2 emissions in the EU27; and are expected to increase even further in the coming years. This implies that a regulatory framework for CO_2 emissions from shipping in the Mediterranean area is going to be imposed in the near future. Moreover, we analysed the influence on transport flows and ship traffic in the area that depends on the correct design and implementation of this framework.

NOTES

1 Maritime SO_2 emissions are directly related to the sulphur content of fuel oil used for the ship's engines.

2 In contrast to land-based industries.

3 Representing only 18% of the total Mediterranean Littoral States' trade.

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