INTERSESSIONAL MEETING OF THE WORKING GROUP ON GHG EMISSIONS FROM SHIPS
3rd session
Agenda item 3

GHG-WG 3/3/11
25 February 2010
Original: ENGLISH

REVIEW OF PROPOSED MBMs

Towards an optimal rebate key for a global maritime MBM

Submitted by the World Wide Fund for Nature (WWF)

SUMMARY

Executive summary:	This document provides detailed information on identifying an optimal rebate key to ensure that no net incidence on developing countries arises from the application of a global Market-Based Measure for GHG emissions from international maritime transport. A country's share of global imports from non-adjacent countries is proposed as the basis for the optimal key to be used with the Rebate Mechanism or any revenue-raising MBM under consideration. Detailed calculations are provided for over 150 countries
Strategic direction:	7.3
High-level action:	7.3.2
Planned output:	7.3.2.1
Action to be taken:	Paragraph 11
Related documents:	MEPC 60/4/55, MEPC 61/5/33, MEPC 61/INF.2 and MEPC 62/INF.3

Introduction

1 The Rebate Mechanism (RM) proposal is currently under IMO consideration. It proposes to reconcile the principles of the UNFCCC with the global IMO regime by rebating the economic cost incurred by a developing country Party participating in a global Market-Based Measure (MBM) for greenhouse gas (GHG) emissions from international shipping.

2 During the course of IMO discussions of the RM proposal (submitted in documents MEPC 60/4/55 and MEPC 61/5/33) a question was raised as to whether an appropriate key could be found that would rebate the economic cost incurred on consumers in a developing country Party participating in a potential MBM for GHG emissions from international shipping with an acceptable degree of accuracy. More specifically, whether a more appropriate key than a country's share of global imports by value could be identified, using data currently available. The "optimal" key will strike the best balance between accuracy, simplicity of calculation and data availability.

3 The IMO Expert Group on the Feasibility Study and Impact Assessment of possible Market-Based Measures (MBM-EG), established by the Secretary-General as authorized by MEPC 60, in its assessment of the RM stated the question as follows (MEPC 61/INF.2, paragraph 18.66):

> "[…] It will also have to be considered if the proposed "share of imports", to be used as a factor for calculating the rebates to developing countries, is a clear reflection of the shipping industry's contribution to GHG emissions, as imports to a country could be transported via different means and not exclusively by shipping. In this regard it is noted that the proposal points out that Parties could replace the use of global imports by value with another measure when such information becomes available (for instance by a country's share of global seaborne imports by value-distance, or similar)."

4 A similar question was raised within the report of the UN High-level Advisory Group on Climate Change Financing (MEPC 62/INF.3, annex), in the context of whether the proposed rebate key would ensure that "no net incidence" (cost burden) for developing countries arises from the application of a maritime MBM.

5 This document provides results of an in-depth quantitative study addressing the above questions, entitled "Optimal rebate key for an equitable maritime emission reduction scheme". The study is set out as annex to this document.

Key Results

6 A country's share of value of imports from non-adjacent countries, adjusted for trade patterns in Europe and in Latin America, is found to be the optimal attribution key to calculate incidence on the country from a global MBM, for all countries irrespective of their trade distances. The key provides the best estimates of the incidence given readily available and reliable data.

7 According to the calculations presented, in 2007 circa 70% of global trade by value was transported by sea and air. Of this, developed and developing countries accounted for circa 60% and 40% respectively. Thus, the estimate of total incidence on developing countries from a global maritime MBM is circa 40% of its global costs. This is around 7% higher than a simple estimate based on value share of imports by all modes of transport. The summary of the incidence, in percentage points of total costs, is shown on the next page.

8 Possible rebate keys for over 150 developing countries and attribution keys for developed countries are calculated and presented in the annex.

9 Conditions to integrate the optimal rebate key with the MBM proposals under consideration by IMO are also provided.

Rebate keys for selected developing countries, 2007 data (study's calculations)

Developing Country/region	R Key, %
China	8.35
Republic of Korea	3.68
Singapore	2.36
Taiwan Province of China	2.27
Hong Kong SAR, China	2.06
India	1.98
Mexico	1.46
Next 27	13.55
Bangladesh	0.16
Next 25	2.41
Ethiopia	0.06
Next 25	0.93
Papua New Guinea	0.03
Next 25	0.45
Guyana	0.01
Remaining 40+ countries	0.44
TOTAL non-Annex I	**40.19**

Conclusions

10 The annexed Study demonstrates that it is feasible to calculate a suitable proxy for incidence from a global maritime MBM, such as a levy or an emission trading scheme, on different countries. Thus, if so decided, it is feasible to design and implement a global maritime MBM with "no net incidence" on developing countries, by ensuring these countries are compensated for the cost incurred from the global maritime MBM, through a rebate approach.

Action requested of the Intersessional Meeting

11 The Intersessional Meeting is invited to consider the information and analysis provided, and to take action as appropriate.

***

ANNEX

OPTIMAL REBATE KEY FOR AN EQUITABLE MARITIME EMISSION REDUCTIONS SCHEME

Dr Andre Stochniol[1]

Introduction

1 This paper explores a way forward to agree an equitable scheme to reduce greenhouse gas (GHG) emissions from international maritime transport (maritime emissions). Specifically it studies how to compensate poor countries for the scheme's incidence through a Rebate Mechanism (RM) under consideration at the IMO. It focuses on identifying an optimal "attribution key" for RM, for which reliable data is available. It recommends a country's share of imports from non-adjacent countries (after minor adjustments) as the optimal key. Finally, it calculates the attribution key for 190 countries.

2 The paper is structured as follows. Following this introduction, Section I outlines the "differentiation impasse" in addressing maritime emissions. Section II discusses data selected for the attribution key. Section III introduces a new approach to derive global imports by sea and air. Section IV analyzes the impact of trade distance. Section V provides results for the optimal attribution key and discusses its application. Section VI concludes.

I. DIFFERENTIATION IMPASSE

I.1 Purpose of a Market-Based Measure

3 Various proposals for a Market Based Measure (MBM) for GHG emissions from international shipping aim to address one and/or two complex challenges facing the international community. One of the challenges is how to cost-effectively reduce GHG emissions from international shipping which are large in absolute terms, and not covered under the Kyoto Protocol, or any other international regulation. Another challenge relates to the scaling-up of financing for climate change action, particularly for adaptation to climate change impacts. Current financial mechanisms aimed at helping the world's poor deal with the consequences of global warming are inadequate in both scale and predictability, and financing from a maritime MBM could reduce the gap in funding needed.

4 Both challenges require solutions respecting equity, between countries and between actions by different transport sectors. They also require unprecedented global cooperation.

5 In 2009 in Copenhagen, developed countries committed, in the context of meaningful actions and transparency on implementation, to a goal of mobilizing jointly US$100 billion per year by 2020 to address the needs of developing countries. This goal was subsequently recognized in the Cancun Agreements (UNFCCC 2010).

---

[1] The contents of this paper are the author's sole responsibility, E-mail: andre@imers.org.

Acknowledgements
To my wife Halina and daughters, Nina and Kasia. This paper would not have been possible without their incredible support and patience during the last 4 years, as I switched from a business career to the public good initiative known as the International Maritime Emission Reduction Scheme.

This paper has been made possible through contributory funding from WWF.

6 The High-level Advisory Group on Climate Change Financing (AGF), established by the Secretary-General of the United Nations, pointed at carbon pricing of international transport emissions as an important potential source of climate financing (and mitigation) that could contribute substantially towards mobilizing the US$100 billion committed annually. The AGF's key recommendation was that there should be no net incidence on developing countries from any scheme raising climate financing (AGF 2010a). The AGF's analysis of international transport concluded that universal-application cost impacts on particular countries could be addressed via a well-designed compensation mechanism to address equity and political acceptability concerns. The same analysis identified the rebate approach, described in the Rebate Mechanism proposal (document MEPC 60/4/55), as a compensation mechanism that could address the incidence issue in international maritime transport (AGF 2010b).

I.2 Opposition to proposals considered under the auspices of the IMO

7 It is generally agreed that any MBM for international maritime transport should be global and apply to all ships irrespective of the flag they fly, for legal reasons, and in order to avoid evasions and competitive distortions. Thus all MBM proposals currently being considered by the IMO assume application to all ships. They are (see MEPC 61/INF.2):

.1 International Fund for GHG emissions from ships (GHG Fund);

.2 Leveraged Incentive Scheme (LIS);

.3 Port State Levy (PSL);

.4 Ship Efficiency Credit Trading (SECT);

.5 Vessel Efficiency System (VES);

.6 Emission Trading System (ETS); and

.7 Rebate Mechanism (RM).

8 None of the above proposals, except the RM, differentiate explicitly between developed and developing countries and are therefore opposed by many developing countries. Developing countries maintain that the UNFCCC principle of common but differentiated responsibilities and respective capabilities (CBDR) must apply to the climate change regime in the IMO.

9 All the above proposals, with the exception of SECT, can raise revenue. Some of them consider disbursing the majority of the revenue raised for climate change action in developing countries. Discussions at the IMO and UNFCCC have shown that such an approach is not generally perceived by developing countries as sufficient to fulfil the UNFCCC principle of CBDR. It became clear that the heart of the matter for many developing countries is "who really pays" for the MBM.

10 Assuming a global application of an MBM, the cost incurred by the shipping industry will be mostly passed on to consumers in both developed and developing countries. Depending on local competition for imported goods, a portion of the cost may also be passed on to producers (exporters). Some developing countries will therefore carry a share of the burden of the MBM, unless every developing country gains more than the total cost burden to its economy. In this context, arguably, none of the above proposals so far truly incorporate the principle of CBDR, regardless of their revenue raising potential.

11 Consider an example where the majority of the MBM revenue raised is spent on purchasing emission credits from the Clean Development Mechanism (CDM) in developing countries, in order to offset maritime emissions growth. The GHG Fund is an example of such an approach. In this scenario, many developing countries would in fact carry a share of the MBM burden as they would receive less than their cost incurred. The reason is that an overwhelming majority of CDM projects are concentrated in just a few countries.[2] Many developing countries, especially smaller ones, would therefore be net contributors to the generated funds, rather than being beneficiaries. The funds would go to the larger, often more advanced developing countries. This is at odds with both the equity and the CBDR principle. It is also against the UNFCCC obligations and commitments of developed countries to provide climate financing.

12 Broadening the revenue disbursement to other categories, such as adaptation and forestry, is unlikely to resolve the equity issue. As recent negotiations suggest, the opposition of developing countries to raising financing from all countries is based on fundamental principles, and thus is likely to remain strong. Even though some countries or their groups may become net MBM beneficiaries, others would not. The opposition from poor countries that anticipate a significant cost burden, and no benefits, is likely to remain strong.

I.3 Complexity of excluding developing countries

13 In theory, it could be more efficient to exclude developing countries from participation in a MBM altogether so as to comply with the CBDR and avoid the complexity associated with compensating these countries for the cost burden that falls on them. This would require differentiating the application of an MBM based on final destination of goods. This option was proposed in the second generation of the IMERS proposal, and was thoroughly studied (Stochniol 2009a). Ships transporting goods to developed countries would be covered, while ships transporting goods to developing countries would not. Ships transporting goods to both developed and developing countries would be partially covered. Such an approach would eliminate, from the outset, any impact on developing countries.

14 However, the approach based on the final destination of goods although relatively simple for tankers and dry bulk carriers proved complex for ships carrying multiple goods, particularly for container ships. It would require obtaining a verifiable share of goods transported to developed countries by each ship or company worldwide. Given the tens of thousands of ships operating worldwide, collecting and validating such information would require significant administrative efforts. This complexity was recognized also by various experts and negotiators from developing countries, and the proposal was not formally tabled at the IMO.

---

2 According to the UNEP Risoe, CDM/JI Pipeline Analysis and Database, available at www.cdmpipeline.org, as well as World Bank 2009, approximately 90% of all CDM credits have been issued so far to projects in four countries: China, India, Republic of Korea and Brazil, with circa 48% issued to projects in China.

I.4 Complexity of attributing emissions and cost burden

15 The current approach for reporting GHG emissions from international shipping, under the UNFCCC, is based on the amount of fuel sold in a country to ships engaged in international transport (called international bunker fuels). This approach was found to be inadequate as it underestimates the emissions for countries that sell a disproportionally low amount of international bunker fuels, such as the United Kingdom (UK). For instance, if the emissions from international shipping were calculated based on the share of unloaded goods or the share of imports, and similar, the UK's share of shipping emissions would be circa six times more than currently reported based on fuel sold (Stochniol 2009b, Gilbert *et al*. 2010). The fuel-based approach also overestimates the emissions for countries with high fuel sales, such as the Netherlands and Singapore. No other superior option to report or account for these emissions has been found thus far. The problem directly relates to the complexity of international shipping. Whether ship or trade data is considered, the emission calculation and attribution is complex.

16 Attributing shipping emissions based on data relating to the ship, such as the origin of the voyage, the destination or the volume of goods transported is complex and not equitable, given that ships often transport goods to many countries. This is especially true for container ships where for instance a container ship en route from Asia to Europe may drop-off a few containers in an African port (say less than 1% of all containers carried to Europe). Attributing all emissions from the Asia-Africa leg of the voyage to an African country, or similar, would not be equitable. It would overlook the fact that the majority of containers carried were destined to Europe. Furthermore, from a practical standpoint alone, making a direct calculation of emissions attributable to different countries based on cargo transported to them would be administratively complex.

17 Attributing shipping emissions to a country based on the volume of its seaborne trade and distances travelled by ships is not much simpler. As different ship types have significantly different energy efficiency performances (per tonne-km of cargo carried), attributing ship emissions to countries would be difficult as this would require including data on the energy efficiency of the ships. For most countries, data for such calculations are not readily available.

18 If the calculation of emissions attributed to countries seems complex, the calculation of a country's cost burden generated by a MBM is even more complex. The reason is that freight rates are determined by multiple variables, as reported by Wilmsmeier and Hoffman (2008), Korinek and Sourdin (2009), and UNCTAD (2010a) for instance. Some of the major variables determining freight rates include the ship type, the trade volumes (economies of scale), the trade imbalances (especially for container traffic), the price of fuel, the type and value of goods carried, the distance travelled (or time spent at sea), the competition level, the port infrastructure and efficiency, and the relevant regulatory requirements. For example, the cost of transporting a container from Asia to the United States (US) is double the cost of transporting the container in the opposite direction, reflecting in particular the impact of the trade imbalances that affect the Asia-US container trade route.

19 Introducing an MBM may increase the freight rates in various ways, depending on the relevant determinants of freight rates and the prevailing market conditions. Thus creating an accurate formula that could precisely determine the size of the cost burden of an MBM for all countries is impossible. What is warranted however is a formula or attribution key that is perceived as fair, supported by reliable data, and closely approximates the burden born by countries.

I.5 Rebate Mechanism (RM)

20 It has been proposed that in order to comply with the principles of the UNFCCC, the application of a maritime MBM has to be differentiated. Developing countries could recover the cost of the MBM through an agreed rebate mechanism, thus ensuring at the least no net incidence to any developing country, and a positive net benefit to any developing country that received climate change assistance. Furthermore, the most vulnerable countries should benefit the most through additional means, such as the disbursement of net financing raised.

21 Under the proposed rebate mechanism (RM), each developing country would be entitled to obtain an unconditional payment (rebate) equal to the attributed burden of its participation in the maritime MBM.[3] The amount of the rebate would be calculated annually from the global MBM costs using a simple country-level "attribution key". A country's share of global imports was the proposed "attribution key", given that relevant data is readily available.[4] In this paper, it is further proposed to constrain the import statistics to data from non-adjacent countries (in order to exclude data on imports between countries that share a land border, which typically relates to land transport). Details of this approach and other alternative "attribution keys" are discussed in the following section.

22 Under the proposed rebate scheme, a developing country could decide to forego its rebate, or a part of it, and be internationally recognized for such action. This provides additional flexibility to reflect the different national circumstances of developing countries.[5] Developed countries are not entitled to any rebates, and are automatically credited for the amount of financing raised through the MBM, based on the same attribution key, namely a country's share of global imports. Consequently, the net revenue raised after rebates have been issued, would come from consumers in developed countries only, complying therefore with the principles and provisions of the UNFCCC.

23 The proposed RM does not specify how the net revenue raised should be used. However, since the revenue is generated from international activity, it seems that it should be used in its entirety for international purposes rather than to contribute to national budgets. The net revenue could be split between supporting developing countries in implementing climate change action and assisting the global shipping sector in accelerating reductions of its growing emissions through technological advances. The disbursement of this net revenue could be managed by the operating entity of the financial mechanism of the UNFCCC, according to relevant rules and provisions. This could be the Green Climate Fund (GCF) established in the Cancun Agreements (UNFCCC 2010). Thus, developing countries would be beneficiaries of the revenue generated by the MBM, with the more vulnerable countries benefiting the most. The shipping sector should also benefit potentially through a maritime funding window in GCF, or a new global Maritime Technology Fund, or similar, which should be established given the need to invest in clean technology development and transfer in the maritime sector.

---

3 According to the RM proposal, the rebate, or a part of it, could be used for climate change action, subject to a sovereign decision by the receiving country Party.

4 The RM proposal anticipates that Parties could replace the use of imports by value with another more accurate measure when such information becomes available (for instance by a country's share of global seaborne imports by value, or similar).

5 A rebate rate or multiplier from 0 to 1 may also be agreed, and recorded for each developing country. When it is 0, the developing country would agree to forego its entire rebate, and be internationally recognized for such action, for instance within a climate change agreement or otherwise.

24 The RM can therefore apply, in principle, to any maritime MBM which generates revenue, such as a contribution or a levy on fuel, or an emission trading scheme. The mechanism cannot apply to an MBM that does not generate revenue.

II DATA SELECTED

II.1 Imports rather the exports

25 Given that most of the transport costs are passed on to the final customers, data on country's imports is selected rather than exports, or the sum of imports and exports, or any other combination.

II.2 Value rather than volume

26 Value of imports rather than volume (weight) is selected primarily because of readily available data. Value of imports is typically collected by customs, is easy to aggregate and is reported centrally in all countries, including those which are land-locked, and thus the aggregated data is unlikely to be challenged by governments. This contrasts with volume of imports (weight) which is not generally available in many countries, as some ports do not collect all relevant data, especially regarding final destination of unloaded cargo. Generally trade by weight is not measured as precisely as trade by value.

27 Looking at the value of goods carried by different ships shows that there is a correlation between the value of goods carried and the emission rate of the ship. Bulk goods, which are low value, are carried by bulk ships with the lowest emission rate. Manufactured goods, which are high value, are carried by fast container ships that have much higher emission rates than slower bulk ships per tonne-km carried. Although even lower value goods are increasingly transported by containers, on average the value-efficiency relationship holds true for containers.[6] Thus the value of imported cargo alone is needed. In contrast, using cargo volume would also require knowledge of the efficiency of ships carrying the cargo, making such calculations administratively complex, and often impossible as relevant data is not collected.

28 Yet another argument for using value is that it would better reflect the burden of any emission reduction regime to small countries, including many small island developing states (SIDS), which are away from well served and competitive markets. For these remote countries prices of imported commodities and goods are typically higher than for the well connected countries, and thus the share of imports by value would yield higher results than if calculated based on volume of imports, and as such is more equitable. Finally, using value rather than volume allows combining trade by sea and air as they are of similar order. Combining volume (weight) of trade by sea and air does not make sense as these differ typically by two orders of magnitude. A separate question whether or not to include distance is discussed in a dedicated section Impact of Distance.

II.3 Why not use overall imports?

29 Country-level data on global imports by value is readily available, for instance from the International Monetary Fund (IMF 2009) and the United Nations Conference on Trade and Development (UNCTAD 2010c), in contrast to data on seaborne imports which is not generally available. Thus a country's share of global imports (overall, by value) is also readily available, and can be used as a simple key to proxy the country's share of global

[6] Detailed calculations by the author for various ship types confirmed this general relationship, and are available from the author. In this study only overall results for sea and air transport are provided.

seaborne imports. However, for countries that trade extensively by land (i.e. road, train and pipeline) this proxy would overestimate their share of seaborne imports. For islands that trade exclusively by sea and air, such proxy would underestimate its share of seaborne imports, given that it would be derived by dividing by the overall global imports that incorporates additionally the imports by land. The share of imports was originally proposed by the author as an initial measure, until another more precise option or data became available (IUCN 2010). The above example of islands trading exclusively by sea and air suggest that using such data should be investigated.

II.4 Using combined air and sea data

30 Splitting the value of trade carried by international transport, into seaborne and airborne, is difficult, as the air-sea split may vary between countries, and no relevant data exists for the majority of countries. However, analysis of the emission intensity of international transport per dollar of cargo carried provides justification that additional accuracy gained may be marginal, while effort very significant.

31 Generally low-value cargo is carried by sea and high-value by air. The difference in average value per tonne of cargo transported by air and sea is significant, circa 70 fold, or more.[7] However the difference between average emission rates between ships and aircraft is also very significant, circa 70 fold, with all types of ships being much more efficient than aircraft per tonne-km of carried cargo. For instance average emission rates for seaborne and airborne transport in 2007 are calculated as 14.9 gCO2/tonne-km and 1,029 gCO2/tonne-km, respectively.[8]

32 To a great degree, these two effects balance each other out for these two transport modes. Thus the emission intensity of trade, defined as the amount of emissions per dollar of carried cargo, is of the same order of magnitude for seaborne and airborne trade, confirming the usage of value measure to proxy responsibility for emissions even between two different transport modes. For 2007, the emission intensity for international seaborne trade is calculated as 113 gCO2/US$ of cargo carried.[9] The emission intensity for international aviation is estimated to be of similar order of magnitude.[10]

33 Thus the value of imports by sea and air can be used to proxy emissions attributable to a country from international maritime transport. If in a given country the split between imports by sea and air were significantly different than in another country, these would balance out for the reasons provided above, providing a similar approach were used for aviation. Any inaccuracy of attributing more usage of international aviation to a country that uses it a little would balance out by attributing more usage of international shipping to this country. This could also allow an approach to compensate the cost burden resulting from a MBM for international aviation, but such considerations are outside the scope of this study.

---

7 For instance average value per tonne of cargo imported to the United States in 2007 was US$968 and US$88,143, for sea and air modes respectively. Obtained using the Freight Analysis Framework, Federal Highway Administration, United States Department of Transportation; available at http://www.ops.fhwa.dot.gov/freight/freight_analysis/faf/.

8 The emission rate for international maritime transport is calculated by dividing its total emissions of 870 MtCO2 by the seaborne transport work of 58,199 billion tonne-km (as per IMO 2009 and UNCTAD 2010b data for 2007). The emission rate for international aviation is calculated by dividing its emissions of 380 MtCO2 by airborne transport work of 369.40 billion revenue tonne kilometres, RTK (as per ICAO data for 2007; The ICAO Journal vol. 64, No. 1, 2009; available at http://www.icao.int/icao/en/jr/2009/6401_en.pdf).

9 The emission intensity for international maritime transport is calculated by dividing its emissions of 870 MtCO2 by the total seaborne exports of $7,723 billions in 2007 (trade data from US DOT 2010).

10 The data for international airborne trade, that includes intra-EU, is practically not available. At the time of writing various estimates are being validated.

III. DERIVING GLOBAL IMPORTS BY SEA AND AIR

III.1 Trade with non-adjacent partners

34 Three-quarters of world trade by value takes place between countries that do not share a land border, and nearly all of this trade moves via sea and air, as noted by Hummels (2009). This is typical for developing countries, especially in Africa. For islands, all of their trade is by air or sea, unless there is some trade by pipeline or the island is connected to another country by a bridge, but these are rare. There are some exceptions though, mostly in the developed world. In Europe notable trade by land takes place between various non-adjacent land countries, for instance between Italy and Germany, given small distances (proximity), good roads and rail links.

35 Thus, a country's share of global trade between non-land-adjacent partners, by value, is a simple proxy for a country's seaborne and airborne trade combined. It is especially viable for islands and developing countries. Given that it effectively excludes trade by land for many countries, it is significantly better than a country's share of global imports, which was proposed as the initial measure for the rebate mechanism (document MEPC 60/4/54).

36 For instance, for each island the new proxy would be approximately one third larger than the initial one, given that the denominator in the share calculations would be lower, circa three-quarters of all world trade. This new proxy can be improved further by implementing adjustments for areas where it is less accurate.

III.2 Trade with non-adjacent partners, adjusted (TNAP)

37 An effective approach to improve further the above proxy is to adjust the definition of an adjacent partner (AP) as follows. Two countries that are land-adjacent are adjacent partners (APs). Any island country that is connected to another country, via bridge, tunnel or similar, is an AP of that country, and vice-versa[11]. Any two countries in Europe that are two borders apart are also APs (such as Germany and Italy). A non-adjacent partner (NAP) is any country that is not an AP. The above approach was selected to reflect the greater share of land transport for various countries which are close by but not-land-adjacent, namely for countries in Europe and islands having land transport connections to mainland.[12]

38 Furthermore, to reflect significant air and sea transport between certain APs that are far apart, the real values of the share of trade by land between them are used. This applies to the U.S., Canada and Latin America countries and their main APs.[13]

---

11 In the case of the United Kingdom (UK), which is connected by the Channel Tunnel with mainland Europe, two countries are set as adjacent to the UK, France and Belgium.

12 A more accurate approach through adjusting the share of land transport between various European countries is not possible, as data on modal transport shares within Europe (i.e. EU-27) is not available. Alternatives based on distance between countries were studies as well, but proved to require complex assumptions and were difficult to verify while not guaranteeing a more accurate result.

13 For instance, Brazil and Argentina share a land border but trade a little by land due to large distances between and position of their major economic centres that are located close to sea.

III.3 TNAP algorithm and calculations

39 Detailed calculations were made for trade with non-adjacent partners by combining bilateral trade flows with NAPs data (TNAP calculations). For each country first the country's trade with NAPs is calculated, and summed to provide the global trade with NAPs. Subsequently, each country's share of global trade with NAPs is calculated. The trade data from the United Nations Commodity Trade Statistics Database (UN Comtrade) is used to obtain the following TNAP results for 2007 (for imports).

40 Without any adjustments, global imports from non-adjacent partners (i.e. from non-land-adjacent partners) accounted for just over three-quarters (76.7%), of imports from all partners. Of these, developed and developing countries accounted for 63.5% and 36.5%, respectively, according to author's calculations.

41 After the accuracy adjustments, for Europe, U.S., Canada and Latin America countries, the imports from NAPs accounted for 69.4% of global trade. Thus the adjustments reduce the share of imports from NAPs from approximately three-quarters to circa 70% of global trade. Of these, developed and developing countries accounted for circa 60% and 40%, respectively.

42 The global share of imports by sea and air is not officially tracked or reported. However, its various estimates are very close to 70%. Thus, it is warranted to use the TNAP algorithm to calculate the countries' share of import by sea and air.

III.4 Country share of global imports by sea and air

43 Using the TNAP approach, a country share of global imports by sea and air can be calculated for each country. Tables 1 and 2 provide such results for selected developed and developing countries respectively. These are shown together with the share of global imports by all modes of transport, for comparative purposes. Developed countries are defined as per Annex I of UNFCCC.

Table 1: Developed countries' share of value of global imports in 2007 (author's calculations)

Developed Country (as per the UNFCC Annex I)	**Share of global imports, by sea and air** **%**	**Share of global imports, by all transport modes** **%**
USA	15.97	14.43
Japan	6.41	4.45
Germany	4.60	7.58
UK	3.96	4.47
Italy	2.96	3.66
France	2.60	4.37
...	...	...
All developed countries:	**59.81**	**66.84**

Table 2: Developing countries' share of value of global imports in 2007 (author's calculations)

Developing Country/region	Share of global imports, by sea and air %	Share of global imports, by all transport modes %
China	8.35	6.84
Republic of Korea	3.68	2.55
Africa (all)	3.48	2.56
Singapore	2.36	1.88
Taiwan Province of China	2.27	1.57
Hong Kong SAR, China	2.06	2.65
India	1.98	1.56
Mexico	1.46	2.02
Ethiopia	0.06	0.04
Guyana	0.01	0.01
…	…	…
All developing countries:	**40.19**	**33.16**

44 As illustrated in Tables 1 and 2, the developed and developing countries accounted for circa two-thirds and one-third of global imports value respectively (for all transport modes). Developing countries clearly account for a higher share of global imports by sea and air (circa 40%) then by all transport mode modes of transport (circa 33%), while the opposite is true for developed countries. This reflects that generally land transport is more extensively used by developed than developing countries.

IV. IMPACT OF DISTANCE

45 This section analyzes the impact of distance in attributing responsibility for emissions to countries and calculating impacts on the countries from a global MBM for shipping emissions. The concept of trade-weighted distance is introduced and is used to justify why distance is of less relevance, and can be omitted in the context of various efficiencies of ships used on different routes and distances.

IV.1 Trade-weighted distances (TWD)

46 As the geographical location of countries differs significantly, it may seem that the distance over which a country trades with its partners, via air and sea, also varies significantly. However, a detailed analysis of bilateral trade patterns reveals that this is not the case. To further analyse this issue, a trade-weighted distance for international transportation (TWD) is defined as follows. The TWD is a nautical distance of the country from its trading partners weighted by their bilateral trade by air and sea (i.e. excludes trade by land). More specifically, it is calculated as a weighted average of bilateral distances and value of seaborne and airborne trade, of the country with each of its trading partners. Thus the TWD is a single measure of a country's location relative to its trading partners, quantifying how far a country is from its (current) trading partners by sea.

47 A model is constructed to calculate the TWD by integrating:

.1 Nautical distances between countries,

.2 Bilateral trade flows by air and sea between countries.

48 The nautical distances are based on the UNCTAD Maritime Connectivity Data Base, kindly made available by UNCTAD. The trade flows by air and sea are calculated by the TNAP algorithm discussed. TNAP is applied to the value of bilateral trades (sum of imports and exports) obtained from the United Nations Commodity Trade Statistics Database (UN Comtrade).

49 The algorithm to calculate TWD for a country/region is as follows. For each of its trading partners, the nautical distance between the country and the partner is multiplied by their TNAP bilateral value. The results are summed and divided by the country's total TNAP value, thereby providing its TWD, i.e. the country's trade-weighted distance, by sea and air.[14]

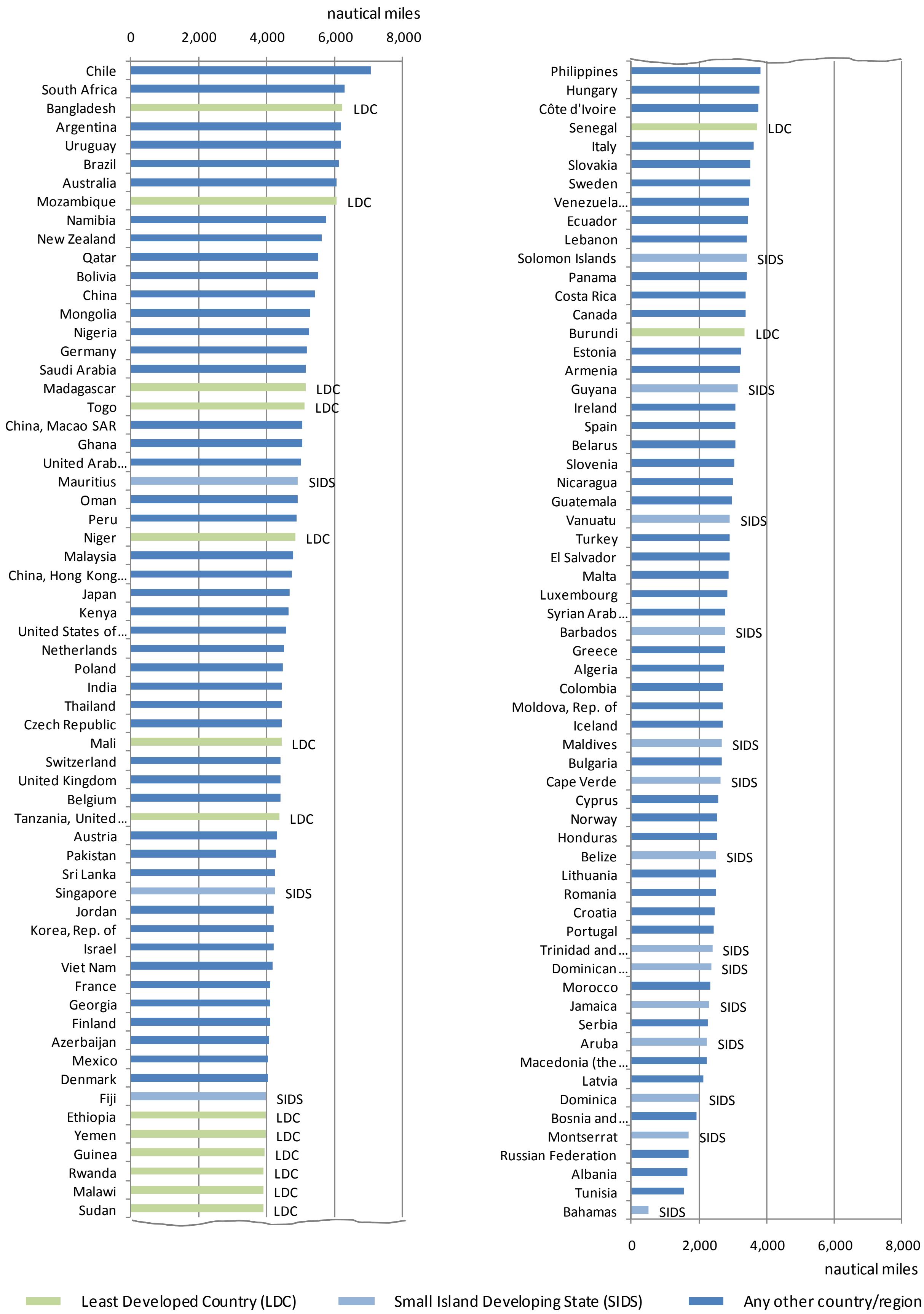
50 TWD results for 124 countries/regions are shown in Figure 1, representing circa 97% of international trade in 2007 (as per UN Comtrade). The results are arranged from the highest to the lowest TWD, and split into two parts for clarity.

51 The results illustrate that the TWD variability is somewhere between 2,000 and 6,000 nautical miles (miles), for nearly all countries, with an average TWD under 4,000 miles. Only Chile has TWD greater than 7,000 miles, and only one country has TWD of less than 1,000 miles: the Bahamas. Eight countries have TWD greater than 6,000, and seven countries less than 2,000 miles.

52 Thus the countries that trade over largest distances are only circa three times further from their trading partners than countries that have smallest TWD, and only 50% further than the global average. Closer analysis reveals that the countries with the highest TWD, such as Chile, South Africa, Bangladesh, and Australia, trade with far away countries in large volumes.

14 This approach differs slightly from calculations weighted by overall trade, presented in MEPC 61/INF.2, as those were based on overall trade flows, including by land. The TWD approach presented in this paper improves on the previous approach by including only trade by sea and air, and thus is deemed superior for analyzing international transport. For instance, in the previous analysis the trade distance of many European countries was relatively, which was not surprising given that the majority of the intra-European trade is carried by land, and involves mainly neighbouring countries.

Figure 1: Trade-weighted distances, international transport (TWD) (author's analysis)



53 On the other end of the spectrum, at low TWD, many of the countries are Small Island Developing States (SIDS), such as Dominica, Aruba, Jamaica, and other smaller countries. These countries trade mostly with their closest partners. The Bahamas has the lowest TWD, due to its proximity to the USA, by far its largest trading partner. The Russian Federation also has a relatively low TWD, but this should be interpreted with caution. The low value is related to its vast geographic area and how the nautical distances between countries are derived.[15]

54 The TWD on Figure 1 are calculated using trade data, but very similar results are obtained when import or export data are used. Thus, the above has shown that perhaps contrary to some expectations, the TWD does not vary greatly between countries. The ratio of largest to smallest TWD is only circa 3 for nearly all countries. Furthermore, majority of SIDS trade over smaller distances while many larger countries trade over longer distances.

IV.2 Excluding distance from calculations

55 To justify why distance can be excluded from the attribution process (as used in the rebate mechanism) the combined effect of trading distance and ship efficiency is analyzed. According to industry data, the emission rate of smaller ships is circa 3 times lower than the emission rate of larger ships. This needs to be considered in the context of the TWD analysis, that the largest trading distances are circa 3 times greater than the smallest.[16]

56 The smaller ships often operate on shorter routes, and especially on routes to small countries. This is often related to small transport volume, smaller ports, and occasionally the remoteness from major trading routes. Thus many countries with relatively low TWD generally experience greater emissions per tonne-mile, than the countries with relatively high TWD, served by larger ships. Therefore these two measures, TWD and the average emission rate of ships serving a country are negatively correlated. Thus when these two measures are combined (multiplied), the resulting efficiency-distance distribution would be much flatter than the TWD itself – albeit not entirely flat. In fact, the efficiency-distance result for the small islands may be somewhat higher than for the countries with large TWD. Using the value measure for these islands would thus be more appropriate, given that prices of imported commodities and goods on these islands are higher than elsewhere.

57 Therefore including distance could bring only a marginal increase in the accuracy of attributing shipping emissions to different countries, if any, when compared with using just the value measure. Yet incorporating distance is administratively very complex given the need for detailed cargo and distance data, potentially from each of the tens of thousands ships worldwide. At the same time calculating incidence from an MBM on small countries, which experience higher costs of imported goods, the share of imports by value would reflect their incidence better than share of imports by volume.

---

[15] The bilateral distance in the model is equal the distance between two closest major ports of the given two countries. For the Russian Federation three ports are used: Novorossiysk, St. Petersburg and Vladivostok. One is selected for each partner. For instance for Japan Vladivostok is used, which is just under 1,000 nm from Tokyo, the port used for Japan. In reality not all trade between the Russian Federation and Japan is carried over such a relatively short distance.

[16] For instance emissions rates, in grams CO_2 per tonne-km of cargo carried are reported in the Second IMO GHG study 2009 as follows: crude oil tankers: from 2.9 - 9.1; bulk carriers 2.5 - 7.9; containers: 12.5 - 32 (from the larger to smaller ships, but excluding the smallest ships as they often do not operate internationally). Similar effect of scale was reported by IMarEST in the document MEPC 60/4/34.

58 Various reports have found that distance is not that strong a determinant of freight costs, which supports the above findings. The Organisation for Economic Co-operation and Development (OECD) studied the determinants of maritime transport costs, and found distance is a poor proxy for the costs. It concluded that the various other determinants such as ship size make the aggregate effect of distance complex (OECD 2008). Various researchers, based on empirical data, quantified the impact of distance on freight costs, and found it to be small. Doubling the distance led to an increase of maritime costs (including insurance) by circa 15-20% (see for instance Micco and Pérez 2002, Wilmsmeier and Hoffman 2008).

V. OPTIMAL ATTRIBUTION KEY AND ITS APPLICATION

59 The analysis in the previous section demonstrated that distance can and should be eliminated from calculations when a country incidence (cost burden) arising from a global MBM is assessed, without losing much accuracy while making such calculations feasible today. Thus the optimal attribution key to attribute the global cost burden to countries for which reliable data exist is the country's share of imports from non-adjacent countries (NAPs). These values are provided by the TNAP calculations.

60 Table 3 provides attribution (rebate) keys for example developing countries. The values are equal to the estimate of the countries' share of global imports by sea and air, as provided for some countries in Table 2.

61 The keys for 156 developing countries/regions are contained in the appendix.

Table 3: Rebate keys for selected developing countries, 2007 data (author's calculations)

Developing Country/region	R Key, %
China	8.35
Republic of Korea	3.68
Singapore	2.36
Taiwan Province of China	2.27
Hong Kong SAR, China	2.06
India	1.98
Mexico	1.46
Next 27	13.55
Bangladesh	0.16
Next 25	2.41
Ethiopia	0.06
Next 25	0.93
Papua New Guinea	0.03
Next 25	0.45
Guyana	0.01
Remaining 40+ countries	0.44
TOTAL non-Annex I	**40.19**

V.2 Integration conditions

62 As stated in MEPC 60/4/55, in principle the proposed RM could apply to any MBM, providing it generates enough gross revenue to cover the rebate needs. According to the original proposal, given that developing countries import approximately a third of goods worldwide by value (as shown in Table 2), the gross revenue of an MBM that can provide rebates for developing countries must be greater than 30% of the instrument's global cost burden. Based on the optimal rebate key proposed in this paper, the above condition may need to be changed to 40%, or another appropriate amount. However, given that some developing countries may pursue the option of foregoing all or part of their rebates, it is still viable to use the 30% as an illustrative integration condition.[17] As this is the only condition, any MBM based on a levy or a GHG contribution can directly use the proposed RM and the optimal rebate key, as its cost burden equals the gross revenue raised.

63 For an MBM based on emissions trading, such as cap-and-trade, the successful integration depends on the design of the MBM. For instance, the total economic cost of a cap-and-trade measure is the sum of (1) the cost of emission allowances distributed to the maritime sector and (2) the cost of emission allowances and credits purchased from other sectors. As the revenue in a cap-and-trade system is typically raised through emission allowance auctioning, only schemes that auction at least 30% of the emission allowances could apply the proposed rebate mechanism. For any scheme that assumes non-uniform application, for instance applying different charges based on the efficiency of ships, integration of the rebate mechanism would be more difficult. The cost burden for a given country would for such schemes depend on the efficiency of ships serving the country, and thus its rebate cannot be calculated easily.

V.3 Integration with MBM proposals

64 This section considers the various MBMs being considered at the IMO with a view to assessing the possibility of integrating the RM into these proposals. As introduced earlier, these include: GHG Fund, LIS, PSL, SECT, VES, ETS, and RM. Given that the IMO is in the process of developing a potential MBM, these proposals should be seen as subject to changes and improvements, not as options set in stone. The RM has been submitted to the IMO by the International Union for Conservation of Nature (IUCN) as two options: the RM add-on which could be added or integrated into certain MBM proposals that raise revenue, and the RM integrated which is the IMERS proposal (see MEPC 60/4/55 and MEPC 60/5/33).

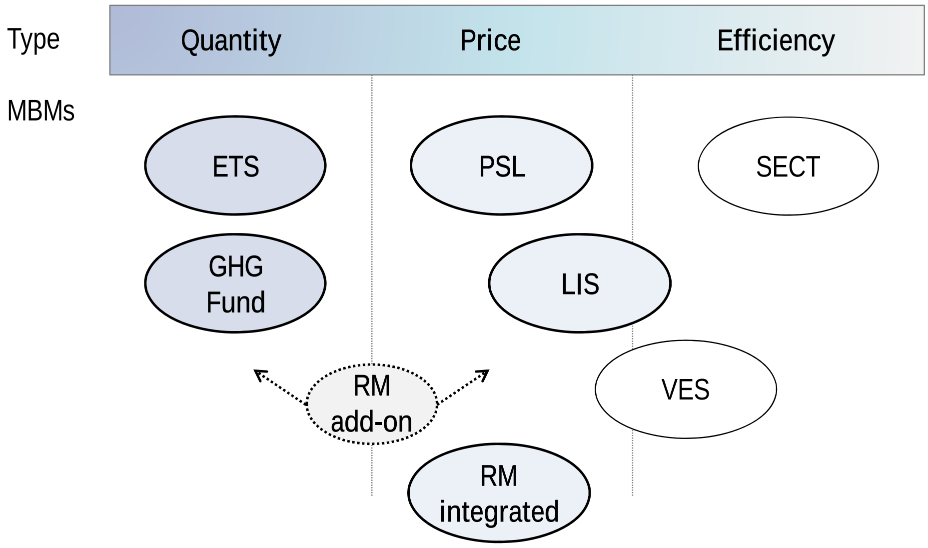
65 All proposals except SECT anticipate that a MBM will generate revenue, and require a Fund to disburse it. All the following proposals GHG Fund, ETS, PSL, and LIS would raise revenue from all participating ships, in a uniform manner (see MEPC 61/INF.2 for more details). Thus the RM add-on could apply to each of them, providing sufficient revenue is generated to cover the rebates.

66 The applicability of the RM to the MBMs being considered at the IMO is illustrated in Figure 2. The RM add-on could be easily integrated with ETS, GHG Fund, PSL, and LIS. The only proposal thus far that incorporates the RM is the IMERS scheme (RM integrated), as described in the MEPC 61/5/33, and evaluated by the MBM-EG in MEPC 60/INF.2.

[17] For illustrative purposes only, the rebates corresponding to the imports of the Hong Kong Special Administrative Region (SAR) of China, Taiwan Province of China, Republic of Korea, and Singapore, amount to around 10% of gross revenue. If the rebate that these entities were entitled to were foregone, the respective countries/regions could be recognized internationally for such action, given that in this proposal such decisions are voluntary in nature.

67 The RM add-on cannot apply to SECT, given that this scheme does not raise revenue at all. Applying the RM add-on to VES would be complex, as VES would only raise revenue from the non-compliant, existing ships. Only existing ships failing to meet the required standard through technical modifications would be subject to a fee applied to each tonne of fuel consumed. Thus the cost burden to countries would depend where the non-compliant, fee paying ships operate. As a result, compensation based on a simple rebate key, such as the proposed country's share of global imports from non-adjacent countries, cannot apply. A much more complex rebate key would be required.

Figure 2: Applicability of rebate mechanism to various MBM (author's analysis)



MBM legend:

ETS	Emission Trading System
GHG Fund	International Fund for GHG emissions from ships
LIS	Leveraged Incentive Scheme
PSL	Port State Levy
RM	Rebate Mechanism; add-on, and integrated (IMERS)
SECT	Ship Efficiency Credit Trading
VES	Vessel Efficiency System

68 To further clarify and generalize the findings, MBMs are categorized in Figure 2 by the dominant characteristic or the type of MBM, reflecting their different designs. These are:

.1 Quantity;

.2 Price; and

.3 Efficiency.

69 The quantity proposals require a cap or target for total quantity of GHG emissions from international maritime transport. The price proposals require a levy or a contribution (on ship fuel or GHG emissions). The efficiency proposals require efficiency targets for existing ships.

70 Figure 2 illustrates only one possible categorization, albeit the dominant ones, as certain proposals employ features of a different type, or types. For instance, the GHG Fund proposal is categorized as a quantity measure, but some may see it as a price measure, given that it is based on GHG contribution per tonne of fuel bunkered. However, in this paper it is categorized as a quantity measure as it is the cap on emissions that is established

first, that subsequently drives the level of GHG contribution. LIS partially belongs to the efficiency type, as it requires a ship energy efficiency score for a refund to be granted to each of the most efficient ships. VES partially belongs to the price category, as the level of penalty on fuel for ships that do not comply with the efficiency standard needs to be set, and penalties need to be collected. The positioning of these proposals between the different types aims to illustrate their hybrid features.

71 Thus, Figure 2 shows that generally the RM can apply to quantity and price measures, but not to measures based on efficiency. This relates to the need to (1) generate revenue and (2) the scheme being applied in a uniform manner across the fleet, irrespective of ship efficiency, age, and so on.

VI. CONCLUSIONS

72 As this study has demonstrated, it is feasible to implement the principles of equity and CBDR in a maritime MBM through the proposed RM, or any similar approach that can deliver no "net incidence" on developing countries.

73 After extensive research, the country share of value of global imports from non-adjacent partners (after certain simple accuracy adjustments), is identified as the most appropriate proxy for a country's cost burden from a global maritime MBM, which is readily available and does not require significant adjustment. Thus optimal attribution or rebate has been identified.

74 According to the calculations presented, in 2007 circa 70% of global trade by value was transported by sea and air. Of this, developed and developing countries accounted for circa 60% and 40% respectively. Thus, the estimate of incidence on developing countries from a global maritime MBM is circa 40% of global costs. This is greater by circa 7% when compared with a simple estimate based on value share of imports by all modes of transport.

75 The RM with the optimal rebate key can be integrated into almost all revenue-raising schemes currently being considered by the IMO. Once integrated, the net revenue raised would come from developed countries, complying with the relevant UNFCCC provisions and commitments. Furthermore, the proposed RM provides important additional flexibility for a country to forego the rebate or part of it. This seems the optimal way to creatively reconcile the principles of the IMO and the UNFCCC, as well as take into account various national circumstances.

76 Rebating to developing countries the cost burden (incidence) generated by the MBM is more straightforward than the complete exemption of these countries from the application of the MBM. This will also ensure that the MBM can be easily implemented globally. Approximately, only 150 rebates are to be issued, i.e. one rebate for each developing country. With data required to calculate the rebates being readily available, the rebates could be issued annually, or more frequently. The attribution keys for 190 countries, that are rebates to developing countries, have been calculated in this study based on data trade data for 2007 and can be used for various scenario or validation country-by-country. The results are in the appendix.

77 In summary, the quantified analysis illustrate that it is feasible to create an equitable revenue-generating MBM that can reconcile the principles and provisions of the UNFCCC with a global IMO regime for all ships. Such an approach could break the current impasse and facilitate swift progress in this longstanding and controversial area of reducing GHG emissions from international shipping. Considering the overriding imperative to act globally to address the impact of climate change and growing shipping emissions, such an innovative and practical approach seems timely, justified and potentially transformative.

***

APPENDIX

Table 4: Rebate keys for developing countries/regions, 2007 data (author's calculations)

Country/region	R Key %	Country/region	R Key %	Country/region	R Key %
Afghanistan	0.0238	Gambia	0.0030	Nigeria	0.3311
Albania	0.0346	Georgia	0.0360	Niue	0.0001
Algeria	0.2820	Ghana	0.0727	Oman	0.1176
Angola	0.0893	Grenada	0.0038	Pakistan	0.2747
Antigua and Barbuda	0.0075	Guatemala	0.1182	Palau	0.0018
Argentina	0.3586	Guinea	0.0126	Panama	0.0655
Armenia	0.0282	Guinea-Bissau	0.0010	Papua New Guinea	0.0273
Azerbaijan	0.0404	Guyana	0.0101	Paraguay	0.0340
Bahamas	0.0320	Haiti	0.0156	Peru	0.1676
Bahrain	0.1130	Honduras	0.0577	Philippines	0.5980
Bangladesh	0.1565	India	1.9806	Qatar	0.2129
Barbados	0.0134	Indonesia	0.6912	Rwanda	0.0056
Belize	0.0059	Iran (Islamic Rep. of)	0.4176	Saint Kitts and Nevis	0.0028
Benin	0.0103	Iraq	0.1952	Saint Lucia	0.0063
Bhutan	0.0049	Israel	0.5823	Saint Vincent and the Grenac	0.0034
Bolivia	0.0177	Jamaica	0.0695	Samoa	0.0027
Bosnia and Herzegovina	0.0724	Jordan	0.1048	San Marino	0.0000
Botswana	0.0370	Kazakhstan	0.1729	Sao Tome and Principe	0.0008
Brazil	1.1268	Kenya	0.0907	Saudi Arabia	0.8851
Brunei Darussalam	0.0195	Kiribati	0.0007	Senegal	0.0502
Burkina Faso	0.0158	Korea, Dem. People's Rep. of	0.0153	Serbia	0.1593
Burundi	0.0042	Korea, Rep. of	3.6796	Seychelles	0.0089
Cambodia	0.0492	Kuwait	0.2070	Sierra Leone	0.0041
Cameroon	0.0350	Kyrgyzstan	0.0168	Singapore	2.3585
Cape Verde	0.0076	Lao People's Democratic Rep	0.0099	Solomon Islands	0.0029
Central African Republic	0.0021	Lebanon	0.1197	Somalia	0.0044
Chad	0.0240	Lesotho	0.0179	South Africa	0.8077
Chile	0.3783	Liberia	0.0047	Sri Lanka	0.1174
China	8.3490	Libyan Arab Jamahiriya	0.0627	Sudan	0.0970
China, Hong Kong SAR	2.0579	Macedonia (the former Yugo:	0.0421	Suriname	0.0097
China, Macao SAR	0.0322	Madagascar	0.0252	Swaziland	0.0118
Taiwan Province of China	2.2651	Malawi	0.0113	Syrian Arab Republic	0.1396
Colombia	0.2847	Malaysia	1.1751	Tajikistan	0.0228
Comoros	0.0012	Maldives	0.0113	Tanzania, United Rep. of	0.0595
Congo	0.0277	Mali	0.0147	Thailand	1.3440
Congo (Democratic Rep. of th	0.0274	Malta	0.0510	Timor-Leste	0.0043
Cook Islands	0.0011	Marshall Islands	0.0007	Togo	0.0077
Costa Rica	0.1283	Mauritania	0.0133	Tonga	0.0015
Côte d'Ivoire	0.0682	Mauritius	0.0402	Trinidad and Tobago	0.0790
Cuba	0.1123	Mexico	1.4594	Tunisia	0.1872
Cyprus	0.0902	Micronesia (Federated State:	0.0004	Turkmenistan	0.0213
Djibouti	0.0044	Moldova, Rep. of	0.0263	Tuvalu	0.0002
Dominica	0.0020	Mongolia	0.0075	Uganda	0.0308
Dominican Republic	0.1415	Montenegro	0.0298	United Arab Emirates	1.2684
Ecuador	0.1196	Morocco	0.3182	Uruguay	0.0354
Egypt	0.2499	Mozambique	0.0210	Uzbekistan	0.0450
El Salvador	0.0790	Myanmar	0.0304	Vanuatu	0.0021
Equatorial Guinea	0.0288	Namibia	0.0089	Venezuela (Bolivarian Rep. o	0.3620
Eritrea	0.0066	Nauru	0.0008	Viet Nam	0.5119
Ethiopia	0.0592	Nepal	0.0274	Yemen	0.0827
Fiji	0.0184	Nicaragua	0.0325	Zambia	0.0388
Gabon	0.0204	Niger	0.0090	Zimbabwe	0.0130

Table 5: Attribution keys for developed countries, 2007 data (author's calculations)*

Country	Attr Key %	Country	Attr Key %
Australia	1.5983	Latvia	0.0958
Austria	0.4521	Lithuania	0.1143
Belarus	0.0910	Luxembourg	0.0506
Belgium	1.6705	Netherlands	2.3298
Bulgaria	0.2399	New Zealand	0.3177
Canada	1.9773	Norway	0.4904
Croatia	0.2318	Poland	0.7256
Czech Republic	0.4328	Portugal	0.5020
Denmark	0.3991	Romania	0.5534
Estonia	0.1123	Russian Federation	1.3992
Finland	0.6018	Slovakia	0.3236
France	2.6018	Slovenia	0.0961
Germany	4.6015	Spain	3.0122
Greece	0.7362	Sweden	0.9112
Hungary	0.4480	Switzerland	0.5129
Iceland	0.0690	Turkey	1.6386
Ireland	0.5932	Ukraine	0.5624
Italy	2.9651	United Kingdom	3.9644
Japan	6.4161	United States of America	15.9771

* Accuracy of attribution keys for individual EU-27 countries is generally lower than for others, and cannot be easily improved at present as data on intra-EU transport modal shares is not available. However, the accuracy of attribution to the EU-27 as a whole is comparable to the other countries, as individual attribution inaccuracies generally balance out in the EU-27 total (calculated as 28.9%).

Bibliography

AGF (2010a) 'Report of the Secretary-General's High-level Advisory Group on Climate Change Financing' (AGF), New York, USA; http://www.un.org/wcm/webdav/site/climatechange/shared/Documents/AGF_reports/AGF%20Report.pdf

AGF (2010b) 'Work Stream 2: Paper on potential revenues from international maritime and aviation sector policy measures', The Secretary-General's High-level Advisory Group on Climate Change Financing' (AGF), New York, USA; http://www.un.org/wcm/webdav/site/climatechange/shared/Documents/AGF_reports/Workstream_2_International_Trasnsport_Revised.pdf

Gilbert P. and Bows A. and Starkey R. (2010) 'Shipping and climate change: Scope for unilateral action', The University of Manchester, Manchester, UK; http://documents.manchester.ac.uk/display.aspx?DocID=8127

Hummels, D. (2009), 'Globalization and Freight Transport Costs in Maritime Shipping and Aviation', International Transport Forum, Paper 2009-3, OECD/ITF, Paris, France; www.internationaltransportforum.org/2009/workshops/pdf/Hummels.pdf.

IMF (2009), Direction of Trade Statistics (DOTS), International Monetary Fund, Washington DC.

IMO (2009), Second IMO GHG study 2009, MEPC 59/INF.10, MEPC 59/INF.10/Corr.1, International Maritime Organization, London, UK.

IMO (2010a), 'A rebate mechanism for a market-based instrument for international shipping', MEPC 60/4/55, by the International Union for Conservation of Nature (IUCN), International Maritime Organization, London, UK.

IMO (2010b), 'Further information on a rebate mechanism for a market-based measure for international shipping', MEPC 61/5/33, by the International Union for Conservation of Nature (IUCN), International Maritime Organization, London, UK.

IMO (2010c), 'Full report of the work undertaken by the Expert Group on Feasibility Study and Impact Assessment of possible Market-based Measures', MEPC 61/INF.2, MEPC 61/INF.2/Corr.1, MEPC 61/INF.2/Corr.2, International Maritime Organization, London, UK.

Korinek J. and Sourdin P. (2009) 'Clarifying Trade Costs: Maritime Transport and its Effect on Agricultural Trade', OECD Trade Policy Working Papers, no. 92, OECD Publishing.

Micco A. and Pérez N. (2002), 'Determinants of Maritime Transport Costs', Inter-American Development Bank, Research Department Working paper 441, Washington DC, USA; http://www.iadb.org/res/publications/pubfiles/pubWP-441.pdf

OECD (2008), 'Clarifying trade costs in maritime transport', Working Party of the Trade Committee, Trade and Agriculture Directorate, TAD/TC/WP(2008)10, Organization for Economic Co-operation and Development.

Stochniol, A. (2009a) 'A levy on fuel for international shipping, which differentiates responsibilities between developed and developing countries', Multi-year expert meeting on Transport and Trade Facilitation, Maritime and Climate Change Challenge, UNCTAD, Geneva, Switzerland; http://www.unctad.org/sections/wcmu/docs/cimem1p20_en.pdf

Stochniol, A. (2009b) 'Memorandum for the UK's Environmental Enquiry', Reducing CO_2 and other emissions from shipping, Fourth Report of Session 2008-09, House of Commons, Environmental Audit Committee, HC 528, pp 57-61/Ev9-13, London, UK; http://www.publications.parliament.uk/pa/cm200809/cmselect/cmenvaud/528/528.pdf

UNCTAD (2010a) 'Oil Prices and Maritime Freight Rates: An Empirical Investigation', Technical Report by the UNCTAD secretariat, UNCTAD/DTL/TLB/2009/2, United Nations; http://www.unctad.org/en/docs/dtltlb20092_en.pdf

UNCTAD (2010b) Review of Maritime Transport 2010, Report by the UNCTAD secretariat, United Nations, New York and Geneva; http://www.unctad.org

UNCTAD (2010c) UNCTAD handbook of statistics 2010, United Nations, New York and Geneva; http://www.unctad.org/en/docs/tdstat34_enfr.pdf

UNFCCC (2010), Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action under the Convention, Cancun, Mexico; http://unfccc.int/files/meetings/cop_16/application/pdf/cop16_lca.pdf

U.S. Department of Transportation (2010), Research and Innovative Technology Administration, Bureau of Transportation Statistics, 'Freight Transportation: Global Highlights, 2010', Washington, DC; http://www.bts.gov/publications/freight_transportation/pdf/entire.pdf

Wilmsmeier G. and Hoffman J. (2008) 'Liner Shipping Connectivity and Port Infrastructure as Determinants of Freight Rates in the Caribbean', Maritime Economics & Logistics, 10, pp 130-151

World Bank (2009), World Development Report 2010, Development and Climate Change, World Bank, Washington, USA
http://siteresources.worldbank.org/INTWDR2010/Resources/5287678-1226014527953/Chapter-6.pdf

____