Disclaimer: This paper is the result of the analysis carried out by a sub-group within the AGF. However, the paper does not purport to represent the views or the official policy of any member of the AGF.

WORK STREAM 2: PAPER ON POTENTIAL REVENUES FROM INTERNATIONAL MARITIME AND AVIATION SECTOR POLICY MEASURES

Context and summary

This paper is part of the AGF's exploration of potential sources of revenue that may be used to enable and support climate change action in developing countries. Under the Copenhagen Accord Parties agreed to the goal of mobilising up to US$100 billion by 2020, from a variety of sources.

Currently the environmental externality associated with emissions from fossil fuel use in both the international maritime and aviation sectors is under-priced at a global level. In 2007, greenhouse gas emissions from international shipping represented around 1.7% of world emissions, while aviation emissions represented around 0.8%, these shares are expected to rise in coming years.[1] Policy measures which appropriately price this externality could deliver environmental and net social benefits whilst also raising revenues which could be made available to enable and support climate change action in developing countries.

This paper canvases three possible generic policy constructs — an emissions trading scheme (ETS), a fuel levy and an aviation ticket tax — that may be used to raise revenue whilst also attempting to target the externality. The paper makes broad qualitative assessments of the policies against the AGF's criteria, and also outlines some quantitative analysis of the policies' revenue potential and their effect on the pattern of trade.

It is important to note that this paper does not seek to provide a comprehensive examination of all possible policy measures or related issues in this sphere. Nor should it be seen as pre-empting or superseding consideration of such measures in appropriate venues. Rather it has instead been framed to facilitate a broad internal discussion of the major issues related to this topic within the advisory group.

This paper acknowledges the significant and ongoing efforts of the International Maritime Organization (IMO) and the International Civil Aviation Organization (ICAO) in working to build an international consensus on addressing their respective sector's CO_2 and other emissions. While an agreement on adoption of comprehensive control measures has yet to be reached, this paper builds on information publicly available through both organisations, including their invaluable internal discussions on similar policy measures. Both organisations will be informed of the AGF process and progress will be communicated to them.

[1] This is a conservative estimate, with some estimates suggesting combined emissions could represent up to 7% of the total global CO_2 emissions The figures are based on an IMO estimate for international maritime emissions of 870Mt (2009 IMO GHG Study), an IEA estimate of emissions from international aviation of 391Mt (IEA CO_2 emissions from fossil fuel combustion, 2009 edition) and assumes global anthropogenic emissions of 50 Gt in 2007, a figure which is consistent with the IPCC 4th Assessment Report.

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GENERAL POLICY OBSERVATIONS

POLICY UNDER UNIVERSAL APPLICATION

1. The nature of the mechanism implies that all (or a significant proportion) of the revenue raised from the maritime and aviation sectors could be used for international climate finance. While this paper does not canvass implementation issues in depth, it appears possible that a central fund could be established for the purposes of making the necessary compensation payments and for financing climate change action in developing countries (although alternate approaches may also be appropriate).

2. To be consistent with IMO/ICAO principles of non-discrimination and flag neutrality (which call for equal treatment of operators of all nationalities), any policy should be applied universally to all *participants* in each sector.[2]

   2.1. Universal application would also effectively address the long unresolved difficulty in attributing international transportation emissions to individual states. With either sector effectively becoming a 'country' in itself for emissions accounting purposes, then international transportation emissions would move from being uncovered and unattributable, to being appropriately addressed by responsible parties at an international level.

3. However, developing *countries* could be treated differently. In order to ameliorate universal-application cost impacts, a share of funding could be returned directly to them as compensation, which could be consistent with the UNFCCC CBDR principle (common but differentiated responsibilities). Such a compensation option would moderate cost impacts and could result in net positive impacts. (However, while this would ease cost impacts, it would also lower revenue available for mitigation and adaptation activities in developing countries.)

ANALYSIS — GENERAL OBSERVATIONS

Reliability/predictability of revenue stream

4. Directing money through an international administrator, rather than national governments, would increase the reliability of the reve nue streams for developing countries by taking them outside countries' domestic decision processes.

Efficiency

5. Universal application would eliminate behavioural effects *within* each industry, ensuring that all shipping companies/airlines are treated equally.

6. Measures should attempt to maintain neutrality between the maritime and aviation sectors, so as to reduce substitution effects between them. This could be achieved by a number of means including applying a similar market-based policy to both sectors.

7. In terms of carbon efficiency and a link to world mitigation, targeted use of revenues could be deployed to purchase additional abatement outside existing schemes, adding to overall abatement achieved. If revenue was directed solely towar ds adaptation (or other uses), less abatement would be generated.

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[2] More broadly, any measure should seek to take account of the principles of the respective conventions and customary practices of ICAO and IMO and the principles and provisions of the UNFCCC.

Practicality

8. Achieving an international agreement to enact any policy will likely prove highly difficult and could potentially take a very long time (reaching agreement in multilateral bodies usually takes some years from proposal to ratification). Whilst cross-national policy design issues would have to be addressed, conceivable difficulties may not be insurmountable where political will exists to enact a measure.

9. There may be a question about whether the infrastructure to implement these approaches exists, particularly in developing countries. However, fuel use is one of the more highly regulated areas globally and there are relatively few points of purchase to monitor, suggesting that there is a strong possibility that the existing infrastructure could be used to implement these policies.

10. There would be major competitive neutrality issues under all policies if any major player were to opt out. Any international service provider who was not subject to the measure would be able to provide the service at a cost lower than those who are included in the measure. It would also affect the environmental outcome from the scheme, as the price would not incorporate the cost associated with the negative environmental externality, resulting in higher than optimal consumption. Moreover, as reflected in industry objections in both sectors, country differentiation would cause a behavioural response (re-routing and re-flagging) which would drive down scheme revenue. This is likely to result in significant practical difficulties in implementation. This suggests universal application may be more appropriate, if it can be supported by compensation options for vulnerable least developed countries.

Political acceptability

11. Either industry may object to the imposition of a measure in the absence of a carbon price (or similar tax) on other sectors, notwithstanding the application of domestic carbon pricing on other sectors in certain jurisdictions. While efforts in both sectors are ongoing, and progress has been made (particularly in relation to technical and operational measures), efforts to achieve an international consensus on introducing comprehensive CO_2 emissions control measures in either sector (including related revenue-raising aspects) have as yet been unsuccessful.

12. Business in advanced economies would likely object to a country-differentiated measure due to the introduction of a competitive disadvantage (which reduces efficiency) and increased administrative costs and complexity.

13. Similarly, there may also be resistance to a universally applied measure. Universal application would likely be better for efficiency and environmental integrity reasons, however it means that countries which are geographically isolated (particularly vulnerable Least Developed Countries) will be significantly disadvantaged.

14. However, in relation to the UNFCCC principle of CBDR, while the scheme would be a *common responsibility* for operators under universal application, country *differentiation* could be achieved via a well-designed compensation element; especially for the most vulnerable developing countries. Revenue use policies could mitigate cost impacts or turn them into a net benefit.

15. In principle, countries disproportionately impacted by the incidence of the revenue raising measure could be compensated. Remaining revenues would then be distributed to meet the objective of funding climate change action. Further design consideration would be needed in relation to the specifics of any compensation approach, including whether this should be restricted to least developed countries or determined directly by impact (which may result in some compensation to developed countries that are impacted by the scheme).

15.1. However, assessing which countries should receive compensation (ie only small, remote and vulnerable developing countries or all developing countries?), and how incidence impacts may be measured and accounted for would need to be agreed amongst Parties (noting the difficulties in attributing emissions to particular countries). The need to provide compensation through an objective, principles based process suggests a centralised fund to distribute collected financing and compensation may be appropriate.

16. Political acceptability will also depend on the use and distribution of revenue. In this regard revenues may be divided into two broad categories[3]: the first being transfers to compensate developing countries for incidence impacts; and the second being transfers to enable action on climate change in developing countries.

16.1. In relation to the first compensation category — where funds need not be used for climate change action — there may be concern if developing countries were to use any compensation they receive to eliminate the measure's carbon price signal, as this would put industrialised countries' industry at a competitive disadvantage.

16.2. In relation to the second, acceptability would decline amongst industrialised countries where final funds for climate change finance are treated as general revenue by national developing country governments and are not targeted to clearly defined and transparent uses that deliver real environmental benefits through low-carbon solutions.

17. These factors highlight the importance of using resources effectively for climate purposes and ensuring that the carbon price signal is not blunted. Consideration of a centralised fund to distribute collected financing and compensation may well increase acceptability for industrialised countries.

[3] Scheme administration costs will also need to be funded, though this is only likely to represent a small share of total revenues.

POLICY CONSTRUCT 1 — ETS — GENERIC ASPECTS

POLICY DESCRIPTION

18. This proposal involves setting a sectoral cap on emissions in the international maritime and aviation sectors and then establishing a sector specific international cap-and-trade mechanism to facilitate the necessary emissions reductions in each sector.

19. The targets for each sector could be negotiated as part of the UNFCCC negotiation process and could apply to the post-Kyoto commitment period. Both emissions trading schemes would ideally be integrated with a broader international climate change agreement with scheme participants able to make full use of attendant flexibility mechanisms in meeting their liabilities (including, for example, access to purchasing offsets under CDM-like arrangements).

20. The limit would be enforced by requiring one emission permit to be surrendered for each tonne of carbon dioxide released from activities covered by each scheme. However, as CO_2 is difficult to measure directly, fuel could be used as a proxy for CO_2 emissions. Standard conversion rates will be used to convert different types of fuel to CO_2 emissions.

21. A number of permits equivalent to the annual limit would be released into the market every year and could be exchanged between buyers and sellers in a secondary emissions permit market. Permits from other recognised emissions trading schemes could also be used to comply with the scheme ensuring that any scheme emissions in excess of the annual limit are offset by reductions in other sectors and providing for continued sectoral growth. Secondary markets and the import/export of permits would enable permits to move to their highest value use and provides financial incentives to reduce emissions where cost-effective.

22. Once a target has been established, an appropriate central body (potentially the IMO, ICAO, the UNFCCC or other newly created bodies) would administer and enforce each ETS. These bodies would set the rules that govern ETS operation, including the approach to managing compensation for developing countries, the proportion of auction revenues to be allocated to climate change financing and how annual limits for the sector are set. Appropriate institutional arrangements would be established at the international level to run scheme elements that cross national boundaries and parties would be required to put in place domestic legislation to implement the scheme at the national level.

23. In theory, up to 100% of permits could be auctioned with, possibly, a central administrative body having control over the collection and redistribution of auction proceeds in order to reduce duplication costs and simplify administration. Alternative institutional arrangements for auctioning permits and collecting auction revenues are also possible.

ANALYSIS — ADVANTAGES AND PROBLEMS

Reliability/predictability of revenue stream

24. Assuming that both the maritime and aviation industries are price-takers in the international carbon market, and that industry permits are fully fungible with other international permits, the revenue volatility of this proposal could also be influenced by fluctuations in the international carbon price. To the extent that the international carbon price fluctuates with economic cycles, revenue may also be affected, notwithstanding likely continued growth in underlying fuel consumption in both sectors.

Efficiency

25. Provided the ETS is linked to the world carbon price then the measure would appropriately internalise the price of the negative environmental externality associated with fuel emissions. As each increment of fuel use would attract the same marginal price, emitters would have an incentive to adopt all cost-effective abatement options available. From this static efficiency perspective an ETS is intrinsically cost-effective. Imperfect coverage of regions would result in efficiency losses, however this would not be evident in a scheme with universal application as competitive neutrality would be maintained across companies/counties.

26. In relation to dynamic efficiency, an ETS could provide continuing incentives for research, development and the adoption of low-emissions technologies. These benefits will be greater if investors consider that the carbon price is likely to be set at a significant level and sustained over a long period of time.

27. If the ETS were not linked to the world carbon price (and other emissions trading schemes) then efficiency will decline, as abatement may not occur in the region or sector where it is least expensive. If the carbon price operating in either sector is different to that in other sectors, it is possible that more or less abatement would occur in the sector than is socially optimal. For example, to the extent that the aviation carbon price is higher (or lower) than the carbon price operating in competing land-based transport sectors, less (or more) passengers and freight will be transported by air than by land than would be economically efficient.

28. Under an ETS, demand for emissions permits will decline during a recession as activity falls, putting downward pressure on the carbon price. The opposite is true during a period of growth. Achieving the same result with a fuel levy would require timely action by the central administrator of the fuel levy scheme (or coordinated action by governments) in order to temporarily lower or raise the tax rate.

29. The efficiency of the scheme may be affected by administrative and enforcement costs associated with the establishment and ongoing monitoring of the scheme.

30. In terms of carbon efficiency and a link to world mitigation, by setting a quantity limit, an ETS ensures environmental outcomes are delivered (the scheme *would* reduce industry emissions). To the extent that it is linked to international or national emissions trading schemes it could achieve this at least cost. (In contrast a closed ETS system would be likely to deliver the highest revenues but impose higher costs on either sector – assuming that the marginal cost of abatement is higher in the aviation and maritime sector than in the broader economy.)

Practicality

31. To ensure maximum efficiency and to minimise competitive neutrality issues, either ETS would be most appropriately implemented at an international level.

32. Whilst the monitoring of bunker fuel sales is likely to be relatively feasible, variations in the capacity to implement and administer the measure across nations may need to be addressed[4]

33. The practicality of implementing an ETS depends on how readily functional elements used in emissions trading schemes can be adapted to either sector. The functional elements of greatest significance are:

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[4]The IMO's Long Range Identification and Tracking System (LRIT) — which allows the verification of all merchant ship movements across the global — may assist implementation. LRIT, combined with an existing ship particulate database (that includes specific fuel consumption), could prove an efficient monitoring tool.

- an international governance structure to agree the total cap on sector emissions, and to modify and to set this cap over time,
- a platform or platforms to auction permits,
- a fund or funds to manage revenue from auctioning,
- national and/or international registries to keep track of allowance ownership and the surrender of permits,
- national laws to ensure compliance with scheme requirements backed by national compliance and enforcement capabilities,
- assignment to a particular level of the supply chain, responsibility to account for and surrender permits for shipping emissions.

34. Auction platforms and registries could be located centrally or distributed. Centralised systems would minimise administrative complexity and costs but could present constitutional or sovereignty issues for some states. Moreover, the ability of international frameworks to support this approach would need to be carefully considered. A fully decentralised approach gives control of these functions to national governments but replication would involve costs, more extensive coordination and additional institutional capacity. Distributed auctioning also implies appropriation of revenue into national budgets as opposed to a centralised platform where revenue is directly deposited in an international fund. Domestic legislation may be required to implement many of these aspects.

Political acceptability

35. From the perspective of ensuring the environment objective is met in a cost-effective manner, without introducing distorting effects, a universally applied ETS has policy merit and would be entirely consistent with efforts under the Copenhagen Accord to restrain emissions. The difficulty in reaching agreement to introduce such a measure to date suggests political sensitivities.

POLICY CONSTRUCT 2 — FUEL LEVY — GENERIC ASPECTS

UNIVERSAL APPLICATION

POLICY DESCRIPTION

36. This proposal involves introducing a universal fuel levy on international fuels for the maritime and aviation sectors, with a rate directly linked to the world carbon price. The levy would ensure that the negative environmental externality is appropriately reflected in consumption and production decisions.

37. A possible option suggested has been for bunker fuel suppliers to undergo mandatory registration,[5] and all shipping companies/airlines could be required to purchase bunker fuel from a registered supplier. The suppliers would remit receipts from the levy to an international administrator (such as the IMO, ICAO or the UNFCCC). Alternatively, a separate legal entity for each sector could be established under a new convention. Domestic legislation would be required to give effect to an international agreement underpinning these transfers and to establish robust compliance and enforcement systems to ensure requirements are met.

38. A universal fuel levy would have many features in common with an ETS but with some key differences. Like an ETS a levy could be used to put a price on emissions from fuel use, but a fuel levy differs from an ETS in how the price is set. An ETS sets a quantitative limit on the sector and the trading of permits establishes the price. A carbon levy, on the other hand, would establish the price (preferably linked to the global ETS price) and allow the quantity to vary.

39. The international framework under which a levy would operate would be similar to the framework for an ETS. The designated international body administering the levy would specify how the levy is to be collected, how its rate would be set, where revenue is to be deposited and how monies may be spent.

ANALYSIS — ADVANTAGES AND PROBLEMS

Reliability/predictability of revenue stream

40. Assuming that the levy is appropriately benchmarked to the international carbon price at regular intervals, the revenue of this proposal would be influenced by such benchmarking, notwithstanding likely continued growth in underlying fuel consumption.

Efficiency

41. A fuel levy would be an effective, transparent and administratively simple mechanism, provided it is a universal measure. As the proposal would leverage off existing fuel sales systems and compliance mechanisms (including for environmental and safety regulation), additional compliance costs for suppliers would likely be marginal.

42. A fuel levy only correctly prices the underlying environmental externality where it is based on the CO_2 equivalence of the greenhouse gases released from the combustion of a unit of fuel and is set at a rate linked to the world carbon price. (If the levy is set too high then it would over-correct for the externality and distort resource allocation, whereas if it were set below the world carbon price then it would under-price the externality.) Obviously the level of the levy would vary, based on the CO_2 equivalent content of the fuel used (ie a new renewable fuel could be zero-rated where it releases no emissions).

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[5] To minimise the risk of bankruptcy and fraud, suppliers would be required to provide a banker's guarantee prior to registration.

42.1. Faced with the higher marginal cost of fuel, emitters would have an incentive to adopt all cost-effective fuel efficiency options available. From this static efficiency perspective a fuel levy is intrinsically cost-effective. Imperfect coverage of regions would result in efficiency losses, however this would not be evident in a scheme with universal application as competitive neutrality is maintained across companies/countries.

43. In relation to dynamic efficiency, a fuel levy would provide similar incentives for research, development and the adoption of low-emissions technologies as an ETS. While a fuel levy would not provide a future price curve (as an ETS can via the forward sale of future year permits) links between the fuel levy and global carbon markets could provide much the same information and guidance to investors and industry participants.

44. There are other trade-offs to consider in relation to the period for which the level of the levy is fixed, and how closely it can mirror changes in the global carbon price applying in other sectors. Since a central governing body controls the levy rate and potentially the period for which the rate is fixed, a policy choice could be made to maximise stability of the revenue stream. The trade-off for this stability is reduced economic efficiency at the global scale if the levy rate diverges from the global carbon price. For example, if a maritime fuel levy is higher than the carbon price applying in other transport sectors, then it is possible that too little cargo will be transported by sea, and too much by other transport modes.

45. In terms of carbon efficiency and a link to world mitigation, the fuel levy would reduce emissions only to the extent it encourages fuel efficiency, and so overall emissions may not decline as much as under an ETS. (In theory a fuel levy can achieve the same emissions reductions as an ETS, provided the correct levy rate is adopted *and* a share of the revenues are used to purchase the offsets that would be purchased under an ETS for above-cap activity.)

Practicality

46. A fuel levy may be more practical to implement than an ETS in these sectors. The key difference being that the auctioning and registry platforms are not required to implement a levy (many nations also have fuel taxation systems that may be readily adapted).

47. Compared to an ETS, similar choices must be made about who has responsibility for emissions, the shipping company/airline or the fuel supplier. Targeting fuel suppliers could deliver efficiency gains due to the lower number of bunker operators.

48. To ensure maximum efficiency and to minimise competitive neutrality issues, a fuel levy would be most appropriately implemented at an international level.

49. Whilst the monitoring of bunker fuel sales is likely to be relatively feasible, variations in the capacity to implement and administer the measure across nations may need to be addressed[6]

50. A significant issue that would need to be resolved is whether levies would be paid directly into a central administered international fund, or as a national tax. In either case allowing for electronic reporting and payment could lower administrative complexity and costs. Centralised systems could present constitutional or sovereignty issues for some states and the ability of international frameworks to support this approach would need to be considered carefully. Decentralised collection gives control of these functions to national governments and would require

[6] The IMO's Long Range Identification and Tracking System (LRIT) — which allows the verification of all merchant ship movements across the global — may assist implementation. LRIT, combined with an existing ship particulate database (that includes specific fuel consumption), could prove an efficient monitoring tool.

appropriation of revenue into national budgets which creates an added complexity around transferring levies to the central fund. Domestic legislation may be required to implement many of these aspects.

Political acceptability

51. From the perspective of addressing the environment objective in a cost-effective manner, without introducing distorting effects, a universally applied fuel levy has policy merit and could be entirely consistent with efforts under the Copenhagen Accord to restrain emissions (depending on the levy rate). The political difficulty of introducing such a policy instrument to these sectors has been evident in discussions to date.

MARITIME SECTOR CHARACTERISTICS

Reliability/predictability of revenue stream

52. Long-term reliability of the revenue stream will depend in part on ongoing demand for maritime transportation, and the associated ship demand for fossil fuel. Key drivers for this fuel demand will be maritime sector growth (influenced by the price and income elasticities of demand for maritime transport) and technological and operational responses to the introduction of a carbon price.

53. Historically, there is a strong relationship between economic growth and an increase in shipping — with higher global demand driving higher demand for shipping services and thus fuel consumption. IMO data show compound annual growth in international maritime fuel consumption was a solid 3.7% from 1990-2007.[7] Notwithstanding further potential global business cycle impacts, projections generally suggest continuing solid sectoral growth.

54. While there are a wide range of options available to increase fuel efficiency and reduce emissions of maritime transport, there appears to be limited scope to replace fossil fuels as the primary energy source over the medium term. Ongoing reliance on fossil fuels coupled with projected growth of the sector suggests a stable revenue base.

54.1. However, cost-effective alternative fuels for international shipping may emerge in future. If this were to occur then measure revenues could decline as a result (though sector emissions may also decline, delivering an environmental benefit).

Efficiency

55. Introducing a price on carbon in the maritime sector may result in some behavioural effects. Cross-national coastal shipping may be affected where it competes with cost-effective road, rail or air services (which are not subject to appropriate carbon pricing) — especially on short trips, which have a higher elasticity of demand. However, substitution options to other modes of transport are limited, as shipping generally provides the lowest cost and most efficient method of bulk international transportation. (Indeed IMO-commissioned research has found that no other mode of transport is more energy efficient than shipping on a per tonne mile basis.[8])

Incidence

56. Legal incidence would apply at the fuel supplier or ship level. Determining the economic incidence of a carbon price – ie who actually pays the carbon price – is much more difficult to establish. Economic incidence impacts are complex and will depend on the relative elasticities of supply and demand for: a) exporters; b) importers; and c) freight service providers. Furthermore, economic incidence will vary for different countries and for different goods (depending on the industry structure in both the exporting and importing country).

56.1. As an example, one would reasonably expect US consumers to pay the full cost of a carbon price on bunker fuels for both the laden voyages from the Middle East to the US and for the return journey of an oil tanker (reflecting the elasticity of demand and supply of oil).

56.2. By contrast, Japanese auto exporters would be likely to bear at least some of the additional carbon cost of transport to the US reflecting the strong competition in the

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[7] Second IMO GHG Study 2009, p40.
[8] First IMO GHG Study 2000.

auto market from domestic US manufacturers and from other (closer) competing nations including in Europe.

57. Notwithstanding these difficulties, general price elasticities in the maritime sector do provide some guidance. Most estimates suggest the sector's price elasticity of demand is low, with a price increase of about 10% commonly expected to decrease trade by about 2-3%.[9] With a US$30 carbon price (under the High End Copenhagen Scenario), one would expect the total freight costs to increase by around 5-6 per cent, suggesting a reduction of trade by 1-1.5 per cent (relative to what it would have otherwise been); and a reduction of 0.5-0.75 per cent under the Low End Copenhagen Scenario price of US$15.

58. Elasticities for inland and domestic shipping are much higher, which has been attributed to the availability of alternative modes of transport. In contrast, lower elasticities of international maritime transport suggest the absence of alternative options, which means fuel suppliers/shipping companies will likely be able to pass on the bulk of any cost increase. Furthermore, as international maritime transport is significantly less carbon intensive than its competitors (road, rail or air), it is likely to benefit from a carbon charge on sector emissions (provided competitor modes of transport are taxed on a broadly equivalent basis).

59. To the extent that importers of cargo are sensitive to the cost of transport, it is possible that adding to fuel costs could render some sources of supply of some commodities or goods uneconomic. Adding to transport costs could also reduce the returns earned by some exporters. However, fuel costs as a proportion of total shipping costs, let alone the final landed price of goods, are small, so impacts on patterns of trade are likely to be similarly small (see Annex A for further information).

60. Depending on the final elasticity of demand for specific goods, it is possible that cost impacts may induce a substitution of consumption away from traded goods toward domestically-produced goods at the margin. However, the likely magnitude of such an effect is also expected to be relatively minor on current data.

61. Geographical and nation state impacts will depend on both the destination of cargo and the ownership of tonnage (that is, the maritime transport fleet). At least 63% of the world's fleet (in terms of deadweight tonnage) is controlled by nationals from Annex 1 countries, while at least 33% is controlled by non-Annex 1 nationals.[10]

62. In terms of import destinations, IMF data show that advanced economies consume around two-thirds of world imports by value.[11] This is equivalent to around US$11,000 of imports per capita (around 30% of per capita incomes). Emerging and developing economies consume around a third of imports by value, or around US$850 per capita (around 17% of per capita incomes). While it should not be assumed that importers will bear all cost impacts, some impacts are likely. In this context, a greater portion of cost impacts (in value terms) are likely to be borne by industrialised country consumers and ship owners.

63. However, some research suggests that developing countries consume a higher share of imports by volume (potentially due to importation of lower value bulk goods imports, whereas advanced economies consume higher value imports). While this has not been confirmed, it is possible that developing countries may bear a higher proportion of the costs of a carbon pricing measure than would be suggested by value data. However, it is not clear whether cost impacts

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[9] A Global Maritime Emissions Trading System: Design and impacts on the shipping sector, Countries and Regions. Faber, J., Markowska, A., Eyring, V., Cionni, I., and Selsatd, E. 2010.
[10] Ibid.
[11] IMF World Economic Outlook April 2010.

would be higher in aggregate compared to advanced economies. (That said, advanced economies are still likely to bear a markedly higher proportion of costs in per capita terms.)

64. As noted above, final incidence will depend on a range of broader factors and is very hard to determine with accuracy. Annex A of this paper provides additional incidence analysis, based on particular assumptions and some alternate data. The analysis supports the conclusion that caution should be exercised in making unambiguous statements about final incidence.

65. Nonetheless, it would be possible to design a mechanism to ameliorate the cost impacts on developing countries (in respect of the incidence of higher prices for delivered imports and potentially lower returns to some exports). Decisions on the use of revenue raised would moderate these cost impacts and could result in net positive impacts.

65.1. For example, recognising that the detailed information on the elasticities of demand and supply for exporters, importers and freight service providers for each country and for each good is unlikely to be available, 'rules of thumb' could be devised to provide a rough approximation of the likely incidence on countries. The International Union for Conservation of Nature (IUCN) has proposed that developing countries should be compensated for any adverse impact based on their share of global imports.[12] This approach implicitly assumes that importing countries are more likely to bear the economic incidence of a carbon price than exporting countries which, a priori, appears to be a reasonable working assumption.

65.2. Under this approach, around one-third of collected revenues would be returned to developing countries as compensation, with up to the remaining two-thirds being made available for international climate finance.

[12] Prevention of Air Pollution from Ships: A rebate mechanism for a market-based instrument for international shipping Submitted by the International Union for Conservation of Nature (IUCN) , MEPC 60/4/55 (29 January 2010)

POLICY CONSTRUCT 1 — ETS — MARITIME SPECIFIC

UNIVERSAL APPLICATION

POLICY DESCRIPTION

66. A maritime ETS would place a limit on greenhouse gas emissions from fuel use in international shipping. Other aspects are as described in the generic section on the ETS.

POTENTIAL REVENUE IN 2020

	Revenue range (US$b)[#] **Up to**		**Comments**
Maritime: ETS	Scenario 1	*2.4 – 5.6*	Assumes measure directly linked to the world carbon offset price and 100% auctioning.
	Scenario 2	*4.1 – 9.3*	Emissions projections from IMO SRES projections for 2020.
	Scenario 3	*8.1 – 18.5*	Assumes compensation for developing countries account for 30% of total revenues (equal to developing country share of imports). 25-50% of remaining revenues made available for international climate finance (in accordance with the AGF Guiding Principles).

*Estimates assume the measures have universal application with no administrative and implementation costs.
Note: revenue estimates provided by Australian Department of Climate Change and Energy Efficiency. Scenario 1 is where countries implement their low range Copenhagen commitments, Scenario 2 is where countries implement their high range Copenhagen commitments, and Scenario 3 is where countries implement commitments equivalent to reducing world temperature rise to 2°C (the most ambitious scenario).

- The revenue estimates above assume no behavioural change as a result of the carbon price on bunker fuels. This approach has been adopted to provide the estimates as transparently as possible, rather than making arbitrary assumptions about the magnitude of a possible behavioural response. Thus, the estimates should be seen as an upper bound of likely revenues.
  - That said, while the IMO has identified the potential to reduce emissions by 15-30% through technical and operational measures by 2020, there are significant market failures which prevent them from being taken up. For example, recent research by Society for Naval Architects and Marine Engineers (SNAME) indicates that "perhaps the biggest institutional barriers to implementing fuel saving projects that require capital investment is the divided responsibility or 'split incentive' and between ship owner or charterers for fuel cost".[13] Such examples of market failures would act to limit any behavioural response from a carbon price on bunker fuels.
  - Furthermore, as noted above, the elasticity of demand for international maritime transport services is likely to be relatively low as: the cost increase would be small relative to the value of the goods being transported; and as sea freight is a relatively carbon efficient mode of transport, it is likely to be advantaged in the transition to a low-carbon world (relative to other transport modes).
- The potential revenue from this scheme will depend on the total emissions reduction cap for the industry, the percentage of permits which are auctioned and the international carbon price.

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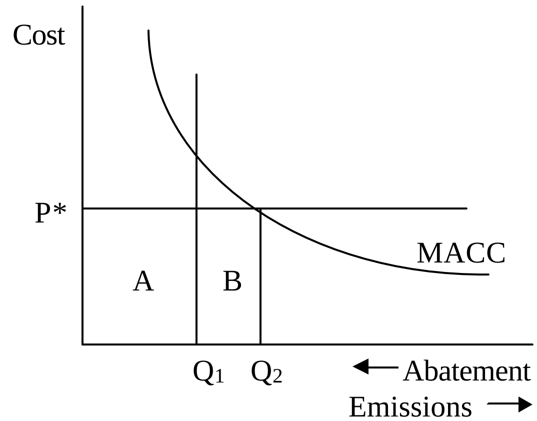
[13] Reduction of GHG Emissions from Ships: Marginal abatement costs and cost-effectiveness of energy-efficiency measures, Submitted by the Institute of Marine Engineering, Science and Technology (IMarEST), MEPC 61/INF.18, 23 July 2010

– In theory both an ETS and fuel levy can raise the same revenue, however, an open ETS[14] may well in practice raise less revenue than a fuel levy, given declines in its cap over time. The fuel levy (set at the world offset price) and the ETS (capped at the offset price) would raise the same up until the ETS cap is hit. After this point the ETS would raise less revenue, as the maritime sector will purchase any further permits necessary from the global carbon market, resulting in revenue leakage from the sector. By contrast, under a fuel levy, the maritime sector would pay the levy for all emissions from the sector.

Figure 1: ETS vs fuel levy revenues



– This is illustrated in *Figure 1* — with revenues determined by an illustrative industry marginal abatement cost curve (MACC). Under an ETS, with a cap of Q_1 (vertical line), auction revenues would be the area A (as the price could not rise above the world offset price (P*). In order to acquit the rest of its above-cap emissions, industry would then purchase Q_2-Q_1 worth of offsets in the global offset market (at a cost of area B). In contrast, under a fuel levy scheme revenues would be whole area of A+B.

ANALYSIS — ADVANTAGES AND PROBLEMS

Practicality

67. Country differentiation would cause a behavioural response — *re-routing* and/or *re-flagging* (see below) — which would drive down scheme revenue. This is likely to create significant practical difficulties in implementation. This suggests universal application may be more practical, if it is supported by compensation options for vulnerable least developed countries.

68. Responsibility for emissions could be assigned to the fuel supplier or ship. The choice influences the design of other scheme elements including whether compliance and enforcement functions can build on existing national systems established to implement IMO instruments. (For example, verification of emissions could be linked to fuel purchases listed in the bunker delivery note.)

Political acceptability

69. The maritime industry has already discussed specific industry ETS proposals (submitted by IMO members), and may not oppose a well-designed scheme. A maritime ETS is also likely to be moderately acceptable from the perspective of operators. Compliance requirements would be relatively simple, particularly if monitoring and recordkeeping requirements build on existing IMO requirements (such as the bunker delivery note).

DIFFERENTIATED MARITIME ETS APPLICATION

70. Two options could be considered to differentiate the ETS, differentiation by route and differentiation by flag. A differentiated maritime ETS would have all the key elements of an undifferentiated ETS.

[14] However, if the ETS is *not* linked to global markets, a lower cap would result in a higher permit price and an indeterminate impact on total revenue (as the revenue outcome will depend on elasticity of the marginal abatement cost curve in the sector).

71. Differentiation by flag would exempt ships flying a particular flag from participation in the scheme. Flag state differentiation would simply result in an almost immediate switching to flags of convenience. In a scenario where particular flags are exempt, this would result in a major loss of revenue, coverage and distortions between ships competing for the same transportation task. Moreover, flag is a poor indicator of the country in which a ship is owned, with 67% of ships (by deadweight tonnage) flying a flag that does not reflect its substantive ownership.[15] Over a quarter of the world fleet fly the Panama or Liberia flag (as context, Panama and Liberia comprise just 0.06% and 0.002% of the world economy respectively[16]).

72. On the other hand, differentiation by route would exempt ships transporting cargo to or from certain developing country ports (effectively exempting the emissions from burning fuel on route to the exempt location). However, under the Kyoto Protocol, emissions from international maritime transport were not included in national inventories or national emissions reduction targets because of the difficulty in allocating them to specific countries — this illustrates the difficulty of the task.

73. Exemption based on final destination of goods is complex and would add to compliance costs, reducing the simplicity and effectiveness of the measure. It would require obtaining a share of goods transported to industrialised countries for each ship or company worldwide. Given the tens of thousands of ships operating worldwide, collecting and validating such information is likely to require significant administrative efforts.

73.1. Moreover, such differentiation might not result in lower transport costs for developing countries, as shipping companies (or other stakeholders in the transportation chain) may *increase* their profit margins on these routes, instead of reducing their rates.

74. Differentiation by route is also highly likely to result in evasive behaviour (*re-routing*) in order to minimise liability. For example, conducting the first leg of a voyage between two exempt ports, before conducting a shorter leg to the final destination. Alternatively, cargo could be offloaded at the nearest exempt port then transported by another mode such as rail. (Container shipping is generally not route specific, as a container can travel over many different routes, using hub and feeder ports and land bridges, until it reaches its final destination.)

75. Both approaches to differentiation have the potential to compromise the environmental and economic integrity of the scheme, reducing its efficiency and effectiveness.

76. Because of these concerns, the IMO has proceeded in its deliberations on the basis that any obligation would be universal, given the competitive distortions that differentiation is likely to bring.

[15] Review of maritime transport 2008, United Nations Conference on Trade and Development (UNCTAD), 2009.
[16] Share of world GDP on a purchasing-power-parity basis (IMF World Economic Outlook database — April 2010).

POLICY CONSTRUCT 2 — FUEL LEVY — MARITIME SPECIFIC

UNIVERSAL APPLICATION

POLICY DESCRIPTION

77. Like a maritime ETS, a levy could be used to put a price on greenhouse gas emissions from fuel use in international shipping. Other aspects are as described in the generic fuel levy section.

POTENTIAL REVENUE IN 2020

	Revenue range (US$b)#		**Comments**
Maritime: Fuel levy	Scenario 1	*2.4 – 5.6*	Emissions projections from IMO SRES projections for 2020. Assumes the carbon levy is applied to all eligible emissions. Assumes compensation for developing countries account for 30% of total revenues (equal to developing country share of imports). 25-50% of remaining revenues made available for international climate finance (in accordance with the AGF Guiding Principles).
	Scenario 2	*4.1 – 9.3*	
	Scenario 3	*8.1 – 18.5*	

*Estimates assume measures have universal application.
Note: revenue estimates provided by Australian Department of Climate Change and Energy Efficiency. Scenario 1 is where countries implement their low range Copenhagen commitments, Scenario 2 is where countries implement their high range Copenhagen commitments, and Scenario 3 is where countries implement commitments equivalent to reducing world temperature rise to 2°C (the most ambitious scenario).

- The revenue estimates above assume no behavioural change as a result of the carbon price on bunker fuels. This approach has been adopted to provide the estimates as transparently as possible, rather than making arbitrary assumptions about the magnitude of possible responses to the introduction of a carbon price on bunker fuels (see revenue estimates under *Policy Construct 1* for further details).

ANALYSIS — ADVANTAGES AND PROBLEMS

Efficiency

78. Japan has proposed a variant of such a fuel levy scheme (the Leveraged Incentive Scheme) whereby ships pay the levy but then can apply (voluntarily) for a refund of a share of the levy based on the 'energy efficiency during operation' of their ship. This would enhance the incentive to invest in more efficient ships and operational practices (encouraging more abatement), however it would also lower revenues and add to scheme administrative costs.

Practicality

79. Country differentiation is likely to cause a behavioural response (re-routing and *tankering* (see below)) which would drive down scheme revenue. This is likely to cause significant difficulties in implementation. This suggests universal application may be more appropriate, supported by compensation options for vulnerable least developed countries.

80. Similar choices to an ETS must be made about who has responsibility for emissions, the ship or fuel supplier. Fuel purchases listed in the bunker delivery note (on ship) may assist in verification of emissions. However, targeting fuel suppliers over ships may deliver administrative gains due to the lower number of bunker operators (although the national arrangements required to

do this are unlikely to utilise existing national systems established to implement IMO instruments which centre on regulating ships).

Political acceptability

81. The maritime industry has already discussed specific industry fuel levy proposals (similarly submitted by IMO members) and may not oppose a well-designed scheme. A maritime fuel levy is likely to be moderately *more* acceptable from the perspective of operators, as compliance requirements would be relatively simple, particularly if monitoring and recordkeeping requirements build on existing IMO requirements (such as the bunker delivery note).

DIFFERENTIATED MARITIME FUEL LEVY APPLICATION

82. As with a maritime ETS, differentiation by route or differentiation by flag is possible. Differentiation by flag would be equally difficult under a fuel levy as with an ETS.

83. However, differentiation by route could operate differently under a fuel levy by differentiating by fuel sale point. However, this would encourage *tankering*, a process whereby a ship would purchase all fuel at exempt fuel sale points, thereby avoiding the fuel levy. This is possible because ships can carry a large amount of fuel and thus avoid refuelling at every destination. For example, a Panamax bulk carrier (with a fuel consumption of 35 tonnes/day and a bunker capacity of 2,200 m^3) is able to stay at sea for 56 days without refuelling. This would allow it to make over four one-way trips between Sydney and Shanghai (a 13 days trip assuming a speed of 15 knots).[17] Indeed, some vessels in around-the-globe services only bunker once on a full around-the-globe voyage of 3-5 months.

84. Differentiation by route would still have the potential to encourage re-routing (as with an ETS). This could include conducting the first leg of a voyage between two exempt ports, before conducting a shorter leg to the final destination.

85. As with a maritime ETS, differentiation would severely compromise the environmental and economic integrity of the scheme, reducing its efficiency and effectiveness.

86. Because of these concerns, the IMO has proceeded in its deliberations on the basis that any obligation would be universal, given the competitive distortions that differentiation would bring.

[17] Calculation based on Lloyd's Maritime Atlas and data from Society of Naval Architects and Marine Engineers.

AVIATION SECTOR CHARACTERISTICS

Reliability/predictability of revenue stream

87. Long-term reliability of the revenue stream will depend in part on ongoing demand for international aviation transportation, and the associated aircraft demand for fossil fuel(although fuel demand is not important for the ticket tax). Key drivers for this fuel demand will be aviation sector growth (influenced by the price and income elasticities of demand for aviation transport) and technological and operational responses to the introduction of a carbon price.

88. While the industry is subject to volatility in underlying demand (particularly for individual airlines), there is a strong relationship between economic growth and increased consumption of aviation services. It is arguable that international air travel is a superior good with a high income elasticity of demand (ie demand for international air travel likely increases more than proportionately to general growth in income). Consistent with this, ICAO data shows compound annual growth in international passenger kilometre's travelled was a solid 5.6% from 1999-2008.[18] Projections generally suggest very solid growth continuing in the sector.

89. While there are some options available to increase fuel efficiency and reduce emissions of aviation transport, there appears to be limited scope to replace fossil fuels as the primary energy source over the medium term. Ongoing reliance on fossil fuels coupled with strong projected growth of the sector suggests a stable revenue base.

89.1. However, cost-effective alternative fuels for international aviation may emerge in future. If this were to occur then measure revenues could decline as a result (though sector emissions may also decline, delivering an environmental benefit).

Efficiency

90. In light of cost impacts, there may be some behavioural effects. Short-haul international flights may be affected where they compete with road or rail options which are not subject to appropriate carbon pricing (or a similar tax). Depending on the scale of cost impacts, business use of teleconferencing may increase (which would lower revenues, although it may also have net environmental benefits). There may also be some substitution away from international leisure destinations. However, in terms of timeliness, aviation would remain superior to other modes of transport, which would likely limit substitution for long-haul and some short-haul destinations.

Incidence

91. Legal incidence could apply at the fuel supplier or airline level. Economic incidence would likely be primarily borne by the final consumer, particularly for business travel and time-sensitive air cargo. (However, airlines are likely to bear a higher incidence on price sensitive leisure destination flights.).

92. The price elasticity of demand for international air travel depends on whether it is long- or short-haul and whether it is for business or leisure. Long-haul business travel is highly inelastic (with an elasticity under 0.3), while short-haul leisure travel is much more responsive (with an elasticity of around 1.5).[19] The availability of substitutes such as road, rail or ocean transport is also a factor, particularly for short-haul flights or where time is not a critical factor in travel decisions.

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[18] Calculation from data in ICAO Annual Report 2008, Table 2 World revenue traffic — international, p97.

[19] Canadian Department of Finance, Air Travel Demand Elasticities: Concepts, Issues and Measurement, 2008 http://www.fin.gc.ca/consultresp/Airtravel/airtravStdy_1-eng.asp#Summary.

93. Therefore cost impacts will likely affect demand for international leisure travel and affect tourist destinations more strongly relative to business destinations. (However, the flight is only one component of a tourist package (which also includes accommodation, catering and leisure.) Similarly, since cost impacts would represent a higher share of the operating costs of low-cost airlines, which have customers with a higher price elasticity of demand, then they could be more significantly affected.

94. While business travel represents a minority of passenger numbers, it makes up much higher proportion of revenue, as a consequence traditional airlines may be able to pass on the bulk of cost increases to customers. It may be possible that costs could increase in the services sector, where employees travel regularly.

95. With advanced economies comprising around 66% of world aviation traffic,[20] and with developing world passengers predominantly coming from the wealthiest sections of their societies, consumer impacts are likely to be relatively progressive.

96. However, in the absence of any compensatory measures, some cost impacts will also fall on developing countries, both in respect of higher prices for travel and air freight, and potentially lower returns to their airlines. Decisions on the use of revenue raised would moderate these impacts and could result in net positive impacts. Countries most in need of assistance would be vulnerable small island developing states (especially as these countries can have a high demand for aviation services and are a long way from their major trading markets).

[20] ICAO, States Ranking of International Aviation Traffic (RTK), 2008.

POLICY CONSTRUCT 1 — ETS — AVIATION SPECIFIC

UNIVERSAL APPLICATION

POLICY DESCRIPTION

97. An aviation ETS would place a limit on greenhouse gas emissions from fuel use in international aviation. Universal application would reflect the equal basis on which carriers from industrialised and developing countries operate in international aviation markets (more than 30% of the largest airlines are registered operators from developing countries). Due to the expected high cost of mitigation within the sector, and forecast continued industry growth into the foreseeable future, the importation of permits should be allowed to moderate cost impacts on airlines. Other aspects are as described in the generic section on ETS.

POTENTIAL REVENUE IN 2020

	Revenue range (US$b)#		**Comments**
Aviation: ETS	Scenario 1	*0.9 – 1.9*	Assumes measure directly linked to the world carbon offset price. Assumes ETS covers all international aviation emissions including passenger and freight but excluding domestic flights, intra-EU flights covered by the EU ETS and flights between developing countries ETS assumes 100% auctioning, with emissions at business-as-usual level in 2020 (ie the cap is set at exact industry emissions in 2020).
	Scenario 2	*1.6 – 3.1*	
	Scenario 3	*3.1 – 6.3*	

*Estimates assume measures have universal application.
Note: revenue estimates provided by Project Catalyst. Scenario 1 is where countries implement their low range Copenhagen commitments, Scenario 2 is where countries implement their high range Copenhagen commitments, and Scenario 3 is where countries implement commitments equivalent to reducing world temperature rise to 2^{o}C (the most ambitious scenario).

- The potential revenue from this scheme will depend on the total emissions reduction cap for the industry, the percentage of permits which are auctioned and the international carbon price. In practice, an open ETS may raise less revenue than a fuel levy (see above discussion around *Figure 1*).

ANALYSIS — ADVANTAGES AND PROBLEMS

Practicality

98. An aviation ETS *may* be more practical than a fuel levy, given international legal issues surrounding taxing aviation fuel (see aviation fuel levy discussion below). However, it is also noted that a functioning ETS would similarly be contingent on internationally coordinated action, which is just as difficult to achieve.

99. Country differentiation is likely to cause a behavioural response (*re-routing* (see below)) which would drive down scheme revenue. This would introduce practical difficulties in implementation. This suggests universal application may be more appropriate, supported by compensation options for vulnerable least developed countries.

Political acceptability

100. The industry is likely to object to the imposition of the measure in the absence of a carbon price on other sectors. However, some in the industry appear to prefer an ETS to a fuel levy, as reflected in the Aviation Global Deal Group (AGD) proposal by some major airlines. This is

because an ETS allows assistance via grandfathering, and permit trading. Additionally, a levy does not allow airlines to directly offset their emissions, at a potentially lower cost, in the global offset market.

101. In addition, there is likely to be pressure to provide a significant proportion of permits to existing airlines at no price. Depending upon its design, grandfathering of permits may not reduce the environmental integrity of the scheme. However, grandfathering would be a violation of the polluter pays principle and result in a reduction in revenue generated by the scheme.

DIFFERENTIATED AVIATION ETS APPLICATION

102. As before, differentiation by route and differentiation by carrier is possible.

103. Differentiation by carrier would exempt airlines from a particular country. This is likely to encourage customers to purchase from the exempt airline, thereby putting covered airlines at a competitive disadvantage, with no environmental benefit and a loss of permit revenue.

104. On the other hand, differentiation by route would exempt flights to or from certain developing country airports (effectively exempting the emissions from burning fuel on route to the exempt location). However, under the Kyoto Protocol, emissions from international aviation were not included in national inventories or national emissions reduction targets because of the difficulty in allocating them to specific countries — this illustrates the difficulty of the task.

105. Exemption based on final destination is complex and would add to compliance costs, reducing the simplicity and effectiveness of the measure. It would require obtaining a share of all flights and air cargo to industrialised countries for each plane or company worldwide. Given the thousands of planes operating worldwide, collecting and validating such information would require significant administrative efforts.

106. Differentiation by route could also result in evasive behaviour (*re-routing*) in order to minimise liability. If the cost impacts were very high then this could include, at the margin, some destination switching (substituting to exempt holiday destinations) or some re-routing via developing country hubs. For example, a flight from Auckland to Hawaii might require a permit whereas an Auckland-Tonga-Hawaii flight might not (as it transits through a developing country).

107. Both approaches to differentiation have the potential to compromise the environmental and economic integrity of the scheme, reducing its efficiency and effectiveness.

108. Airlines have argued strongly that differentiation and country-by-country policy selection are unsuitable for international aviation, arguing that any obligation should be universal. For example, the AGD Group has argued that because ‘its business is carried out in international airspace and across national borders, connecting people and businesses between countries of all levels of development… unilateral, regional, or indeed any type of differential policy initiative is ill-suited to this international industry’.[21] AGD goes on to note that ‘policy measures to deal with aviation's contribution to climate change must be developed at a global sectoral level covering all emissions from international aviation, to avoid competitive distortion and avoid creating a patchwork of conflicting and potentially overlapping national and regional policies’. Observing that ‘airlines must face equal treatment in any given origin-destination market regardless of routing, intermediate journey points or operator nationality, in keeping with the spirit of the non-discrimination embodied in Article 11 of the Chicago Convention’.

[21] AGD, A sectoral approach to addressing international aviation emissions, June 2009.

POLICY CONSTRUCT 2 — FUEL LEVY — AVIATION SPECIFIC

UNIVERSAL APPLICATION

POLICY DESCRIPTION

109. Like an aviation ETS, a fuel levy could be used to put a price on greenhouse gas emissions from fuel use in international aviation. Other aspects are as described in above sections.

POTENTIAL REVENUE IN 2020

	Revenue range (US$b)#		**Comments**
Aviation: Fuel levy	Scenario 1	*0.9 – 1.9*	Assumes measure directly linked to the world carbon offset price. Fuel levy assumes total annual fuel consumption growth of 4.1% for passenger, 5.1% for cargo and an efficiency increase of 1.7% (on net from business as usual).
	Scenario 2	*1.6 – 3.1*	
	Scenario 3	*3.1 – 6.3*	

* Estimates assume measures have universal application.
Note: revenue estimates provided by Project Catalyst. Scenario 1 is where countries implement their low range Copenhagen commitments, Scenario 2 is where countries implement their high range Copenhagen commitments, and Scenario 3 is where countries implement commitments equivalent to reducing world temperature rise to 2^{o}C (the most ambitious scenario).

ANALYSIS — ADVANTAGES AND PROBLEMS

Practicality

110. An aviation fuel levy *may* be more practical than an aviation ETS — to the extent legal issues can be overcome — as it would not require the auctioning and registry platforms needed for an ETS. Legal concerns *may* be overcome by carefully defining the levy. For example, a 'carbon charge', specifically defined based on CO_2 content, may circumvent legal concerns over fuel taxation. However, this may depend on how provisions are interpreted by courts.

111. That said, an ETS could be more practical if international legal issues surrounding taxing aviation fuel are more intractable. The Convention on International Civil Aviation (Chicago Convention), which gives effect to the ICAO, prohibits the taxing of fuel already onboard an aircraft (the stock of fuel), while reciprocal exemptions in around 95% of bilateral Air Service Agreements (ASAs) currently prohibit the taxation of fuel uploads (the flow).

> 111.1. Nonetheless, legal issues around a potential fuel levy remain disputed. In 2005, a Special Group was commissioned by ICAO to explore legal issues related to emission levies. The conclusions of the Special Group were divided. Some states asserted that emission charges may be allowable, as they could be consistent with Convention Articles 15 and 24, whilst other states disagreed.

112. However, with around 4,000 bilateral ASAs in existence around the world, a fuel levy could potentially necessitate the renegotiation of thousands of agreements.[22] Renegotiation would be a lengthy and cumbersome process even if most countries agree, since ASAs are generally subject to parliamentary ratification. However, the experience of the European Union suggests that it is possible to renegotiate agreements in a manner consistent with the Chicago Convention (that is, by explicitly noting that a tax will only be applied with the mutual consent of both parties).

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[22] Above figures and legal background provided in comments from ICAO.

113. Country differentiation has the potential to cause a behavioural response (re-routing and *tankering* (see below)) which would drive down scheme revenue. This suggests universal application may be more appropriate, supported by compensation options for vulnerable least developed countries.

Political acceptability

114. The industry is likely to object to the imposition of the measure in the absence of a carbon price on other sectors. Moreover, some in the industry appear to prefer an ETS to a fuel levy, as reflected in the Aviation Global Deal Group proposal by some major airlines. This is because a cap guarantees emissions reductions, whereas a fuel levy does not allow airlines to directly offset their emissions, at a potentially lower cost, in the global offset market.

> 'By targeting a [fuel levy] at the aviation sector in isolation, the amount of emissions reduction is determined purely by emissions abatement achieved within the sector and the demand response from travellers to increased costs. The aviation sector faces high emissions abatement costs relative to other sectors, and demand is not price 'elastic', hence high taxes or levies will not result in any significant reduction in emissions, and will certainly not be cost-effective.' - Aviation Global Deal Group

However, a fuel levy can in theory achieve the same emissions reductions, provided the correct levy rate is adopted *and* a share of resulting revenues are used to purchase offsets.

DIFFERENTIATED AVIATION FUEL LEVY APPLICATION

115. As with an aviation ETS, differentiation by route or differentiation by carrier is possible. Differentiation by carrier would be equally difficult under a fuel levy.

116. Differentiation by route could operate differently under a fuel levy by differentiating by fuel sale point. However, this would encourage *tankering*, a process whereby a plane would purchase as much fuel as possible at exempt fuel sale points, thereby minimising the impact of the fuel levy. While planes can tanker a lesser amount of fuel than ships, tankering can still reduce fuel costs. This would be especially true for short-haul flights, where it is possible to carry enough fuel for a return flight (rather than refuel after the first leg). However, on longer haul flights tankering is also possible to a certain degree. For example from Singapore to Saudi Arabia, tankering can cover only some 25% of the fuel required for the return flight. However, this would still mean a 25% fuel tax reduction. The advantage for operators gained by such action would depend on the level of taxation and the availability of untaxed fuel somewhere along the route — the higher the tax rate the *more* attractive tankering would become. As tankering adds to the weight of the aircraft, causing more fuel to be burned, it reduces the environmental benefits of the measure even further (although higher fuel burn also reduces the attractiveness of tankering to airlines).

117. Differentiation by route could also still encourage destination switching/re-routing (as with an aviation ETS).

118. As noted above, airlines have argued strongly that differentiation is unsuitable for international aviation, arguing that any obligation should be universal.

POLICY CONSTRUCT 3 — TICKET TAX — AVIATION

UNIVERSAL APPLICATION

POLICY DESCRIPTION

119. A tax would be applied on all international airline tickets at the point of sale, with revenue to be directed to international climate financing. Air cargo would be exempt from the tax.

120. The tax could be set at a flat rate or otherwise applied *ad valorem* so that more expensive tickets incur a higher tax. An example of the latter is a 5% aviation ticket tax proposed by George Soros. Alternatively, the Maldives has proposed a flat tax rate of US$6 for international economy tickets and US$62 for business and first-class tickets (on the basis that these rates as currently applied in France (to combat HIV/AIDS) have not materially affected demand).

121. On the other hand, the tax could be set to try to mimic the underlying fuel emissions associated with the flight. This could be on a kilometres-travelled or fuel-used basis and would have a proportional impact on the demand for air travel. Measuring the kilometres travelled for each ticket is likely to add to complexity and compliance costs for carriers. In this regard, bands incorporating locations with similar distances could simplify the system. This method is similar to that adopted by the UK for its Air Passenger Duty.

122. The tax could be set at a low level to have minimal impact on growing demand for air travel. This option would raise revenue but would not achieve a significant reduction in aviation emissions (except for any reductions achieved through the targeted use of revenue).

POTENTIAL REVENUE IN 2020

	Revenue range (US$b)[#]		**Comments**
Aviation: Ticket tax	Scenario 1	*0.7 – 1.4*	Tax applies to passenger flights only (and excludes the air-cargo segment). Estimates assume the ticket tax would be set in line with the externality caused by aviation fuel emissions.
	Scenario 2	*1.2 – 2.4*	
	Scenario 3	*2.4 – 4.7*	

*Estimates assume measures have universal application.
Note: revenue estimates provided by Project Catalyst. Scenario 1 is where countries implement their low range Copenhagen commitments, Scenario 2 is where countries implement their high range Copenhagen commitments, and Scenario 3 is where countries implement commitments equivalent to reducing world temperature rise to 2°C (the most ambitious scenario).

ANALYSIS — ADVANTAGES AND PROBLEMS

Reliability/predictability of revenue stream

123. As described in the preceding aviation sections, reliability of revenue from the ticket tax will depend in part on ongoing demand for international aviation, but not on aviation fuel demand.

124. If attempts are made to partially benchmark the tax to the international carbon price at regular intervals, the revenue of this proposal would be influenced by such benchmarking, notwithstanding likely continued growth in the sector.

Efficiency

125. Ideally, a ticket tax should be applied within a complementary framework of similar taxes on other forms of transport to reduce competitive distortions. All airlines should be treated equally otherwise substitution effects would unfairly disadvantage airlines liable for the ticket tax.

126. In light of ticket tax cost impacts, behavioural effects will be similar to those described in the *aviation sector characteristics* section, although they will not be the same, as the ticket tax is not likely to be as proportional to fuel use/distance travelled.

127. While the ticket tax would be relatively efficient at raising revenue, as it can utilise existing electronic ticket compliance systems, it would not be effective at addressing negative environmental effects. As the measure does not tightly target the carbon externality, it is unlikely to be appropriately internalised.

127.1. In theory a distance-based ticket tax, based on flight distance in kms, may be able to more closely mimic underlying emissions. However, such a ticket tax would still introduce a distortion as it would not incentivise more efficient fuel use or reductions in emissions (because airlines would remit the same amount of tax, no matter how little fuel was used on route).

128. In addition, even if it were set at a modest rate it could easily cause the sector to be over-taxed relative to the externality associated with the aviation fuel emissions released per passenger. On current expectations for a global carbon price, both the upper tax level of $62 proposed by the Maldives and the 5% tax proposed by George Soros exceed the value needed to fully price the externality for most flights. For a world carbon price of around US$30 per tonne, a carbon ticket tax would generally represent a very small fraction of ticket cost, since most flights produce less than 2 tonnes of emissions per person.

128.1. For example, a US$30 carbon price would add around US$44 (or less than 3%) to a US$1,500 return flight from Singapore to London (for about 1.48 tonnes of CO_2 per passenger). Similarly, just over US$7 (less than 2%) would be added to a US$400 return ticket from Seoul to Tokyo (for about 0.24 of a tonne of CO_2 per passenger).[23] Any ad valorem or flat ticket tax set above such levels would therefore be taxing passengers more than is required by the US$30 world carbon price.

129. In terms of carbon efficiency and a link to world mitigation, the ticket tax is unlikely to incentivise any abatement itself, as it does not tightly target the externality. Specifically, a ticket tax would not encourage airlines to use more fuel-efficient aircraft, greater load factors or less carbon-intensive fuel. Abatement would likely only be achieved through the targeted use of revenue to purchase carbon offsets.

Incidence

130. Legal incidence would apply at the ticket retailer level (utilising existing administrative systems). The economic and other aspects of incidence are described in the preceding aviation section.

Practicality

131. While the tax might appear practical in the short run, over the longer term, as the global carbon market evolves, it could be rendered obsolete and another market-based measure would need to be implemented to directly address the sector's emissions.

132. Cross-national tax design issues would have to be addressed, but conceivable difficulties are not insurmountable, administrative ticket tax systems are already in place in most jurisdictions. As the proposal would leverage off existing ticket sales systems and compliance mechanisms,

[23] Based on the ICAO emissions calculator and recent flight prices.

additional compliance costs for suppliers would be marginal. Variations in the capacity to administer the tax across nations may need to be addressed.

133. A flat or *ad valorem* tax would be simpler to implement, while a tax calculated to mimic carbon pricing would increase complexity and compliance costs. For a carbon ticket tax, bands grouping routes of similar distances could reduce the complexity to some degree. A process to respond to changes in the global carbon price may also be required. Methodologies and processes would need to be agreed between nations and may require verification.

134. There are unlikely to be international legal issues as the tax may be equivalent to many current departure taxes. However, the tax would need to be designed with a view to obligations under the World Trade Organisation (WTO), General Agreement on Tariffs and Trade (GATT) and Free Trade Agreements. Under these obligations, flights from a particular country must be treated *no less favourably* than those of any other country.

135. The ticket tax would not be practical if a major player opted out. Non-universality, for example through nationality-based airline differentiation, would introduce a competitive distortion, driving down scheme revenues and effectiveness. However, while universal application, supported by compensation options for vulnerable least developed countries, would be more neutral, a country differentiated system may not be entirely impractical.

Political acceptability

136. A modest *ad valorem* tax would be more politically acceptable in that those more able to pay (industrialised country passengers) would pay a greater contribution, while a flat tax would be relatively regressive.

137. The tax may gain popular acceptance where it is seen as directly assisting developing countries. On the other hand, populations may oppose the tax where they perceive it as an unrefined revenue-raising measure. This perception would be bolstered by the fact that the ticket tax does not provide a sustainable solution to dealing with the sector's emissions.

138. The industry is likely to object to the imposition of the measure in the absence of a similar tax on other sectors. Airlines will also object unless they are all treated equally for each origin-destination leg (all in or all out). Businesses in advanced economies would likely object to anything more than a modest and low country-differentiated ticket tax, due to the introduction of a competitive disadvantage.

DIFFERENTIATED AVIATION TICKET TAX APPLICATION

139. As before, differentiation by route or carrier is possible. Differentiation by carrier would be equally difficult under a ticket tax, as it would encourage substitution to exempt airlines, reducing revenue with no environmental benefit.

140. Differentiation by route, depending on the cost impact, may also still encourage destination switching/re-routing (as with other measures). For example, a ticket tax may encourage passengers to re-route via developing country hubs or to avoid booking direct tickets and to individually buy separate legs in order to avoid or minimise the tax. However, differentiation by route may be possible, given existing administrative ticket tax systems.

POSSIBLE APPROACHES TO ADDRESS INCIDENCE OF MEASURES ON SIDS AND LDC

141. In principle, countries disproportionately impacted by the incidence of the revenue raising measure could be compensated. Remaining revenues would then be distributed to meet the objective of funding climate change action. Further design consideration would be needed in relation to the specifics of any compensation approach, including whether this should be restricted to least developed countries or determined directly by impact (which may result in some compensation to developed countries that are impacted by the scheme). In first instance, some suggested approaches that could avoid disproportionate impacts are as follows.

De minimis

142. A *de minimis* rule could be applied to minimise policy measure impacts on vulnerable small island developing states (SIDS) or least developed countries (LDCs).[24] Emissions (for an ETS) or fuel uploads (for a fuel levy) on routes to or from such locations could be exempt. An exemption of this type could not effectively mitigate impacts on all developing countries as broader application would inevitably lead to scheme avoidance through re-routing.

143. To ensure that re-routing through exemption locations is minimised, a maximum annual fuel upload, tonnage value or passenger load could be set. As a result, any re-routing that might occur would cause traffic to exceed the *de minimis* threshold, invalidating the exemption (and so the measure would apply on the same basis as standard destinations). Such exceptions should also be subject to a review system that includes a petition mechanism for adding or removing routes.

144. However, such a mechanism would add to administrative costs and complexity as it would require destination-based records to be kept. (Container shipping would also complicate record-keeping, as detailed records would be required not just for the full load, but also for each container. This is because a large container ship may carry only a few containers destined for a LDC (out of 10,000 boxes). Records would need to document all such deliveries.)

145. An alternative for the maritime sector could be to exempt small ships from the measure (perhaps at a level of 400 gross tonnes, as discussed in the IMO). This could reduce the impact for vulnerable SIDS or LDCs, as these ships are of particular relevance to these countries (they tend to have smaller ports). As smaller ships also emit less than larger ships, emissions impacts may initially be relatively small.[25]

145.1. Nevertheless, this might not result in lower transport costs for developing countries, as shipping companies (or other stakeholders in the transportation chain) may *increase* their profit margins on these routes, instead of reducing their rates.

146. An alternative for the aviation sector could be to set thresholds based on size or frequency of flights, as the European ETS envisages in the its upcoming application to EU aviation services.

Rebates

147. Another option is to directly rebate developing countries as compensation for global market-based measure impacts. Such a compensation option would moderate cost impacts and could result in net positive impacts. It could also be consistent with the CBDR principle.

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[24] Land-locked LDCs would also be affected, with increased transport costs likely to be passed by neighbouring coastal states.
[25] Nonetheless, smaller ships are less efficient than larger ones, as they emit more CO_2 per tonne mile.

148. For example, a proposal has been made in the maritime space to compensate developing countries according to their share of global imports by value, on the basis that it is the importer who ultimately bears the costs. [26]

149. The rebate approach could be much simpler than complete exemption (country differentiation) as 'only approximately a hundred rebates are to be issued, one to each developing country, and the data required to calculate the rebates is readily available'.

150. Moreover, inclusion in the policy measure (with such compensation) would also allow efficiency incentives to reduce developing country costs. As the maritime proposal notes, 'the greatest scope for efficiency improvements is in the [maritime] supply chain to and from developing countries… Due to incentives… and additional investments, the cost of transport for developing countries would be reduced most, contributing positively to their increased trade and development'.

151. In contrast, if all developing countries were exempt then this would require differentiating based on the final destination of goods. This would be complex, requiring a verifiable share of goods transported to industrialised countries for each ship or company worldwide. Moreover, differentiation by volume of imports rather than value would be complex and difficult. Accurate volume data is not as reliable or readily available for many countries, and so may need to be approximated from other data. Additionally, calculation would be complicated by the fact that 'different ship types have significantly different energy efficiency (per tonne-mile of cargo carried). As a result an efficiency-weighted average would have to be used, considering different types of cargo imported by different ships. Such data is not widely available'. [27]

OPTIONS TO INCREASE POLITICAL ACCEPTABILITY

152. To bolster sectoral support for the measure, some revenue could be directed back to industry, potentially for industry fuel efficiency research and development.

Transitional rules

153. In order to encourage political engagement, a threshold rule could be applied that would ensure that the measure would not commenced operation until nations representing a certain percentage of industry traffic (say 80%) sign up to participate. This will reduce first-mover risk and encourage countries to sign up — as the measure would not trigger impacts on their industry until a fair percentage of the world was also ready to commence the measure.

154. Transitional rules could reduce the impact on affected parties by allowing the measure to ramp up over time. A transition period of say 4 to 5 years could apply. This may provide more time for the sector to adjust to costs, which may be important for operators likely to be rendered more uncompetitive.

155. During the transition the tax rate may be gradually increased until it reaches the equivalent of the world carbon price in the final transitional year. Alternatively under an ETS, the share of permits auctioned could gradually rise from an initial say 20%-40% until 100% auctioning is reached in the final transitional year. However, such grandfathering should be unwound promptly as it would undermine revenue (a key purpose of the scheme), whilst cushioning existing operators and discouraging new carriers from entering the market (as they would receive no free permits).

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[26] See also paragraph 65.1 above. International Maritime Emission Reduction Scheme (IMERS) http://assets.wwf.org.uk/downloads/mepc_60_4_55_iucn.pdf
[27] Ibid

155.1. The aviation industry has called for grandfathering under an ETS, but we are not aware of such calls from the maritime industry.

156. To assist developing countries in the transition, a slower phase in could be agreed for these countries (although this may only be applicable to the ticket tax, given the notable difficulties in attributing fuel use to countries). A slower phase-in would be consistent with CBDR and would not undermine the long-term efficacy of the measure. A similar approach was adopted by all nations that were a party to the Montreal Protocol, which applied different targets and timeframes for developing nations.

Maritime non parties

157. If a maritime ETS were based on the Flag State obligations and Port State controls applied to other IMO agreements, there is potential for some states to be a non party to the agreement without affecting the mechanisms integrity. Ships flagged to a non party would be required to participate in the scheme when transporting to or from a party, which would be enforced through Port State controls on the ship of the non party. However, ships that solely trade between non parties would be exempt, but could also be ineligible for other aspects of the scheme including the provision of climate financing and compensation.

Ticket tax options

158. A sunset clause could be included so that the ticket tax is terminated or replaced in the event that a comprehensive international climate change treaty applies a consistent carbon price to all transportation sectors (including aviation).

159. Major developing country tourist destinations could potentially be excluded from the tax to address the greater impacts that they would likely face (compared to business destinations).

CONCLUSIONS AND RECOMMENDATIONS

160. Preliminary conclusions are as follows:

160.1. The universal application of the aviation and maritime revenue mechanism would maintain competitive neutrality, minimise economic distortions and maximise revenue potential.

160.2. Universal-application cost impacts on particular countries could be addressed via a well-designed compensation mechanism to address equity and political acceptability concerns.

160.3. The quantum of revenue expected to be generated under any design option shows such mechanisms have to potential to make a meaningful contribution toward the overall financing goal of raising US$100 billion by 2020, subject to further analysis on attendant impacts on trade, tourism and economic growth.

160.4. The nature of an international aviation and maritime revenue mechanism suggests that a central fund could be a practical approach to distribute collected financing and any compensation. This may not be a consideration for other revenue options.

ANNEX A — THE EFFECT OF A CARBON PRICE ON MARITIME TRADE

Some countries have expressed the concern that they are likely to be particularly affected by the imposition of a carbon price (either by an ETS or a levy) on the aviation or maritime sector. This concern usually stems from two factors: the geographical distance from key markets; and/or the structure of their exports and imports (either being high volume/low value or if they are particularly dependent on air transport).

Section I considers the likely trade impacts of a carbon price on bunker fuels for the maritime sector. Section II provides broad indicative assessments of the likely revenue potential and economic incidence impacts of a carbon price on bunker fuels in the maritime sector.

SECTION I:
BUNKER COSTS AND THE TRADE COMPETITIVENESS OF COUNTRIES

Ideally, this issue would be investigated by a global Computable General Equilibrium (CGE) econometric model which captured the impacts of a carbon price on bunker fuels on exports, imports and the trade competitiveness of nations. We have not as yet found any modelling study of this type.

It is also worth noting that CGE models usually aggregate countries into a small number of regions (around 10-15 regions). Hence, even if such a modelling study did exist, it is unlikely to provide the detailed country by country information necessary to properly assess the likely impacts of a carbon price on bunker fuels.

Consequently, this Annex looks at the likely trade and competitiveness impacts of a carbon price on bunker fuels in three different ways.

1. Are some countries significantly more isolated from their trading partners than others and hence more likely to be particularly affected by a carbon price on bunker fuels?

2. How much would a carbon price on bunker fuels add to total shipping costs?

3. How important are shipping costs when compared to the value of the landed product?

It is important to emphasise that this analysis is indicative only. A comprehensive analysis on the competitive position of nations would depend on a thorough country by country analysis of each country's key export markets and the relative distances with its major competitors. It would also require an assessment of the comparative advantage of nations and the industry structure in each country to determine whether an industry was a truly marginal producer unlikely to be able to absorb any cost increase flowing from higher transport costs. An assessment of likely changes in trade flows would also be an important part of this analysis.

These issues are beyond the scope of this Annex

1. Geographical proximity with trading partners relative to major competitors

To address the question of whether any countries are likely to be particularly affected by the introduction of a carbon price on bunker fuels, the key question is: are there some countries significantly more isolated from trading partners than others?

To properly address this question would be challenging and data intensive. It would require a consideration of all ports in each country, the exports from each port (by weight and value) and the destination port.

However, to provide some insight into whether a carbon price on bunker fuels would affect the trade competitiveness of countries, we focus on two key parameters:

a) nautical distance from key export and import markets.

b) trading relationships between nations including the likely direct competition from domestic producers and from third country producers in each market.

The approach adopted is outlined below.

a. Nautical distances between trading partners

Maritime transport costs are determined by many factors. These include fuel and operating costs, cargo costs, insurance costs, landing costs and other miscellaneous factors such as imbalances in world trade. For example, as can be seen in Table 1 below, average freight rates on the same route vary significantly depending on demand for freight transport services (and the need to fill container ships on the return legs).

Table 1: Average container freight rates, 2006 Q1– 2008 Q2

Route	**Average freight rate (US$ / TEU)**
USA to Asia	820
Asia to USA	1,736
Europe to Asia	841
Asia to Europe	1,703
USA to Europe	1,099
Europe to USA	1,746

Source: UNCTAD 2008

However, only fuel costs are likely to be affected by a carbon price on bunker fuels; all of these other costs are likely to be broadly invariant to such an impost. And as distance travelled is the primary determinant of fuel used and hence fuel costs, it could be argued that a carbon price on bunker fuels would adversely affect a country's competitiveness if it was further away from its key trading partners than its major competitors.

As there are around 3,000 ports around the world, it is clearly not feasible to consider all the ports and the distances between them in this analysis. Instead, we have limited our consideration to twenty-eight 'representative ports'. (See Attachment A for assumptions and a geographical representation of the ports). Nautical distances between each of these ports were calculated using the World Port Distances through the website at www.distances.com.

b. Trading relationships between countries

The importance of a trading relationship is dependent on the level of exports, imports, competition with local production and competition with third countries. Weighting factors for trading relationships are often used for calculating the real exchange rates for countries. The literature typically uses three types of trade-weighting structures: those based on *bilateral* trade flows; those based on *global trade flows;* and those based on *double weights* which capture both bilateral and third market competition[28]. Given our focus on trade competitiveness impacts, we have used

[28] Some of the different possible concepts of competitiveness as applied to national economies can be found at: Hawkings, J (2006), "The Concept of Competitiveness" Australian Treasury Working Paper 2006-02, Canberra.

double weights as calculated by the Bank of International Settlements (BIS)[29]. These double weights capture:

- each country's contribution to the total supply of competing goods (including the supply by domestic producers); and

- the relative importance of each market in the given country's international trade profile.

The BIS have calculated double weights for over 50 countries accounting for nearly 95 per cent of world trade (See Attachment 2). As an illustrative example, Argentina's key trading partners are Brazil (35.6 per cent), China (9.5 per cent), the Euro area (16.0 per cent), and the United States (15.2 per cent) with these calculations taking into account direct trade and competition from domestic producers and third countries.

c. <u>Calculating a measure of 'trade location' and the results</u>

The last step in the analysis is to multiply the BIS trading weights with the appropriate nautical distance between the two countries. Again, using Argentina as an example:

- we multiply Argentina's BIS weighting for trade between Argentina and Brazil (35.6 per cent) with the distance between the Argentinean port of Buenos Aires and the Brazilian port of Salvador.

- Similar calculations are done for all of Argentina's other trading partners including China (Shanghai), Euro area trade (with the port depending on the Euro country trading partner), and the United States (with the trade shares split between the three US ports).

- The results are added together to provide a single measure of Argentina's location relative to its major trading partners and third party competitors.

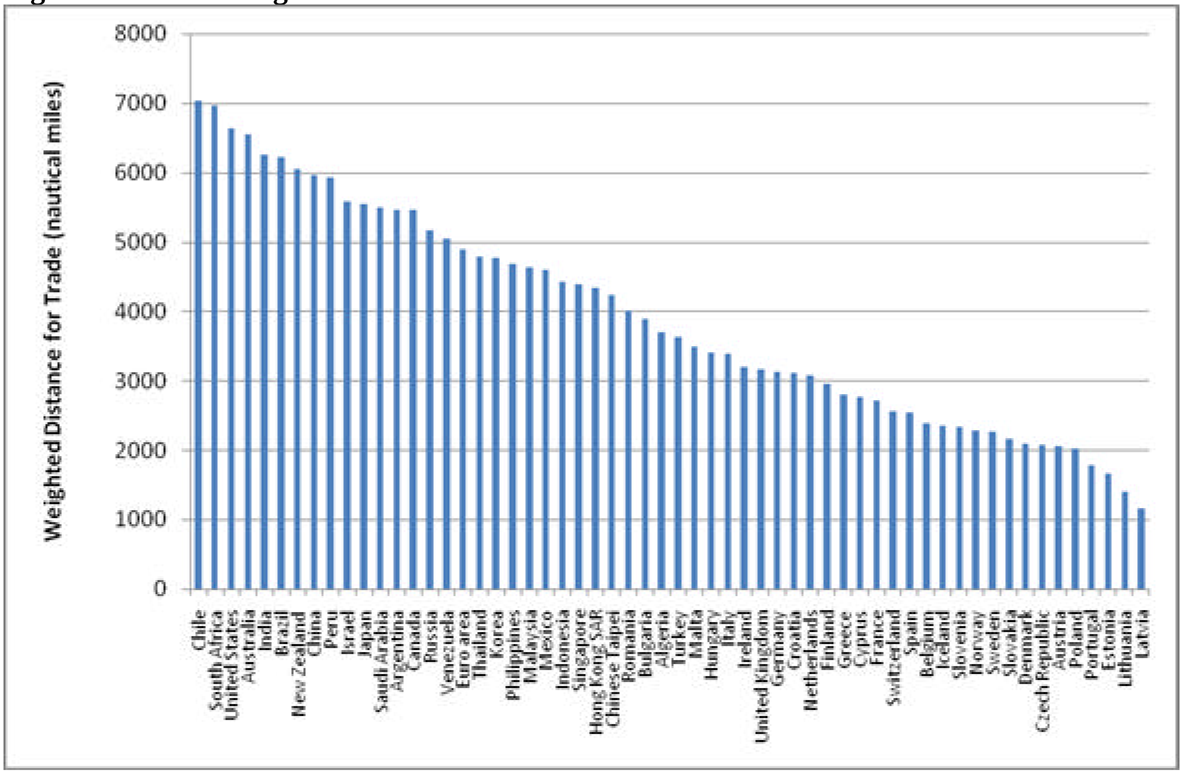
Similar calculations were done for all 57 countries with BIS double weights data (accounting for 95 per cent of world trade). The results are provided in Figure 1.

Figure 1 shows that Chile, South Africa, the US and Australia are further away from their major trading partners relative to their competitors. By contrast, while Argentina is geographically proximate to Chile, its trade weight distance is much lower due to its geographical proximity with its trade partners. For example, Argentina's trade weight with nearby Brazil is 35 per cent, as opposed to Chile's 9 per cent.

The second group of countries with relatively high 'trade weighted distances' are India, Brazil, New Zealand, China, and Peru. Israel, Japan, Saudi Arabia, Argentina and Canada are in the third group, while the Asian countries – Thailand, South Korea, the Philippines, Malaysia, Indonesia, Singapore, Hong Kong and Chinese Taipei – are relatively close to their major trading partners. The results also confirm the very strong intra-Europe trade relationships.

[29] Turner, P and Van't dack (1993), "Measuring International Price and Cost Competitiveness", BIS Economic Papers, No 39, Basel, November (p.1).

Figure 1: Global Weighted Nautical Distances for Trade



Source: Analysis prepared for this report.

2. How much would a carbon price on bunker fuels add to the total transport costs?

The above analysis suggests that some countries – particularly Chile, South Africa, the US and China – are relatively distant from their key trading partners (on a 'distance trade weighted' basis). The obvious question is: how important is this relative isolation? Will it add significantly to the transport costs? Will it increase transport costs by a 10 per cent or 50 per cent?

Studies generally confirm that the cost structures of shipping vary greatly over different ship types, size categories, and age profiles making it difficult to directly estimate the likely impact of a carbon price on bunker fuels on final transport costs. A recent study by Faber et al estimated the carbon costs for six different sized vessels ranging from a handy size bulker to a container main liner. It found that fuel costs ranged from 33 per cent to 63 per cent of the total cost[30]. Assuming a US$360 / tonne fuel price and a $30/ tonne CO_2 carbon price (consistent with the High End Copenhagen Accord scenario), the report estimated total transport cost would increase by between 7 and 16 per cent of total costs and 14 to 22 per cent of variable (operating and voyage) costs depending on the size of ship.

Recognising the uncertainty inherent in calculating oil prices, the Faber et al report calculates the likely ***variable*** cost impacts on a Very Large Crude Carrier for different bunker fuel prices and carbon costs. Based on this analysis, it is also possible to infer the likely impact on ***total*** transport costs. Information on the likely impact on both variable and total costs flowing from a carbon price on bunker fuels is provided in Table 2 below.

[30] Faber, Markowska, Eyring, Cionni & Selstad (2010) "A Global Maritime Emission Trading System: Design and Impacts on the Shipping Sector, Countries and Regions", CE Delft, Fearnley Consultants, DLR, p. 55, calculated from Table 13.

Table 2: Increase in voyage and operational costs under different fuel / carbon assumptions

		Fuel Price (US$ / tonne of fuel)		
		US$360	US$700	US$1,040
Carbon Price (US$/tonne CO_2)	US$10	Variable: 6% Total: 3%	Variable: 4% Total: 2%	Variable: 3% Total: 2%
	US$30	Variable: 18% Total: 10%	Variable: 11% Total: 6%	Variable: 8% Total: 4%
	US$50	Variable: 30% Total: 17%	Variable: 18% Total: 10%	Variable: 13% Total: 7%

Source: Faber, Markowska, Eyring, Cionni & Selstad and analysis in this report based on Faber et al Table 13

The table highlights that the likely impacts of a carbon price on bunker fuels are highly variable with respect to the impact on variable and total transport costs – ranging from 3 to 30 per cent for variable costs and 2 to 17 per cent for total costs.

The table highlights that the choice of fuel price is critical in determining the likely impact of a carbon price on bunker fuels.

There are significant uncertainties in forecasting the likely fuel price for the maritime sector in 2020 given its links with the global oil price (which, the IEA Reference Scenario has increasing to $100 per barrel in 2020 and $115 in 2025 (in 2008 dollars). In addition, the IMO recently amended the MARPOL Annex VI regulations to reduce the maximum sulphur content in fuels to 0.5% by 2020 and 0.1% in the Sulphur Emission Control Areas (SECAs) by 2020. Meeting these standards will require the increased use of distillates (such as Marine Grade Oils) rather than the residuals (or Heavy Fuel Oils) currently used. The IMO expects that this is likely to nearly double the price of maritime fuels in 2020. Under the Reference Case of the fuel price assumptions of the IMO's Expert Group on Market Based Measures, the price for maritime distillates is expected to be $1,205 in 2020 compared to $628 for residual fuels.

As can be seen from Table 2 above, this suggests that a 2020 price for maritime fuels is likely to be over $US1,040 (last column), suggesting that a US$30 carbon price (under the High End Copenhagen Scenario) would increase total transport costs by around 4 per cent and variable costs by around 8 per cent.

3. How important are shipping costs when compared to the value of the landed product?

Another way to look at whether the relative distance of some countries from their trading partners is likely to significantly affect their trade competitiveness is to consider the impact of the increase in shipping costs to the price of the landed product. An increase in shipping costs of $10 is likely to be more important for a low value/high volume agricultural product than a high value/low volume technological product.

Table 3 below shows the expected increase in shipping costs and the increase in shipping costs as a percentage in the price of the landed good assuming a US$30 carbon price and a fuel price of US$360 /tonne (recognising that, as argued above, maritime fuel costs are likely to be significantly higher than $360 in 2020, reflecting the global oil price and the impact of the low sulphur MARPOL VI Regulations).

This analysis suggests that the estimated impact on the competitiveness of imposing a carbon price on bunkers is likely to be small – ranging from 2-3 per cent of the landed price for bulk commodity exports, and less than 1 per cent for crude oil and manufactures. It is also worth highlighting that these estimates represent the *maximum cost disadvantage that would be incurred*. For example, it represents the cost disadvantage for Chilean copper in China relative to domestic Chinese producers; the cost disadvantage for Chilean copper exports to China relative to Australian or South African competitors would be expected to be small (as shown in Section 1 above). This highlights that there may be value in conducting a much more detailed analysis based on assessing the differences in distance between key importing and exporting countries. This is, however, outside the scope of this Annex.

Table 3: Estimated impact of a carbon price relative to the landed price of goods

Type of Commodity	Ship Type	Transport costs (US$/ tonne)	Value of goods (US$/ tonne)	Transport cost as % of landed good	Increase in shipping costs	Increase in shipping costs as % of landed goods
Agriculture	Bulker	80.64	740.50	10.89%	9-11%	1%
Commodities	Bulker	32.59	134.89	24.16%	9-11%	2-3%
Crude Oil	Tanker	18.09	448.88	4.03%	9-10%	0.4%
Manufactures	Container	173.94	3,403.91	5.11%	7-16%	0.4 – 0.8%

Source: Korinek and Sourdin (2009).

This broad finding is given further support by considering the likely increase in transport costs for some agricultural products exported from developing countries to Europe. As can be seen in Table 4, the potential price increase of imposing a US$45 / tonne CO_2 tax combined with a fuel price of $550 / tonne will increase the price of most commodities by less than 1 per cent. Even for a commodity like jute from Bangladesh, where the freight rate share of the price is more than 35 per cent, a US$45/ tonne carbon price will potentially increase the overall price by less than 2 per cent.

Table 4: Potential price increase for different commodity imports into Europe

Commodity	Route	Freight as % of price	Impact of CO_2 price on transport cost (with fuel price of US$550/ tonne)	Potential price increase
Rubber	Malaysia - Europe	6.3	5%	0.32%
Jute	Bangladesh – Europe	37.2	5%	1.86%
Cocoa	Ghana – Europe	3.9	5%	0.2%
Coconut oil	Sri Lanka - Europe	14.5	5%	0.73%
Tea	Sri Lanka – Europe	9.3	5%	0.47%
Coffee	Brazil – Europe	5.1	5%	0.26%
Coffee	Colombia (Atlantic) – Europe	3.0	5%	0.15%
Coffee	Colombia (Pacific) - Europe	3.7	5%	0.19%

Source: Syddansk Universitet (2009), "Background Note on: Effects of Sea Transport Costs due to an International Fund for GHG Emissions from Ships (p. 15).

Summary: Likely impacts on trade competitiveness

There is concern that an international levy on bunker fuels may have a disproportionate impact on particular countries given their geographical isolation relative to their trading partners and third party competitor countries. However, an analysis of the likely impact of an international levy on bunker fuels (with no exemptions) suggest these concerns are overplayed.

Key conclusions are:

- An analysis based on the nautical distance between countries and the trading relationships between nations (including the likely direct competition from domestic producers and from other competitor nations in each market) suggest that there are some differences in the likely impact of bunker fuels with Chile, South Africa, the United States and Australia relatively more distant from their trading partners and competitor nations. By contrast, the European countries trading relationships are generally concentrated within the region.

- That said, further analysis suggested that the likely impact of a High End Copenhagen Accord Scenario of a US$30 / tonne CO_2 price would add around 4 per cent to the total transport cost on plausible bunker fuel forecasts.

- However, this estimated increase in transport cost is small compared to the price of landed goods – ranging from 2-3 per cent of the landed price for bulk commodity exports, and less than 1 per cent for crude oil and manufactures. Even for a commodity like jute where the freight rate share of the price is more than 35 per cent, a US$45/ tonne carbon price will potentially increase the overall price by less than 2 per cent.

It is important to highlight that this analysis is broadly indicative only. As noted above, a comprehensive analysis of this issue would require a country by country assessment of distances between key trading partners, and third party competitors. It would also require a detailed analysis of industry structure and potential for changes in trade flows.

SECTION II:
ASSESSMENT OF ECONOMIC INCIDENCE AND REVENUE POTENTIAL

161. Revenue potential in 2020

The IMO has looked at a range of emission projections from the maritime sector for 2020. The table below combines Copenhagen High, Low and 2C scenario prices with the base IMO scenario to determine the revenue potential from a carbon price on bunkers.

It should be noted that the introduction of a carbon price will result in rational ship owners and operators acting rationally to take measures to reduce emissions until the cost of such reductions is equal to the carbon price. These measures to reduce emissions and increase efficiency will therefore reduce the total revenue. As the calculation below does not include such behavioural responses, they represent a maximum or upper bound revenue estimate.

As can be seen in Table 5 below, a first order approximation is that a carbon price on bunker fuels would raise US$15 billion for a low end Copenhagen Accord Scenario and US$30 billion for a high end Copenhagen Accord Scenario.

	Revenue range (US$b)# **Up to**		**Comments**
Maritime: ETS	Scenario 1	*2.4 – 5.6*	Assumes measure directly linked to the world carbon offset price and 100% auctioning. Emissions projections from IMO SRES projections for 2020. Assumes compensation for developing countries account for 30% of total revenues (equal to developing country share of imports). 25-50% of of remaining revenues made available for international climate finance (in accordance with the AGF Guiding Principles).
	Scenario 2	*4.1 – 9.3*	
	Scenario 3	*8.1 – 18.5*	

*Estimates assume the measures have universal application with no administrative and implementation costs.
Note: revenue estimates provided by Australian Department of Climate Change and Energy Efficiency. Scenario 1 is where countries implement their low range Copenhagen commitments, Scenario 2 is where countries implement their high range Copenhagen commitments, and Scenario 3 is where countries implement commitments equivalent to reducing world temperature rise to 2°C (the most ambitious scenario).

162. Analysis of the Economic Incidence of a carbon price on bunker fuels

It is important to highlight that the economic incidence analysis below is not a proper economic analysis of the likely economic incidence of a carbon price on bunker fuels. Such an analysis would require a thorough understanding of the maritime sector including the demand and supply elasticitie s for the freight services to determine what share of the increased impost was likely to be absorbed by the maritime freight industry and the share which was likely to be passed on to the users of freight services. It would also require a thorough understanding of the markets facing the users of freight services to determine whether the exporters would need to absorb their share of the bunker fuel impost or whether this could be passed on to their consumers.

Such an in-depth analysis of the likely economic incidence of a carbon price on bunker fuels is clearly beyond the scope of this paper. The following provides a broad indication of the likely economic impacts and revenue implications of imposing a carbon price on bunker fuels.

Maritime models typically calculate maritime CO_2 emissions by quantifying global fuel consumption and multiplying the consumption by the appropriate emission factors. While these can provide some indication of total maritime emissions, they do not provide any information on different route groups and, hence, it is not possible to attribute emissions to particular countries (either on a country of origin or destination country basis). And as such, it is difficult to provide any indication of the likely economic incidence of introducing a carbon price on different countries and regions.

To remedy this, Paxian et al (2009) have developed a bottom up model which they directly linked to ship movement data using the Lloyd's Marine Intelligence Unit's ship statistics of six months in 2006 (40,055 vessels) combined with average engine data which has then been used as an input into a SeaKLIM algorithm which determines the most probable shipping route given origin and destination ports and various other important considerations such as canal sizes. These results were then cross checked with various other studies and with IMO top down analysis.

Using this analysis, and as shown in Table 6 below, Faber et al have attributed CO_2 emissions to countries on an arrival and departing basis.

Table 6: CO_2 Emissions attributed on arrival and departing basis

	Arriving Ships	**Departing Ships**
Region	**CO_2 Emissions (Mt)**	**CO_2 Emissions (Mt)**
Annex I countries	468.5	466.3
Non Annex I countries	581.7	538.9
Total	**1050.2**	**1005.2**
G77	464.7	468.9
Least Developed Countries	5.6	16.5
Small Island and Developing States	31.5	93.7

Source: Faber et al (p. 34)

Based on these calculations, Table 7 below provides an indication of the cost increase of maritime transport on different regions for different carbon prices (calculated by attributing the expected increase in global maritime sector to each region equally).

These results assume that the entire increase in freight costs is borne by the importing country. This is not realistic as it would be expected that the increased impost would be shared between: a) the importing country; b) the freight provider; and c) the exporting country with the economic incidence depending on the elasticities of supply and demand.

It is also possible for importing countries to reduce the adverse impact of increased freight costs by substituting imports with increased domestic consumption – particularly where close domestic substitutes exist. However, as argued above, as the estimated increase in transport cost is small compared to the price of landed goods – ranging from 2-3 per cent of the for bulk commodities and less than 1 per cent for crude oil and manufactures. A priori, such a small increase in freight costs will only provide incentives for very marginal changes in import and export patterns (and only where domestic producers already exist and can increase their output relatively easily).

It is possible to estimate the likely impact as a percentage of GDP (by dividing the percentage increase by the forecast GDP in 2020). While this has not been done at this stage, CE Delft analysis (based on 2006 GDP figures and 2006 emission allocations) suggest that a carbon price of US$15-30 would result in an increase of 0.02-0.04 per cent for Annex I countries and 0.07-0.15% for developing countries. However, for small island developing states (SIDS), the Faber et al estimated the increase in cost at around 0.45-0.89 per cent of GDP. That said, as noted by Faber et al, this result is likely to be significantly affected by Singapore, as a SIDS country and a major maritime hub.

Table 7: Cost increase of maritime transport to groups of countries (based on arrivals)

Region of destination	CO_2 emissions ($MT\ CO_2$)	Cost increase of maritime transport USD billion (USD 15/tonne CO_2)	Cost increase of maritime transport USD billion (USD 30/tonne CO_2)
North America	126	1.9	3.8
Central America and Caribbean	56	0.8	1.7
South America	62	0.9	1.9
Europe	291	4.4	8.7
Africa	72	1.1	2.1
Middle Eastern Gulf, Red Sea	65	1.0	2.0
Indian Subcontinent	25	0.4	0.8
North East Asia	204	3.1	6.1
South East Asia	122	1.8	3.7
Australasia	37	0.6	1.1
World	**1060**	**15.9**	**31.8**

Source: Calculations based on IMO projections for 2020 emissions and Faber et al (p.32)

Table 8: Cost increase of maritime transport to groups of countries

Country group of destination	CO_2 emissions ($MT\ CO_2$)	Cost increase of maritime transport US$ bln (US $15/tonne CO_2)	Cost increase of maritime transport US $ bln (US$30/tonne CO_2)
Annex I countries	493	7.4	14.8
Non-Annex I countries	612	9.2	18.4
G77	489	7.3	14.7
Least Developed Countries	14	0.2	0.4
Small Islands and Developing States	104	1.6	3.1

Source: Calculations based on IMO projections for 2020 emissions and Faber et al (p.34)
As noted by Faber et al, the SIDS results are likely to be significantly affected by the classification of Singapore as a SIDS and given its status as a major maritime and refinery hub).

Attachment 1: Port Allocation to Countries

Country	Port
Industrial Countries:	
Australia	Equal weighting - Port Hedland and Newcastle
Canada	Equal weighting - Montreal and Vancouver
Denmark	Rotterdam
Iceland	Rotterdam
Japan	Nagoya
New Zealand	Newcastle
Norway	Rotterdam
Sweden	Rotterdam
Switzerland	Rotterdam
United Kingdom	Rotterdam
United States	Equal weighting - Houston, New York and Los Angeles
Euro area:	Rotterdam
Austria	Rotterdam
Belgium	Rotterdam
Cyprus	Augusta
Finland	Rotterdam
France	Rotterdam
Germany	Rotterdam
Greece	Augusta
Ireland	Rotterdam
Italy	Augusta
Malta	Augusta
Netherlands	Rotterdam
Portugal	Lisbon
Slovakia	Rotterdam
Slovenia	Augusta
Spain	Lisbon
Emerging Asia:	
China	Shanghai*
Chinese Taipei	Shanghai
Hong Kong SAR	Shanghai
India	Visakhapatnam
Indonesia	Tanjung Priok
Korea	Busan
Malaysia	Singapore
Philippines	Singapore
Singapore	Singapore
Thailand	Bangkok
Central and Eastern Europe:	
Bulgaria	Novorrosisk
Croatia	Augusta
Czech Republic	Rotterdam
Estonia	Rotterdam
Hungary	Augusta
Latvia	Rotterdam
Lithuania	Rotterdam
Poland	Rotterdam
Romania	Novorrosisk
Russia	Novorrosisk
Turkey	Augusta
Latin America and others:	
Algeria	Augusta
Argentina	Buenos Aires
Brazil	Salvador
Chile	Valparaiso
Israel	Jeddah
Mexico	Manzanillo
Peru	Callao
Saudi Arabia	Jeddah
South Africa	Equal weighting - Richards Bay and Saldanha Bay
Venezuela	Puerto La Cruz

* While there are many large ports in China, Shanghai is centrally located on China's coast, with ports to the north of Shanghai broadly offsetting trade occurring through the more southern ports.


Vancouver
Montreal
New York
Los Angeles
Houston
Manzanillo
Puerto la Cruz
Callao
Salvador
Valparaiso
Buenos Aires
Rotterdam
Lisbon
Novorossisk
Augusta
Jeddah
Saldanha Bay
Richards Bay
Visakhapatnam
Busan
Shanghai
Nagoya
Bangkok
Singapore
Tanjung Priok
Port Hedland
Newcastle

Attachment 2: Trade Weighting for Countries

Weight on: / In the weighted trade distance for:	Industrial Countries	Euro area	Emerging Asia	Central and Eastern Europe	Latin America and others
Industrial Countries:					
Australia	41.6	17.6	36.2	1.0	3.6
Canada	70.4	8.4	14.8	0.9	5.4
Denmark	32.5	45.7	11.7	8.3	1.6
Iceland	41.3	41.2	9.8	6.7	1.1
Japan	29.5	15.2	47.9	2.7	4.7
New Zealand	55.3	14.1	27.7	0.7	2.1
Norway	40.2	37.8	12.4	8.2	1.3
Sweden	32.1	45.3	10.9	9.0	2.7
Switzerland	24.0	54.7	11.5	6.4	3.3
United Kingdom	24.3	49.5	16.1	6.9	3.3
United States	33.4	17.9	31.0	2.1	15.7
Euro area:	51.0		24.6	18.3	6.2
Austria	19.0	59.7	8.8	10.9	1.6
Belgium	24.7	55.3	10.9	5.9	3.2
Cyprus	23.3	51.0	14.9	9.3	1.5
Finland	31.0	38.2	14.8	13.2	2.8
France	24.6	53.6	12.2	6.7	2.8
Germany	28.6	41.6	14.5	12.1	3.2
Greece	17.1	58.5	12.7	9.8	1.9
Ireland	44.9	35.5	13.6	3.6	2.4
Italy	22.3	51.5	12.2	10.3	3.7
Malta	24.2	44.4	20.8	8.0	2.7
Netherlands	27.2	46.6	16.4	6.9	2.8
Portugal	16.2	70.7	6.3	4.8	2.0
Slovakia	13.2	51.8	11.7	22.3	0.9
Slovenia	11.5	66.0	6.1	15.3	1.1
Spain	19.6	60.4	11.0	5.9	3.1
Emerging Asia:					
China	47.7	18.4	25.2	3.7	5.0
Chinese Taipei	42.5	12.0	39.9	2.0	3.6
Hong Kong SAR	32.9	13.1	50.6	0.8	2.6
India	34.0	24.9	31.4	4.1	5.7
Indonesia	35.8	12.9	46.4	1.9	3.0
Korea	41.4	14.7	35.9	3.3	4.7
Malaysia	38.4	12.7	44.6	1.5	2.7
Philippines	43.1	12.6	40.6	1.5	2.2
Singapore	34.2	12.7	49.5	1.2	2.4
Thailand	42.7	12.1	39.7	1.9	3.5
Central and Eastern Europe:					
Bulgaria	14.0	54.8	9.6	20.2	1.3
Croatia	12.9	64.6	10.7	10.7	1.1
Czech Republic	18.5	57.5	11.7	10.8	1.5
Estonia	24.0	44.9	8.5	21.6	1.0
Hungary	17.7	55.1	12.7	12.8	1.6
Latvia	19.3	40.1	5.5	34.3	0.7
Lithuania	20.5	42.7	6.8	29.4	0.7
Poland	18.8	56.1	12.1	11.6	1.5
Romania	14.3	57.6	9.5	17.2	1.5
Russia	24.0	42.8	20.6	10.4	2.1
Turkey	20.8	47.6	17.1	11.4	3.1
Latin America and others:					
Algeria	17.0	57.3	16.6	7.0	2.2
Argentina	22.7	16.0	15.3	1.5	44.5
Brazil	37.1	21.7	19.2	2.5	19.4
Chile	32.9	21.7	24.1	2.2	19.1
Israel	44.4	28.6	18.0	5.8	3.2
Mexico	69.1	9.5	16.9	0.7	3.8
Peru	38.1	15.3	21.3	1.9	23.4
Saudi Arabia	37.4	28.2	28.7	3.6	2.2
South Africa	38.1	31.7	23.2	3.0	4.0
Venezuela	45.5	15.1	13.2	1.2	25.0

ANNEX B — CURRENT POLICIES AND EXISTING PROPOSALS

Current policies

Norway — air fuel tax

UK — Air Passenger Duty

France — solidarity levy (air ticket tax)

Current proposals

Aviation Global Deal group — international aviation ETS

Maldives — ticket tax

ONGOING WORK ON MARKET-BASED MEASURES BY ICAO AND IMO

Introduction

1. As the demand for international aviation and maritime transport is expected to grow in coming years, ICAO and IMO have been leading industry-wide efforts to limit and reduce GHG emissions from these sectors. This appendix highlights ongoing efforts by ICAO and IMO to develop Market-Based Measures (MBMs) to reduce GHG emissions from international aviation and maritime transport respectively.

2. A summary table of the MBM proposals currently under assessment is provided below.

Key ICAO initiatives

3. Committee on Aviation Environment Protection (CAEP), which is tasked to "study policy options to limit or reduce the greenhouse gas emissions from civil aviation", have undertaken significant work to outline operational, regulatory, policy and legal guidelines for emissions-related levies as well as emissions trading for aviation[31]. These provide practical advice for voluntary measures by ICAO Contracting States.

4. The Group on International Aviation and Climate Change (GIACC), which was established in 2007, has developed a Programme of Action on International Aviation and Climate Change that was endorsed by the ICAO Council in June 2009. As part of its work, the GIACC had formed a workgroup with industry players to consider feasibility of market-based measures in addressing emissions.

5. A High-level Meeting on International Aviation and Climate Change was convened in October 2009 to review the Programme of Action recommended by the GIACC. In summary, ICAO and its member States agreed to a global annual average fuel efficiency improvement of 2% up to 2020, an aspirational global annual fuel efficiency improvement of 2% up to 2050, to explore the feasibility of more ambitious goals, and to establish a process to expeditiously develop a framework for MBMs in international aviation.

6. Post-COP 15, an ICAO Directorate-General Civil Aviation Climate Informal Group (DGCIG) was set up to further the work of the High-Level meeting in the areas of goals, MBMs, and measuring progress. In particular, the MBM Working Group will define principles for MBM in international aviation, examine options, explore access of international aviation to carbon markets, and provision of support to States. The DGCIG is expected to develop a draft resolution for endorsement at the ICAO General Assembly in September/October 2010.

Key IMO initiatives

7. Marine Environment Protection Committee (MEPC), on behalf of IMO, has been conducting in-depth discussions on the development of MBMs for international shipping. In particular, the MEPC's key milestones on MBMs include:

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[31] These includes a document on "Guidance on the use of Emissions Trading for Aviation", which discussed issues relating to operational boundaries, regulatory considerations, trading units, trading system elements and administrative procedures, which was compiled and published by CAEP in 2008.

- Agreement to a work plan on MBM at its 55th session in 2006, which would lead to a progress report by the MEPC to the 27th IMO Assembly in 2011.
- The formation of an Experts Group on MBMs to undertake feasibility study and impact assessment of proposed MBMs, following from extensive discussion on MBM proposals at MEPC 60.
- Two IMO GHG studies (2000 and 2009) have also been produced, both included comprehensive analyses of different policy options including MBMs.

8. The Experts Group on MBMs consists of 36 representatives from the public and private sectors, developing and developed nations. The Experts Group will assess each proposed MBM based on an agreed set of criteria, including environmental effectiveness, cost-effectiveness and potential impacts on trade and sustainable development, practical feasibility and transfers and support for developing countries, in particular the Least Developed Countries (LDCs) and the Small Island Developing States (SIDS). The Experts Group will submit its report to MEPC 61 from 27 September to 1 October 2010.

AVIATION — MARKET-BASED MEASURES

1. Emission Trading Scheme	
Description	Cap on total emissions of international aviation sector. Allowances are created to account for the total allowed emissions. At the end of each compliance period, each entity must surrender sufficient allowances to cover its emissions during that period. Trading occurs when an entity can reduce units of emission at a lower cost than another entity and then sells the allowance.
Reference	ICAO Doc9885, GIACC/3-WP/3, GIACC/4-WP/3, GIACC/4-IP/8, CAEP/8–WP/80
Issues under consideration	• Accounting entities (eg. aircraft operator, fuel suppliers, air navigation services providers, airport operators, aircraft manufacturers etc) • Emissions sources and species to be covered, trading units, base year and targets • Allowance distribution, monitoring and reporting, geographical scope (e.g. de minimis clause to exclude small emitters) and linkages to other ETSs • CBDR principle (e.g. setting differentiated goals on different routes, adopting a phased-in approach, selective distribution of funds etc) • Revenue distribution and ICAO's involvement (e.g. implemented by States or regions without ICAO mandatory framework, global scheme under sectoral approach by ICAO, implemented by States or regions under an ICAO framework).
Revenue potential	Depends on the cap set, and the price of allowances.

2. Emission Charge	
Description	Charge levied on fuel or on passenger with revenue directed to common pool.
Reference	GIACC/3–WP/3, GIACC/4-WP/3, GIACC/4-IP/8
Issues under consideration	• Charge incidence, amount and implementation details • Use of funds collected, process for disbursement • Integration with other measures.
Revenue potential	Depends on the charge amount.

3. Accredited Offset Schemes	
Description	Measures to facilitate purchase of carbon credits by organisation or individuals to offset emissions from air travels.
Reference	CAEP/8–IP/25, CAEP/8–WP/80
Issues under consideration	• Standards and verification of offset credits • Offsetting activities, retirement and cancellation of offset credits • Basis of offsetting - Passenger based offsetting, airline based offsetting, offsetting funded by emission charge.
Revenue potential	*To be studied*

MARITIME — MARKET-BASED MEASURES

1. Emission Trading Scheme	
Description	Cap on total emissions of shipping sector. Ships acquire emission allowances to operate. The amount of emission allowances will have to correspond to a ship's bunker consumption and be periodically surrendered. A fund is generated by the auctioning of emission allowances.
Reference	MEPC 60/4/22, MEPC 60/4/26, MEPC 60/4/41, MEPC 60/4/43, MEPC 60/4/54
Issues under consideration	• Setting of emissions cap, allocation of emission allowances, monitoring, reporting and verification (MRV) considerations, administrative issues, • Links with the global carbon market, possible coverage and participation • How funds raised may be managed • Impact on various actors in the shipping sector (e.g. owners, operators, manager and charterer), impact on different product groups (e.g. agriculture, raw materials, crude oil, manufactures), and impact on different

	regions and groups of countries
Revenue potential	US$20bn annually according to MEPC 60/4/41, or US$15 to $30bn annually according to MEPC 60/4/54, depending on the cap set, and the price of shipping allowances.

2. International fund (Charge on bunker purchases)	
Description	Charge applicable to each tonne of bunker fuel purchased. Charges accrue to an international fund.
Reference	MEPC 60/4/8, MEPC60-Inf.7, MEPC 59/4/5; MEPC 58/4, MEPC 58/23, MEPC 58/4/22, MEPC 58/INF.14; GHG-WG 1/5/1; MEPC 57/21, MEPC 57/4/4 and MEPC 57/INF.13.
Issues under consideration	• Collection of payment from bunker fuel suppliers or shipowners and corresponding obligations required of parties • Responsible entity to administer the GHG fund • Whether GHG contributions should be conceived as a tax • How to meet a global reduction target, the level of GHG contributions and how revenue could be allocated
Revenue potential	Between USD$49 - 9,149m depending on the estimated growth in trade and CDM prices.

3. Leveraged incentive scheme	
Description	Contribution to be collected from all ships based on quantity of fuel purchased. Individual ship may voluntary monitor and record its performance. For good performance, there may be a refund of a part of the contribution that is already paid. Third parties could verify ship's performance and oversee the applications for refunds.
Reference Issues under consideration	MEPC 60/4/37, GHG-WG 1/5/4, MEPC 59/4/34, MEPC 59/4/35, MEPC 60/4/35 and MEPC 60/4/36. Consideration for international fund plus criteria for performance appraisal of ships and functioning of refund mechanism.
Revenue potential	*To be studied*

4. Trading of efficiency credits	
How this may	Develop required efficiency index standards for ships. Have each ship

work	calculate its attained efficiency. Ships whose attained efficiency index exceed the required efficiency index standards may sell their efficiency credit surplus to ships whose attained efficiency index falls short of the required efficiency index standards.
Reference	MEPC 60/4/12, MEPC 59/4/48.
Issues under consideration	• How required efficiency standards may be established • Relationship between the Economic Efficiency Design Index (new ship) and the required efficiency index standards • How a ship could calculate its attained efficiency index and efficiency credits, options for compliance and how efficiency credits could be traded, purchased or sold
Revenue potential	*Not relevant*

5. Vessel Efficiency System	
Description	Establish efficiency design standards for new and existing types of vessels according to ship classes and sizes. For new ships, a mandatory efficiency standard which may be tiered over time is applicable (e.g. x% by year 20xx, y% by year 20YY). For existing ships, less stringent efficiency standards will apply. Charges will be levied on existing vessels which fail to meet the applicable standard. More inefficient vessels will pay more according to a sliding scale. Standards for new builds will be mandatory, and new builds will not be subjected to charge as they would be certified as being in compliance.
Reference	MEPC 60/4/39
Issues under consideration	• Determining efficiency design standards and applicable penalty charges.
Revenue potential	*To be studied*

6. Port levy	
Description	All countries levy a globally uniform emission charge on all vessels calling at their respective ports. The charge would be based on the emission generated from the last port of call. Emission is calculated based on travel distance and predetermined factors which vary according to vessel specifications.
Reference	MEPC 60/4/40
Revenue potential	*To be studied*

7. Contribution in proportion to global emissions	
Description	International shipping contributes to the amount required for climate change action, in accordance to its contribution to global emissions that was calculated to be 2.7%.
Reference	MEPC 60/4/10
Revenue potential	2.7% of amount of money required

8. Rebate Mechanism	
Description	Each developing country party to the UNFCCC to obtain an unconditional payment (rebate) equal to the cost incurred due to the maritime market based instrument. The amount of rebate would be calculated annually in proportion to a key. The proposed key is a country's share of global imports by value. A developing country Party could decide to forego the rebate, or a part of it, to provide additional flexibility to reflect differentiated national circumstances.
Reference	MEPC 60/4/55
Revenue potential	*To be studied*