

CLIMATE STRATEGIES



Linking Emissions Trading Schemes for International Aviation and Maritime Emissions

October 2008

AUTHOR

ERIK HAITES

MARGAREE CONSULTANTS



Acknowledgments

I would like to express my appreciation to Michael Mehling and Andre Stochinol for constructive comments on previous drafts. Work on this paper was partially supported by funding from Climate Strategies.

Abstract

International aviation and maritime emissions must be addressed if global emissions are to be reduced. They can be regulated by implementing a global emissions trading or emissions fee regime for each sector. Such policies can be implemented in ways that minimize adverse impacts on vulnerable developing countries. Those policies also can raise substantial funds for emission reduction measures in the sectors and for mitigation and/or adaptation measures in developing countries. If trading schemes are established for international aviation and maritime emissions, the administrator of each trading scheme could establish a unilateral or bilateral link with another scheme. The best candidate for a unilateral link would be the Clean Development Mechanism. A bilateral link would be much more difficult to implement because the schemes must be “compatible” and an international treaty likely would be needed. The best candidate for a bilateral link would be the EU ETS. If international aviation and shipping are net buyers of allowances as expected, a unilateral link may be sufficient as it would moderate the price of the international aviation/maritime allowances.

Contact

Erik Haites
President
Margaree Consultants
Tel: +1 416 369 0900
E-mail: EHaites@margaree.ca

TABLE OF CONTENTS

1	Scale of the Emissions	1
2	Attempts to Manage International Aviation and Maritime Emissions	1
3	Consequences of Differential Regulation of International Aviation and Maritime Emissions	2
4	Managing International Aviation and Maritime Emissions	3
4.1	Regulating International Aviation Emissions	4
4.2	International Aviation Emissions in the EU Emissions Trading Scheme	5
4.3	Regulating International Maritime Emissions	7
4.4	International Maritime Emission Reduction Scheme	7
5	Linking for International Aviation Emissions	8
5.1	Links among National Trading Schemes	8
5.2	A Unilateral Link of a Trading Scheme for International Aviation with another Scheme	10
5.3	A Bilateral Link of a Trading Scheme for International Aviation with another Scheme	11
5.4	Summary	13
6	Linking for International Maritime Emissions	14
6.1	Links among National Trading Schemes	14
6.2	A Unilateral Link of a Trading Scheme for International Shipping with another Scheme	15
6.3	A Bilateral Link of a Trading Scheme for International Shipping with another Scheme	15
6.4	Summary	16
7	Conclusions	17
8	References	19

1 Scale of the Emissions

International aviation and maritime emissions are large and growing rapidly. Estimates of carbon dioxide emissions by international aviation for 2000 range between 400 and 675 MtCO₂.ⁱ Emissions of other contaminants at altitude by aircraft exacerbate their climate impact by a factor of 1.7 to 5.1.ⁱⁱ Estimates of carbon dioxide emissions by international shipping range between 425 and 900 MtCO₂.ⁱⁱⁱ

Emissions have been growing at 2% to 6% per year for the past 15 years and are projected to continue to grow at rates in this range for at least the next 15 years. Aviation emissions are projected to grow more rapidly than maritime emissions.

Based on CO₂ emissions alone, international aviation and maritime emissions would rank as the sixth largest emitter among the countries of the world, between Japan and Germany. If the effects of other aircraft emissions are included, international aviation and maritime emissions would move ahead of Japan into fifth place.

Stabilization of the atmospheric concentration of greenhouse gases requires that global emissions be significantly reduced. Due to the magnitude and projected rapid growth of international aviation and maritime emissions it will not be possible to stabilize atmospheric concentrations of greenhouse gases without regulating these emissions.

2 Attempts to Manage International Aviation and Maritime Emissions

Efforts to address emissions from international aviation and maritime transport under the Kyoto Protocol have not been successful. The Protocol commits Annex I Parties to pursue limitation or reduction of emissions from aviation and maritime bunker fuels through the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO).^{iv}

This led to discussions on how to allocate international aviation and maritime emissions to Parties. And it led to the presumption that the emissions attributed to Annex I Parties would be regulated while those attributed to non-Annex I Parties would not be regulated consistent with the principle of common but differentiated responsibilities as applied to national emissions.

Options identified for allocating international aviation and maritime emissions to Parties are:^v

1. No allocation
2. Allocation of global emissions from bunker fuels to Parties in proportion to their national emissions
3. Allocation to Parties according to the country where the bunker fuel is sold
4. Allocation to Parties according to the nationality of the transporting company, the country where the aircraft or vessel is registered, or the country of the operator
5. Allocation to Parties according to the country of departure or destination of an aircraft or vessel or shared between the countries of departure and arrival
6. Allocation to Parties according to the country of departure or destination of passenger or cargo or shared between the countries of departure and arrival
7. Allocation to Parties according to the country of origin of the passenger or owner of the cargo
8. Allocation to the Party of emissions generated its national space

Options 5 through 8 are considered to be less practical because of data requirements or their inadequate global coverage.

Despite more than ten years of discussions, there has been no progress on a method of allocating international aviation and maritime emissions to Parties. Countries with significant international aviation or shipping interests resist this approach. Those in Annex I insist that a global approach is needed for environmental effectiveness and economic efficiency. The non-Annex I countries stress the importance of the principle of common but differentiated responsibilities.

3 Consequences of Differential Regulation of International Aviation and Maritime Emissions

An allocation of emissions to Parties followed by differential regulation of the emissions attributed to Annex I and non-Annex I Parties will induce behavior that reduces the effectiveness of the regulations. Regulation of the emissions allocated to Annex I Parties will increase the cost faced by the vessels and aircraft affected.

Under option 3, for example, bunker fuel sold in Annex I Parties would be more costly than fuel sold in non-Annex I Parties because Annex I Parties would need to regulate the emissions associated with the fuel use. This would shift fuel purchases to non-Annex I Parties and lead to increased transport of fuel purchased there – tankering -- thus reducing the effectiveness of the Annex I regulations to limit emissions.

Under option 4 international emissions by aircraft and ships owned by Annex I Party companies would face regulations while the emissions by non-Annex I Party aircraft and ships would not be regulated. The country of ownership can be changed easily for vessels, so ships could easily avoid the regulations. Airlines have less flexibility to change nationality. But Annex I and non-Annex I airlines often fly the same route, so regulation of the Annex I airline would shift traffic to non-Annex I airlines.

Differential regulation of the international emissions attributed to Annex I and non-Annex I Parties induces behaviour that shifts emissions from Annex I to non-Annex I Parties and hence reduces the effectiveness of the efforts to limit emissions due to leakage. Such behaviour may be economically inefficient as well.

Consistent treatment of all international aviation and shipping emissions is the only way to avoid the leakage and economic inefficiency due to differential regulation. Consistent treatment does not require an allocation of international emissions to countries.

4 Managing International Aviation and Maritime Emissions

A different approach to regulating international aviation and maritime emissions is needed as part of a post-2012 agreement. International aviation and maritime emissions should be treated as sectors with their own regulatory regimes. In effect this is option 1; no allocation. It reflects the accounting principle of the Convention that each country is responsible for the emissions that occur on its territory. The international aviation and maritime emissions occur mainly in international territory and hence should be addressed separately rather than being allocated to Parties.

The principle of common but differentiated responsibilities can be addressed by establishing regulatory regimes that raise revenue – emissions fees or auctioned allowances – and use it for climate change mitigation or adaptation in developing countries. Most of the revenue raised would come from developed country residents. The revenue transfers would provide much larger economic benefits to developing countries than exemption from regulation of allocated emissions, although the distribution would be different. Additionally, a global approach that differentiates emission obligations based on the origin or destination of the goods or passengers could be implemented.

Treating international aviation and maritime emissions as two separate sectors provides uniform global regulation of each sector. Then there is minimal scope for adjusting behavior to avoid the regulation with the consequent economic distortions and emissions leakage. Aviation and maritime emissions are better regulated separately because the institutional structures (ICAO and IMO), the opportunities for emissions reductions, the

compliance entities, the enforcement mechanisms, and the growth rates are different. It may also be feasible in the future to address the full climate impact of aircraft in the regulations for that sector.

A technical workshop on emissions from international aviation and maritime transport in Oslo in October 2007 concluded that no technical obstacles related to monitoring and reporting of emissions remain that can not be solved so the absence of global policies is due to lack of political will rather than technical difficulties.^{vi}

4.1 Regulating International Aviation Emissions

ICAO has studied alternative policies to regulate international aviation emissions. It has concluded that emissions trading with the option of buying additional credits from non-aviation sources, such as the CDM, is the preferred policy.^{vii} ICAO has not been able to agree on steps to implement such a policy. At its September 2007 Assembly, ICAO initiated two more years of studies without agreeing to any concrete action to reduce emissions.^{viii}

International aviation is governed by the Chicago Convention (1944) and thousands of bilateral air service agreements. The Convention and most of those agreements prohibit the imposition of taxes on fuel consumed for international travel.

An emissions trading scheme for international aviation implemented by ICAO or some other institution is technically feasible. An emissions cap would be established for the sector. Airlines could use international aviation allowances or Kyoto units, such as CDM credits, for compliance. Countries would agree to collect data on fuel sales by airline for international flights and to cooperate with compliance enforcement actions.^{ix} Each airline would report its CO₂ emissions (based on its fuel use) and remit the necessary allowances and credits annually.

Some or all of the international aviation allowances could be auctioned. Revenue from the auction could be used to fund emissions reduction measures in the aviation industry as well as mitigation and/or adaptation measures in developing countries. The UNFCCC estimates that auctioning allowances equal to the projected international aviation emissions could generate revenue of US\$10 billion in 2010, rising to \$15 billion in 2020.^x

To assist countries that are highly dependent on air service, such as small island nations highly dependent on international tourism, the emissions trading system could include a threshold exemption for all airlines.^{xi} That is very different from exclusion of flights to/from all developing countries, which would benefit mainly a small number of relatively wealthy countries with large international air hubs, such as Singapore, Hong Kong, and Dubai.

The importance of including the international emissions of all major airlines in the emissions trading scheme is shown in Table 1. It shows that six of the twenty largest airlines in terms of international revenue tonne kilometers in 2007 were based in developing countries: Singapore International Airlines, Cathay Pacific, Emirates, Korean Air, Thai Airways and Malaysian Airlines.

4.2 International Aviation Emissions in the EU Emissions Trading Scheme

The European Union proposes to incorporate international aviation emissions into its emissions trading scheme (EU ETS). That proposal would require airlines to remit allowances to a designated member state for the emissions associated with flights to, from and within the European Union beginning in 2012.^{xii} The allocation for international aviation would be 97 per cent of average 2004-06 emissions for 2012 and 95 per cent for 2013. Airlines would receive 85 per cent of the allocated allowances free with the remainder being auctioned by the member states. For subsequent years, the cap likely would be reduced and the share of allowances auctioned likely would rise.

Industrial sources covered by the EU ETS can use EU allowances (EUAs), certified emission reductions (CERs) generated by Clean Development Mechanism (CDM) projects and emission reduction units (ERUs) generated by Joint Implementation (JI) projects for compliance. Separate aviation allowances (AAs) would be created for international aviation. Airlines would be able to use AAs, EUAs, CERs, and ERUs for compliance, but industrial sources would not be allowed to use AAs for compliance. Several industry associations and the US government have expressed their opposition to the proposal.^{xiii} Legal challenges could thus delay, modify or even prevent inclusion of international aviation emissions in the EU ETS as proposed.

Table 1: Twenty Largest Airlines in Terms of 2007 International Revenue Tonne Kilometres

Air Carrier		Total Revenue Tonne Kilometres (000 000)	Passengers Tonne Kilometres (000 000)
1	Lufthansa	20,449,960	11,780,614
2	Air France	17,018,157	10,742,386
3	Singapore International Airlines	15,979,484	7,956,077

4	Cathay Pacific	15,560,421	7,265,576
5	Emirates	14,244,633	8,647,699
6	KLM	12,357,608	7,448,787
7	British Airways	12,322,202	7,856,023
8	Korean Air	11,747,655	4,898,520
9	JAL	9,866,287	5,398,359
10	American	9,824,159	7,384,201
11	United	9,630,636	7,184,186
12	Qantas	8,019,473	5,591,103
13	Thai Airways	7,783,856	5,265,360
14	Northwest	7,097,057	4,859,324
15	Delta	7,022,183	5,743,212
16	Federal Express	6,706,061	0
17	Continental	6,277,859	5,158,220
18	Air Canada	6,149,127	5,053,569
19	Malaysian Airlines	5,987,765	3,402,772
20	Cargolux	5,512,023	0
Sum for 20 airlines		209,556,606	121,635,988
Share of global total		53.97%	50.42%
Notes: Total Revenue Tonne Kilometres includes Passenger Tonne Kilometres.			
Global total may not be complete.			
Source: ICAO data provided by Reed Business Information Limited, September 19, 2008.			

4.3 Regulating International Maritime Emissions

IMO also has studied policies to reduce greenhouse gas emissions from shipping but has not yet implemented any measures to reduce emissions. The Maritime Environmental Protection Committee (MEPC) aims to identify and further develop options to make recommendations to the UNFCCC Conference of the Parties in 2009.

An emissions trading regime, similar to that described above for aviation, could be established for international shipping. Fuel payers, typically charterers, would be responsible for remitting allowances for the CO₂ emissions calculated from the fuel used. Data on fuel use would be provided independently by the ship managers and/or fuel suppliers. The UNFCCC estimates that auctioning allowances equal to the projected international maritime emissions could generate revenue of US\$12 billion in 2010, rising to \$13 billion in 2020.^{xiv}

4.4 International Maritime Emission Reduction Scheme

An alternative regime proposed for international shipping is the International Maritime Emission Reduction Scheme (IMERS).^{xv} An emission cap for all destinations with emission reduction commitments (currently Annex I Parties) would be established. An emissions charge would be established.^{xvi} The charge would be collected based on fuel use and cargo destination.^{xvii} Fuel data would be extracted from obligatory fuel receipts^{xviii} or ship managers' reports on fuel use. The charge would be paid by the fuel payers, typically charterers, monthly. The liable entity is the ship and the scheme is enforced through port state control in Annex I Parties.

The revenue would go to a supra-national fund established under the International Maritime Organization (IMO) and be used to:

- Invest in maritime technology transfer and stimulate longer term technology transformation;
- Purchase CO₂ credits equal to the actual emissions in excess of the established emissions cap; and
- Contribute to climate change adaptation in developing countries.

A charge of US\$10 per tonne of CO₂ would raise about \$6 billion annually from 2012 and increase shipping costs to Annex I Parties by about 3 per cent.^{xix} This is equivalent to an extra \$1 for every \$1,000 of goods imported by Annex I Parties. There is no impact on imports by Non-Annex I Parties.

The scheme is both global (as per the IMO) in that it applies to all ships irrespective of flag and nationality and differentiated (as per the UNFCCC) in that the charge applies only to the emissions associated with cargo destined for Annex I Parties.

5 Linking for International Aviation Emissions

Emissions from international aviation can be covered by emissions trading schemes in one of the following ways:

- One or more national emissions trading schemes, such as the EU ETS, that cover some international aviation emissions as well as emissions by other sources.
- An emissions trading scheme, possibly administered by ICAO that covers some or all international aviation emissions.

A trading scheme that covers international aviation emissions could have a unilateral or a bilateral link with one or more trading schemes covering other emission sources.

This section therefore discusses options for the following cases:

- Links among national emissions trading schemes that cover some international aviation emissions.
- A unilateral link between a trading scheme for international aviation emissions and a trading scheme for other sources.
- A bilateral link between a trading scheme for international aviation emissions and a trading scheme for other sources.

5.1 Links among National Trading Schemes

If international aviation emissions are covered by a national trading scheme, the international aviation sector would be linked with the other sectors unless there are internal barriers or gateways that restrict transfers to/from the international aviation sector. National emissions trading schemes could cover international aviation emissions in different ways. Regardless of how a national trading scheme covers international aviation emissions it could establish unilateral or bilateral links with other trading schemes.

Only the EU ETS has a specific proposal to incorporate international aviation emissions into a national trading scheme. The EU ETS already has unilateral links to the Clean Development Mechanism and Joint Implementation. These links would be available to the airlines covered by the EU ETS and should limit the price for aviation allowances.^{xx} Since other sources would not be allowed to use AAs, developments in other sectors would have a limited effect on the compliance costs for airlines.^{xxi} Growth in demand for allowances by airlines could increase the price of allowances for industry.

The EU has expressed interest in linking its ETS with other national schemes. If such links are established, the international aviation sector in the EU ETS would be linked with the other national schemes directly or indirectly. If the linking agreement allows the airlines subject to the EU ETS to use the units of the linked scheme, e.g. New Zealand allowances, for compliance there would be a direct link.^{xxii} If the linking agreement does not change the list of allowances that airlines can use for compliance, there would be an indirect link due to the impact on the price of EUAs.^{xxiii}

If coverage of international aviation emissions by the EU ETS is implemented, other national emissions trading schemes may also implement coverage of such emissions. The opportunity to capture some of the auction revenue collected by EU member states would provide an incentive for such expansion. Flights between the EU and Switzerland would be covered by the EU ETS and some EU member states would collect revenue for auctioned allowances purchased by airlines serving those routes. The opportunity to collect some of that revenue might induce the Swiss government to include international aviation in its emissions trading scheme.

Other national trading schemes might use a different approach to cover international aviation emissions. The New Zealand scheme, for example, plans to cover transportation emissions by requiring fuel refiners and importers to hold allowances for the carbon content of the fuel. A simple way to expand the scheme to cover international aviation emissions would be to make the same entities responsible for the carbon content of the fuel sold to airlines as well.

Although national schemes might agree to coordinate coverage of international aviation emissions, different approaches might make this difficult in practice.^{xxiv} For example, airlines that are below the threshold for the EU ETS would be covered indirectly by a scheme based on the carbon content of the aviation fuel sold. Differences in the share of allowances auctioned also could remain, but the scheme participants would seek to pass on the market value of the allowances whether they are allocated free of charge or auctioned.^{xxv}

In summary, if international aviation emissions are covered by a national trading scheme the international aviation sector is likely to be linked with the other sectors covered by the scheme. If the national scheme is linked with other schemes, the international aviation sector will be linked with those other schemes directly or indirectly. Revenue from the sale of allowances for international aviation emissions creates an incentive for national trading schemes to extend their coverage to those emissions. Coordinating coverage of international aviation emissions among national trading schemes might prove difficult in practice.

5.2 A Unilateral Link of a Trading Scheme for International Aviation with another Scheme

A trading scheme that covers some or all international aviation emissions could establish a unilateral link with one or more other trading schemes. The question is which scheme(s) to link with. The options are:

- The Clean Development Mechanism
- A national trading scheme in a country with an emissions limitation commitment under the Kyoto Protocol, such as the EU ETS or Swiss emissions trading scheme
- A trading scheme not linked with the Kyoto Protocol, such as RGGI or the Chicago Climate Exchange

The choice of scheme(s) with which to link depends on:

- The perceived quality of the allowances of the target scheme.
- The ease of establishing a link with the target scheme.
- The size of the target scheme relative to the projected demand for external allowances by the trading scheme for international aviation emissions.

At present, Kyoto units are perceived to have the highest quality, suggesting a link with the Clean Development Mechanism or a national scheme in a country with an emissions limitation commitment under the Kyoto Protocol. Most existing and proposed national trading schemes have or plan a link with the CDM.

Establishing a unilateral link with the Clean Development Mechanism or most schemes not linked with the Kyoto Protocol is simple.^{xxvi} To be credible, a link with a national trading scheme in an Annex I Party would need to ensure that purchased allowances led to acquisition and cancellation of Kyoto units equal to the allowances used for compliance by participants in the international aviation scheme.^{xxvii} That might require the cooperation of the Annex I Party, which could make implementation of a unilateral link similar to implementation of a bilateral link.

At present only the EU ETS and the Clean Development Mechanism would likely be large relative to the projected demand for external allowances by the trading scheme for international aviation emissions. A national trading scheme in the United States would also fall into that category. Unilateral links with a number of smaller schemes could meet the projected demand for external allowances by the trading scheme for international aviation emissions as well.

In summary, the best candidate for a unilateral link is the Clean Development Mechanism due to the perceived quality of the allowances, the ease of establishing a link, and its relatively large supply of allowances. A link with a large national scheme in a Kyoto Protocol country, such as the EU ETS, is second choice, but it might require the cooperation of the relevant government(s). A national trading scheme in the United States might be a candidate in the future.

5.3 A Bilateral Link of a Trading Scheme for International Aviation with another Scheme

A trading scheme that covers some or all international aviation emissions could establish a bilateral link with one or more other trading schemes. The options are:

- A national trading scheme in a country with an emissions limitation commitment under the Kyoto Protocol, such as the EU ETS or Swiss emissions trading scheme
- A trading scheme not linked with the Kyoto Protocol, such as RGGI or the Chicago Climate Exchange.

The Clean Development Mechanism is a mechanism that generates credits that can be used for compliance in other trading schemes, so a bilateral link with the CDM is not an option.

The choice of scheme(s) with which to link depends on the same considerations as for a unilateral link -- perceived quality of the allowances, ease of establishing the link, and size of the target scheme relative to the projected demand for external allowances by the trading scheme for international aviation emissions. Size considerations suggest that the preferred candidates are likely to be the EU ETS and a national scheme in the United States.

To ensure that a bilateral link does not compromise the environmental integrity of the linked schemes, the scheme for international aviation emissions and the other scheme(s) must be sufficiently “compatible”. Much of the literature on linking trading schemes focuses on the question of the “compatibility” of the schemes proposed to be linked (see, e.g., Baron and Bygrave, 2002; Haites 2003; Haites and Mullins, 2001; Jaffe and Stavins, 2008; Mace et al., 2008; Sterk et al., 2006; Springer et al., 2006). Technical considerations require harmonization of only a relatively small number of provisions, such as a price cap. However, harmonization of several other provisions, such as allocation of allowances and use of offsets, is desirable and possibly essential for political reasons (Mace et al. 2008).

A trading scheme for international aviation would have some unique features, which could affect the willingness of other schemes to agree to a bilateral link. These include:

- The climate change impacts of aviation emissions
- The status of the international aviation allowances

Aviation emissions have climate change impacts in addition to those due to the CO₂ emissions. It is technically difficult to include the non-CO₂ effects such as NO_x, contrails and water vapour in a trading scheme due to scientific uncertainties related to these effects, their duration, and their variability over time and location.^{xxviii} Thus aviation allowances for CO₂ emissions implicitly permit a larger climate change impact. Other schemes might be reluctant to establish a bilateral link with an international aviation trading scheme because of the difference in the climate change impacts associated with their respective allowances.

Most emissions trading schemes for greenhouse gases are intended to help the country meet a national emissions limitation commitment under the Kyoto Protocol. It is important for such trading schemes that the allowances transferred between linked schemes be Kyoto units. The allowances used by a separate international aviation emissions trading scheme would not be Kyoto units unless there was an agreement concluded under the UNFCCC. A mechanism that allows the international aviation emissions trading scheme to issue Kyoto units is likely to be a prerequisite for a bilateral link with any scheme in an Annex I Party.

A bilateral link would require an agreement between the regulatory authorities of the two schemes. The agreement must balance the competing objectives of “leaving each government with sovereignty over its own scheme while providing linking partners adequate authority to influence those changes in linked schemes that would materially affect their own scheme” (Jaffe and Stavins, 2008). The fact that the schemes are located in different jurisdictions raises legal issues that vary with the jurisdictions involved.^{xxix}

Where divergent interests and other uncertainties generate demand for predictability and stability a binding agreement will be preferred. A bilateral link is most likely to involve a binding agreement between an organization entrusted with the operation of a trading scheme for international aviation emissions and a trading scheme established by a sovereign state or an organization of regional economic integration, such as the EU. Such an agreement will typically be an international treaty.

A treaty must reflect the consent to be bound, as expressed by “signature, exchange of instruments constituting a treaty, ratification, acceptance, approval or accession, or by any other means if so agreed”. It will also call for observance of formal procedures set out in the constitutions and establishing treaties of the parties to the agreement. Because a linking agreement, once entered as a treaty, is binding on the regulatory authority in each jurisdiction, it cannot be unilaterally amended or terminated unless allowed by the treaty itself. Its breach can result in consequences specified in the agreement or under general international law, including countermeasures and retorsion. It follows that such an agreement merits careful design.

Aside from a provision specifying the mutual recognition of allowances a bilateral linking agreement will also need to include:

- Provisions to address specific legal issues such as competency and equivalence.
- A mechanism to provide assurance of the environmental effectiveness of each of the linked schemes.
- A process for agreeing on revisions to the regulations of the linked schemes.
- A process to resolve disputes arising under the agreement.
- A procedure for terminating the linking agreement (Haites and Wang, 2008; Mace et al., 2008).

All these should be preferably included in the agreement from the outset because unilateral amendments are no longer possible once the agreement takes effect, and changes thus require a renegotiation process between the parties to the agreement.

5.4 Summary

If international aviation emissions are covered by a national trading scheme the international aviation sector is likely to be linked with the other sectors covered by the scheme. If the national scheme is linked with other schemes, the international aviation sector will be linked with those other schemes directly or indirectly.

If international aviation emissions are covered by a separate trading scheme, it could have a unilateral or a bilateral link with one or more trading schemes covering other emission sources.

For a unilateral or bilateral link, the choice of scheme(s) with which to link depends on:

- The perceived quality of the allowances of the target scheme.
- The ease of establishing a link with the target scheme.
- The size of the target scheme relative to the projected demand for external allowances by the trading scheme for international aviation emissions.

Based on these criteria, the best candidate for a unilateral link is the Clean Development Mechanism. A link with a large national scheme in a Kyoto Protocol country, such as the EU ETS, is second choice, but it might require the cooperation of the relevant government(s).

A unilateral link is much easier to implement than a bilateral link. A bilateral link requires that the schemes be “compatible” while a unilateral link does not. A bilateral link is likely to require an international treaty, while a unilateral link likely can be implemented without a formal agreement. Other schemes might be reluctant to link with an international aviation trading scheme because of the difference in the climate change impacts associated with

their respective allowances. A mechanism that allows the international aviation emissions trading scheme to issue Kyoto units is likely to be a prerequisite for a bilateral link with most other schemes.

If international aviation is a net buyer as expected, a unilateral link may be sufficient. A bilateral link would allow the sale of surplus allowances to participants in the other scheme, but if there are no surplus aviation allowances this is irrelevant. A unilateral link would allow the purchase of additional allowances by participants in the international aviation scheme. A unilateral link also would moderate the price of allowances in the international aviation scheme.^{xxx}

6 Linking for International Maritime Emissions

Emissions from international shipping can be covered by emissions trading schemes in the same ways as those from international aviation. This section therefore discusses options for the following cases:

- Links among national emissions trading schemes that cover some international maritime emissions.
- A unilateral link between a trading scheme for international maritime emissions and a trading scheme for other sources. This case includes the IMERS proposal which would purchase CERs to cover emissions beyond the cap.
- A bilateral link between a trading scheme for international maritime emissions and a trading scheme for other sources.

6.1 Links among National Trading Schemes

No national trading scheme has yet proposed to cover international maritime emissions.^{xxxi} If international maritime emissions are covered by a national trading scheme, the international shipping sector would be linked with the other sectors unless there are internal barriers or gateways that restrict transfers to/from the shipping sector. National emissions trading schemes could cover international maritime emissions in different ways. Regardless of how a national trading scheme covers international maritime emissions it could establish unilateral or bilateral links with other trading schemes.

If international maritime emissions are covered by a national trading scheme the international shipping sector is likely to be linked with the other sectors covered by the scheme. If the national scheme is linked with other schemes, the international shipping sector will be linked with those other schemes directly or indirectly. Revenue from the sale of allowances for international maritime emissions creates an incentive for national trading schemes to extend their coverage to those emissions. Coordinating coverage of

international maritime emissions among national trading schemes might prove difficult in practice.

6.2 A Unilateral Link of a Trading Scheme for International Shipping with another Scheme

A trading scheme that covers some or all international shipping emissions could establish a unilateral link with the CDM, a national trading scheme in an Annex I Party, or a trading scheme not linked with the Kyoto Protocol. The choice of scheme(s) with which to link depends on the same criteria s discussed in section 5.2 for aviation.

As discussed for international aviation, the best candidate for a unilateral link is the CDM due to the perceived quality of the allowances, the ease of establishing a link, and its relatively large supply of allowances. A link with the EU ETS is second choice, but might require the cooperation of the relevant government(s). A national trading scheme in the United States might be a candidate in the future.

The International Maritime Emission Reduction Scheme (IMERS) would implement a charge on the CO₂ emissions from international shipping based on fuel use. The fees collected would go to a fund established under the IMO. The fund would purchase CERs equal to the actual emissions in excess of the established emissions cap. This is equivalent to a unilateral link to the CDM.

6.3 A Bilateral Link of a Trading Scheme for International Shipping with another Scheme

A trading scheme that covers some or all international shipping emissions could establish a bilateral link with one or more other trading schemes. The choice of scheme(s) with which to link depends on the same considerations as for a unilateral link. Size considerations suggest that the preferred candidates are likely to be the EU ETS and a national scheme in the United States. A bilateral link with the CDM is not an option.

To ensure that a bilateral link does not lead to higher emissions, the scheme for international aviation emissions and the other scheme(s) must be sufficiently “compatible”. Technical considerations require harmonization of only a relatively small number of provisions, such as a price cap. However, harmonization of other provisions, such as the use of offsets, is desirable and possibly essential for political reasons. A mechanism that allows the international maritime emissions trading scheme to issue Kyoto units is likely to be a prerequisite for a bilateral link with any scheme in an Annex I Party.

A bilateral link would require an agreement between the regulatory authorities of the two schemes. Since the schemes are in different jurisdictions, such an agreement will typically

be an international treaty. An international treaty would be difficult to implement and change so it would need to be carefully drafted to cover all eventualities.

6.4 Summary

If international maritime emissions are covered by a national trading scheme the international shipping sector is likely to be linked with the other sectors covered by the scheme. If the national scheme is linked with other schemes, the international shipping sector will be linked with those other schemes directly or indirectly.

If international maritime emissions are covered by a separate trading scheme, it could have a unilateral or a bilateral link with one or more trading schemes covering other emission sources. The best candidate for a unilateral link is the CDM.

The best candidate for a bilateral link is the EU ETS with a national trading scheme in the United States being a future possibility. A bilateral link is much more difficult to implement than a unilateral link because it is likely to require an international treaty and some degree of “compatibility” of the provisions of the schemes.

If international shipping is a net buyer as expected, a unilateral link may be sufficient. A unilateral link would allow participants in the international shipping scheme to purchase additional allowances from the linked scheme and hence moderate the price for the international maritime allowances. A unilateral link would not allow the sale of surplus maritime allowances to other schemes, but if international shipping is a net buyer this is irrelevant.

7 Conclusions

International aviation and maritime emissions are too large and growing too rapidly to be ignored. Attempting to allocate the emissions to countries as a basis for regulation has failed.

These emissions can be regulated by treating them as separate sectors and implementing a global emissions trading or emissions fee regime for each sector. Those policies can be implemented in ways that minimize adverse impacts on vulnerable developing countries, which is very different than exempting all developing countries. Such policies can also raise substantial funds for emission reduction measures in the sectors and for mitigation and/or adaptation measures in developing countries. Most of the funds would come from developed countries and would benefit developing countries, which addresses the principle of common but differentiated responsibilities. Exclusion of air and ship traffic to/from all developing countries would benefit mainly a small number of relatively wealthy countries with large international airlines or shipping fleets.

The European Union proposes to incorporate the emissions associated with flights to, from and within member states into its emissions trading scheme beginning in 2012. That proposal might be extended to international shipping emissions beginning in 2013. Revenue from the sale of allowances for international aviation and maritime emissions would create an incentive for other national trading schemes to extend their coverage to those emissions. Coordinating coverage of international aviation emissions among national trading schemes might prove difficult in practice.

If international aviation and/or maritime emissions are covered by a national trading scheme the international aviation sector is likely to be linked with the other sectors covered by the scheme. If the national scheme is linked with other schemes, the international aviation and/or shipping sector will be linked with those other schemes directly or indirectly.

If trading schemes are established for international aviation and maritime emissions by organizations such as ICAO and IMO, the administrator of each trading scheme could establish a unilateral or bilateral link with another scheme. The choice of scheme(s) with which to link depends on:

- The perceived quality of the allowances of the target scheme.
- The ease of establishing a link with the target scheme.
- The size of the target scheme relative to the projected demand for external allowances by the trading scheme for international aviation emissions.

Based on these criteria, the best candidate for a unilateral link is the CDM. The EU ETS is the second choice, but a bilateral link may be the only option in that case. A national trading scheme in the United States might be a candidate in the future. Most trading schemes have or propose a unilateral link with the Clean Development Mechanism.

A unilateral link is easy to implement. The main benefit of a unilateral link is that the market price for allowances in the other scheme will moderate the price in the scheme establishing the link. The only risk is that the imported allowances do not correspond to actual emission reductions leading to higher total emissions. Thus the environmental integrity of the scheme with which the link is established is important.

A bilateral link is much more difficult to implement. It requires that the schemes be “compatible” and is likely to require an international treaty. The willingness of Annex I Party schemes to agree to a bilateral link with trading schemes for international aviation or shipping would be limited unless the allowances of those schemes are Kyoto units.

The best candidate for a bilateral link is the EU ETS. A national trading scheme in the United States might be a candidate in the future.

If international aviation and shipping are net buyers of allowances as expected, a unilateral link may be sufficient. A unilateral link would allow participants in those schemes to purchase additional allowances from the linked scheme(s). It also would moderate the price of the international aviation/maritime allowances. If a unilateral link is established, the CDM would be the best choice.

8 References and Notes

References

Baron, R., and Bygrave, S., 2002. *Towards International Emissions Trading: Design Implications for Linkages*. Organisation for Economic Co-operation and Development (OECD) and International Energy Agency (IEA), Paris, France.

Den Elzen, M.G.J., J.G.J. Olivier and M.M. Berk, 2007. *An Analysis of Options for Including International Aviation and Marine Emissions in a Post-2012 Climate Mitigation Regime*, MNP Report 500114007/2007, Netherlands Environmental Assessment Agency, Bilthoven.

Forster, P., K. Shine and N. Stuber, 2006. "It is Premature to Include Non-CO₂ Effects of Aviation in Emission Trading Schemes," *Atmospheric Environment*, Vol. 40, pp. 1117 – 1121.

Haites, E., 2003. *Harmonisation Between National and International Tradeable Permit Schemes: CATEP Synthesis Paper*. OECD, Paris, France.

Haites, E., and Mullins, F., 2001. *Linking Domestic and Industry Greenhouse Gas Emission Trading Schemes*. EPRI, International Energy Agency (IEA) and International Emissions Trading Association (IETA), Paris, France.

Haites, E., and Wang, X., 2008. "Ensuring the Environmental Effectiveness of Linked Emissions Trading Schemes Over Time," *MITI-Adaptation and Mitigation Strategies for Global Change*, Special Issue on Linking Domestic Emissions Trading Schemes (in press).

International Civil Aviation Organization (ICAO), 2007, ICAO Policy on Aviation Emissions, Working Paper A36-WP/39, ICAO, Montreal.

International Maritime Organization (IMO), 2008. Marine Environment Protection Committee (MEPC) - 58th session: 6 to 10 October 2008, Briefing 48, 13 October 2008. Available at: <http://www.imo.org/>

Jaffe, J. and Stavins, R., 2008. *Linkage of Tradable Permit Systems in International Climate Policy Architecture*, Discussion paper 08-07, The Harvard Project on International Climate Agreements, Harvard Kennedy School, September. Available at: http://belfercenter.ksg.harvard.edu/project/56/harvard_project_on_international_climate_agreements.html

Mace, M.J., Millar, I., Schwarte, C., Anderson, J., Broekhoff, D., Bradley, R., Bowyer, C., Heilmayr, R., 2008. *Analysis of the Legal and Organisational Issues Arising in Linking the*

EU Emissions Trading Scheme to other Existing and Emerging Emissions Trading Schemes, FIELD/IEEP/WRI, London, United Kingdom.

Mehling, M. and Haites, E., 2008. "Mechanisms for Linking Emissions Trading Schemes," Climate Policy, (forthcoming).

Sausen, R., I. Isaken, V. Grewe, D. Hauglustaine, D. Lee, G. Myhre, M. Kohler, G. Pitari, U. Schumann, F. Stordal and C. Zerefos, 2005. "Aviation Radiative Forcing in 2000: An Update on IPCC (1999)," *Meteorologische Zeitschrift*, Vol. 14 (4), pp. 555 – 561.

Springer, U., Oleschak, R., Suter, S., Forrister, D., and Youngman, R., 2006. *Linking Domestic Emissions Trading Schemes to the EU ETS*, TETRIS Deliverable. Ecoplan, Berne, Switzerland.

Sterk, W., Braun, M., Haug, C., Korytarova, K. and Scholten, A., 2006. *Ready to Link Up? Implications of Design Differences for Linking Emissions Trading Schemes*, Jet-Set Working Paper I/06. Wuppertal Institute, Wuppertal, Germany.

Stochniol, A., 2007. "A New Market-based CO₂ Emission Reduction Scheme," International Maritime Emissions Reduction Scheme (IMERS), London, July. Available at: <http://www.imers.org/>

Stochniol, A., 2008. "Global but Differentiated Principle for International Shipping and Climate Change," Draft 1.2, International Maritime Emissions Reduction Scheme (IMERS), London, July. Available at: http://www.imers.org/files/docs/Global_but_Differentiated_Principle.pdf

UNFCCC, 2007. *Investment and Financial Flows to Address Climate Change*, UNFCCC, Bonn.

Notes

ⁱ Den Elzen, et al., 2007, Box 2, p. 22.

ⁱⁱ Sausen, et al., 2005 and Forster, et al., 2006. The ratio of the total radiative forcing from aviation to the radiative forcing associated with aviation CO₂ emissions is often called the 'uplift factor'.

ⁱⁱⁱ Den Elzen, et al., 2007, Box 1, p. 18. The IMO (2008) reports the consensus estimate for 2007 emissions from international shipping as to 843 MtCO₂.

^{iv} Article 2, paragraph 2.

^v UNFCCC/SBSTA/1996/9/Add.2, pp. 20-22.

^{vi} <http://www.eea.europa.eu/highlights/no-technical-obstacles-to-bringing-international-aviation-and-shipping-under-post-kyoto-protocol>, Accessed September 22, 2008. See also the meeting website <http://www.eionet.europa.eu/training/bunkerfuelmissions> and the report on the workshop by the International Institute for Sustainable Development (IISD) at: <http://www.iisd.ca/YMB/sdosl/>.

^{vii} ICAO, 2007.

^{viii} The ICAO Council's Committee on Aviation Environmental Protection (CAEP) created a Market-Based Measures Task Force (MBMTF) with a mandate of scoping out several issues related to the use of market-based measures to address air emissions from the aviation sector.

^{ix} Data on fuel sales by airline from the fuel suppliers would provide an independent check of the emissions reported by the airlines. If an airline fails to comply, one or more countries may support enforcement measures such as impounding aircraft.

^x UNFCCC, 2007, Table 2, p. 204.

^{xi} For example, the first 0.5 or 1.0 million revenue tonne km could be exempt. This would exclude small carriers that serve only a few small countries. And the threshold exemption would allow larger carriers that serve the same countries to match the fares because the emissions would be exempt.

^{xii} Flights with total emissions of less than 5.7 tonnes would be excluded. Commercial airlines with emissions of less than 10,000 tonnes of CO₂ or who fly less than 243 flights into, out of or within the EU within a 4-month period would be exempt.

^{xiii} See <http://www.euractiv.com/en/climate-change/aviation-emissions-trading/article-139728>

^{xiv} UNFCCC, 2007, Table 2, p. 204.

^{xv} Stochniol, 2007 and Stochinol, 2008.

^{xvi} The emission charge would be announced at least one year in advance so that it could be incorporated into freight rates and be passed on to customers. The charge would be determined based on the prevailing forward carbon market price and the negotiated emission cap. The cap and the market, rather than a body that may be subject to outside influence, dictate the level of the charge.

^{xvii} Ships transporting goods to Annex I Parties pay 100% of the applicable emission charges while ships transporting goods to Non-Annex I Parties pay zero. About 60% of total emissions would be subject to the charge; the developed countries' share of world freight costs, as well as their share of unloaded goods are both approximately 60%.

^{xviii} These receipts are called Bunker Delivery Notes.

^{xix} The example of a \$10/tCO₂ charge was calculated for 2012 assuming 2.1% rate of emission growth, a goal of reducing emissions by 20% from 2005 by 2020, and a market price of \$30/tCO₂ for CERs.

^{xx} Projected emission reductions for international aviation in 2020 are about 200 million tonnes CO₂ and about 300 million tonnes CO₂ for other sectors. Thus, airlines would account for about 40 per cent of the total demand.

^{xxi} High growth in other sectors could reduce the supply of surplus EUAs, CERs and ERUs leading to a higher price for those units and for AAs.

^{xxii} Then airlines covered by the EU ETS would be able to use AAs, EUAs, CERs, ERUs and NZUs for compliance.

^{xxiii} The linking agreement would have an impact on the price of EUAs. Since airlines are allowed to use EUAs for compliance and are projected to be net buyers, the impact on the price of EUAs would also affect airlines.

^{xxiv} Assume that the EU and New Zealand agree that each will regulate half of the emissions for flights between them. A flight leaving New Zealand would have paid for the carbon content of the fuel purchased there as part of the price of the fuel. The EU would need to apply some or all of that implicit allowance purchase as a credit toward compliance with its requirement. For the return flight, New Zealand would collect no revenue. As a result there might need to be financial transfers from the relevant EU member state to New Zealand. The amount would be affected by the share of allowances issued free by the EU ETS.

^{xxv} The fuel suppliers are likely to increase the price of the fuel sold to reflect the market value of the allowances needed for compliance. The effect for the airline is similar to buying the necessary allowances. The EU ETS might continue to distribute a portion of the allowances free to airlines, but they are likely to increase their fares to reflect the market value of the allowances, regardless of whether they were purchased or received free of charge.

^{xxvi} The registry for the international aviation scheme could, but need not, be linked electronically with the target registry. Absent an electronic link, the administrator of the international aviation scheme could establish an account in the registry of the target scheme. Allowances used for compliance in the international aviation scheme could be cancelled in the registry of the target scheme. Difficulties arise only if external entities, such as the administrator of the international aviation scheme, are not able to establish an account in the registry of the target scheme.

^{xxvii} If allowances, but not Kyoto units, are cancelled, higher emissions would be possible outside the national trading scheme while meeting the country's Kyoto Protocol commitment.

^{xxviii} For these reasons the EU ETS proposes to cover only the CO₂ emissions.

^{xxix} Reciprocal unilateral links are a way to avoid the complex issues raised by a bilateral link. A trading scheme for international aviation emissions and another scheme, such as the EU ETS, could agree to establish unilateral links with each other or with a third scheme, such as the Clean Development Mechanism. With reciprocal unilateral links, one scheme would import allowances from the other. Absent restrictions on the quantity of allowances that can be imported (or exported), allowance prices in the two schemes will tend to converge. If two schemes are unilaterally linked to a third, such as the CDM, prices will tend to converge as long as the caps of the two schemes are such that both are net importers of allowances from the third and there are not restrictions on the quantities imported. The economic benefits of reciprocal unilateral links will not differ significantly from a bilateral linking agreement.

^{xxx} Depending on the relative size of each scheme, this effect can be negligible or effectively become a price cap. If small scheme is linked to a much larger scheme, the link caps the price of the allowances in the smaller scheme at the price in the large scheme. If a large scheme is linked with a small scheme, the effect on allowance prices in the large scheme is negligible. If there is a limit on the quantity of the allowances from the linked system that can be used for compliance, the moderating effect will be further limited.

^{xxxi} Reuters reported on 11 September 2008 that the industry committee of the European Parliament proposed that shipping should be included in the EU ETS from 2013.