MULTILATERAL CLIMATE EFFORTS BEYOND THE UNFCCC

CENTER FOR CLIMATE AND ENERGY SOLUTIONS

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A number of established multilateral regimes offer important avenues for climate mitigation efforts complementary to those of the U.N. Framework Convention on Climate Change (UNFCCC). Tackling discrete dimensions of the climate challenge in regional, sectoral and other global venues can yield action on multiple fronts, contributing toward closing the gap between national pledges and the UNFCCC goal of limiting warming to 2 degrees Celsius. This brief examines ongoing and potential efforts in the International Maritime Organization, the International Civil Aviation Organization, the Montreal Protocol, and the Convention on Long-Range Transboundary Air Pollution.

INTRODUCTION

Global climate change draws the attention of governments at every level, from the village board to the U.N. Security Council. At the international level, the U.N. Framework Convention on Climate Change (UNFCCC) has been the hub of efforts to address the threat of climate change. But over time, many other international institutions have become engaged in climate-related work. Indeed, one recent study identified more than sixty institutions that perform some governance function, broadly defined.[1] These include international organizations such as the International Maritime Organization (IMO), the International Civil Aviation Organization (ICAO) and the World Bank, privately-sponsored initiatives such as the Greenhouse Gas Protocol, and public-private partnerships. Together these institutions form what some have called a "transnational regime complex" related to climate change.[2]

Tackling the climate change problem outside the UNFCCC presents both risks and opportunities. On the one hand, proceeding in a piecemeal way in multiple forums may fragment efforts, making it more difficult to mobilize strong global action. On the other hand, given the breadth and complexity of the climate challenge and the limited progress within the UNFCCC, tackling discrete dimensions of the climate challenge in other forums can allow targeted, incremental progress in the near-term, building toward a stronger global response. Moreover, given uncertainties about the success of any individual negotiating process (including the UNFCCC), diversifying one's portfolio of policy approaches helps reduce the risk of failure.

Among other reasons to pursue climate efforts in other multilateral forums:

- In institutions with a track record of success, such as the Montreal Protocol on Substances that Deplete the Ozone Layer, participants have developed working relationships that help instill trust and promote cooperation.

- Institutions with a sectoral focus, such as the IMO and the ICAO, have a tradition of cooperation that can help facilitate agreement, and allow a response tailored to the specific nature of the sector.[3]
- Some institutions have procedural rules that make agreement more likely. For example, in contrast to the consensus rule in the UNFCCC, the IMO allows decisions to be made by a qualified majority vote—a voting rule that allowed the recent adoption of mandatory efficiency standards for new ships, despite opposition by China, Brazil, Saudi Arabia, and others.
- Some, such as the Convention on Long-Range Transboundary Air Pollution (CLRTAP), provide a regional forum for action where established relations may make it easier to achieve agreement around shared interests and objectives, particularly where regional aspects of climate change are at issue.

This paper examines the status of, and prospects for, climate-related efforts in a number of established multilateral regimes—specifically, the IMO, ICAO, the Montreal Protocol and CLRTAP. It focuses, in particular, on options to use these negotiating forums to limit emissions. In taking this focus, this paper does not address other important subjects, including (1) work related to adaptation; (2) the host of activities by sub-state actors, private groups, and public-private partnerships to address climate change; (3) the broader political discussions of the climate change issue in forums such as the U.N. Security Council, the G-20, the Major Economies Forum (MEF), and the U.N. Human Rights Council; and (4) the potential to address climate change through adjudication or other forms of dispute settlement.

GENERAL ISSUES

The Relation of Work Within and Outside the UNFCCC

Work in other multilateral forums could relate to the UNFCCC in several ways. First, the UNFCCC regime could explicitly direct that a particular aspect of the climate change issue be pursued in a different forum. In this case, the relationship between the UNFCCC regime and outside work would be one of delegation. For example, the Kyoto Protocol specifically directs Annex I parties to address emissions from international transport in the relevant U.N. specialized agencies—the IMO and the ICAO, respectively[4]—effectively assigning this part of the climate change problem to these organizations. Similarly, the UNFCCC limits itself to greenhouse gases (GHGs) not covered by the Montreal Protocol.

Second, activities in another organization could supplement efforts within the UNFCCC. For example, the Kyoto Protocol does not address black carbon's contribution to global warming. So efforts to address black carbon in other institutions, such as the Convention on Long-Range Transboundary Air Pollution or the Arctic Council, supplement the emissions targets in the Kyoto Protocol, which are limited to six greenhouse gases: carbon dioxide (CO_2), methane, nitrous oxide, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

Third, activities in another organization could complement the UNFCCC regime—for example, by promoting actions that help achieve the requirements of the UNFCCC regime. For example, reducing energy subsidies under the World Trade Organization (WTO) would cause energy prices to go up and consumption of fossil fuels to go down. The result would be lower emissions of CO_2, which would further the goal of the UNFCCC. Similarly, decisions under the Montreal Protocol to fund projects that replace hydrochlorofluorocarbons (HCFCs) with non-HFC alternatives would further the Kyoto Protocol's efforts to limit HFCs.

Fourth, climate change mitigation efforts in other institutions could compete with action under the UNFCCC. For example, if regulation of HFCs under the Montreal Protocol were intended to displace (rather than complement) regulation under the Kyoto Protocol, then the two regimes would have a competitive relationship.

Pursuing climate change mitigation outside the UNFCCC is unproblematic when the regime delegates action to the other institution, or when outside activities supplement or complement the UNFCCC. But work in other multilateral forums raises more concern when it is perceived as competing with the UNFCCC process.[5] Although regulatory competition has potential benefits, it may risk forum shopping, lack of policy coherence and, more generally, the fragmentation of international law.[6]

Finally, regardless of the relationship of work outside and within the UNFCCC, the UNFCCC could serve a coordinating function for all climate-related work—for example, by providing a unified reporting system or an infrastructure for emissions trading, or by assessing the combined level of emission reductions achieved in different forums in terms of the 2 degree Celsius (2°C) goal adopted in the Copenhagen Accord and the Cancún Agreements.

Applicability of UNFCCC Principles

Article 3 of the UNFCCC sets forth a number of principles to "guide" the parties' work in "their actions to achieve the objective of the Convention and to implement its provisions." These principles include:

- intergenerational equity;
- "common but differentiated responsibilities and respective capabilities" (CBDR);
- the special needs of developing countries;
- precaution;
- cost-effectiveness; and
- sustainable development.

A crucial question is the degree to which these principles—and in particular, the principle of common but differentiated responsibilities and respective capabilities—apply to climate change mitigation efforts outside the UNFCCC. By its terms, Article 3 applies to the actions of the parties to achieve the objective of the Convention and to implement its provisions. Although Article 3 does not specify whether it is limited to actions by the parties under the UNFCCC or whether it is also intended to guide the actions of the parties in other forums, ordinarily the rules of another international institution would apply to actions taken within that institution.

The principle of CBDR is a central pillar of the UNFCCC regime, but it does not apply universally in international law,[7] nor is its meaning within the UNFCCC agreed.[8] Some international regimes differentiate between developed and developing countries and others do not. Moreover, even when there is a rationale to treat developing countries differently, this can be accomplished in different ways—not only through differentiated obligations, but also through the provision of financial and technical assistance. When an institution that does not ordinarily differentiate between the obligations of developed and developing countries addresses climate change, should it apply the UNFCCC principle of CBDR or its normal regulatory approach?

This issue has already arisen in the context of efforts to address climate change in the IMO and ICAO. Given the international character of maritime shipping and civil aviation, the IMO and ICAO seek to regulate all ships and planes uniformly, regardless of their nationality, rather than establish different obligations for developed and developing countries. The question now is whether these institutions should apply the same principle of non-discrimination when adopting measures to limit greenhouse gas emissions. Thus far, the IMO has concluded that its principles should apply to action taken by IMO to address climate change.

Political Effects

Another potential concern about proceeding in other forums is that doing so would dissipate energy within the UNFCCC, and thereby make agreement on a post-2012 climate change regime less likely. This is the flip side of the earlier argument about the benefits of diversifying one's policy portfolio. On the one hand, proceeding on multiple fronts could help to reduce the risk of policy failure. On the other hand, it could also diminish the sense of urgency within the UNFCCC process.

THE MITIGATION POTENTIAL OF WORK IN OTHER FORUMS

The Copenhagen Accord set forth a goal of limiting global warming to no more than 2°C (with the possibility of strengthening this goal in 2015). In the Cancún Agreements, the parties to the UNFCCC confirmed this 2°C goal.

In its so-called *Gap Report*, UNEP estimated that the pledges made by states under the Copenhagen Accord (and subsequently under the Cancún Agreements) would fall short by 5-9 $GtCO_2e$ (gigaton carbon dioxide equivalent) of the annual emissions levels in 2020 needed to achieve the 2°C temperature goal.[9] Work is now underway by UNEP to identify ways of closing this gap.

This provides an important context for evaluating the potential contributions of other multilateral regimes. The

potential emission reductions from actions in other multilateral forums represent a small percentage of total global emissions. So actions in these forums are not a substitute for emission reductions pursuant to states' UNFCCC pledges. But the potential reductions from efforts in other forums could help supplement the emission reductions already pledged, and thereby contribute to closing the 5-9 $GtCO_2e$ gap between the pledges and the 2°C target.[10]

In assessing the mitigation potential of work in other forums, a useful perspective is the "wedge analysis" proposed by Stephen Pacala and Robert Socolow.[11] The 5-9 $GtCO_2e$ emissions gap estimated by UNEP can be subdivided into a number of wedges, each of which represents a fraction of the reductions necessary to close the gap. Of the multilateral forums discussed in this paper, no single forum is likely to be able to deliver enough emission reductions to close the gap between projected emissions and the 2°C goal. But each could contribute a wedge towards the overall amount needed to do so. For example, UNEP estimates that reductions in emissions from maritime shipping alone could close up to 15 percent of the gap.[12]

The importance of action in other forums is reinforced by the fact that some of the sectors in question, such as maritime shipping and civil aviation, although only a small fraction of the problem today, are expected to grow rapidly and will become an increasingly big part of the climate change problem over the coming decades. Given business-as-usual growth, maritime shipping emissions could, by 2050, represent 12 percent to 18 percent of the overall global emissions budget needed to achieve the 2°C goal.[13] HFCs, while accounting for less than 1 percent of GHG emissions now, could account for 9 percent to 19 percent by mid-century.[14]

INTERNATIONAL MARITIME ORGANIZATION

Background

The International Maritime Organization (IMO) is the U.N. specialized agency responsible for governance of maritime shipping, including the prevention of pollution from ships. Established in 1958, the IMO is headquartered in London and currently has 170 member states. It serves a largely regulatory function. Under its auspices, states have adopted 53 treaties and more than 1,000 codes, guidelines, and recommendations related to maritime safety, security, and pollution control. Within the IMO, the Marine Environment Protection Committee (MEPC) has jurisdiction over pollution issues. Like other IMO committees, it is open to participation by all member states.

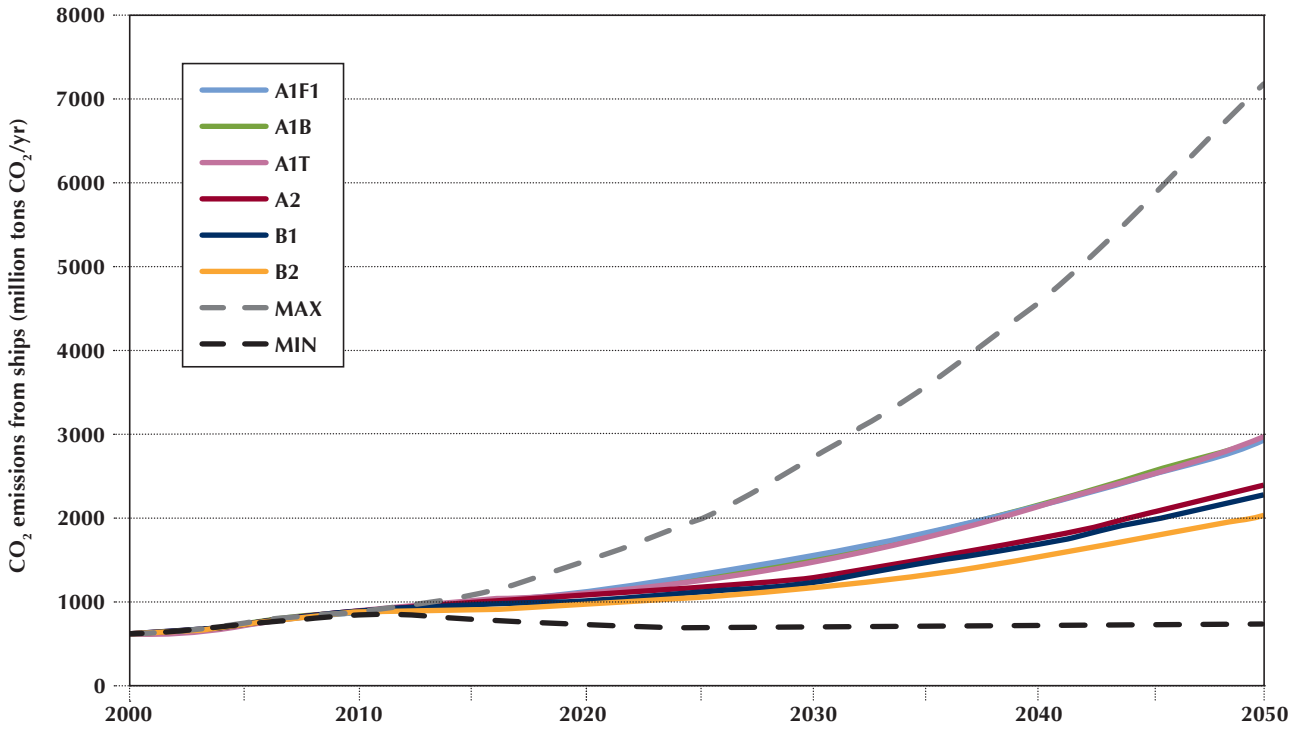
The principal international instrument regulating pollution from international shipping is the International Convention for the Prevention of Pollution from Ships, or MARPOL, which was initially adopted in 1973 but did not enter into force until 1983, after it had been modified by a protocol adopted in 1978.[15] MARPOL has six technical annexes, addressing the various types and categories of pollution from ships, including oil pollution, pollution from noxious liquids, pollution from hazardous materials carried in packed form (e.g., containers), sewage, and garbage. MARPOL Annex VI, which was adopted in 1997 and entered into force in 2005, addresses air pollution from ships.

Earlier this year, the MARPOL parties adopted amendments to Annex VI that would regulate the energy efficiency of ships (see below). The procedure for amending MARPOL annexes allows amendments to be made if they are supported by a two-thirds majority of the parties. This qualified majority voting procedure prevents a small group of states from blocking action, as is possible in the UNFCCC regime.

As with other IMO treaties, MARPOL's requirements apply uniformly to ships of different flags, without any differentiation between developed and developing countries. According to IMO, "there is no precedent in any of the fifty-two IMO international treaties currently in existence where measures are applied selectively to ships according to their flag."[16] Uniform treatment is justified, according to the IMO, because of the global character of the shipping industry. "As shipping is a global industry and ships are competing in a single global market, it must be regulated at the global level for any control regime to be effective and to maintain a level playing field for all ships irrespective of flag (nationality) or ownership. In other words, the global character of shipping justifies and requires global regulation that applies universally to all ships."[17]

Under MARPOL, flag states have the primary obligation to implement and enforce MARPOL's regulatory requirements. Although this creates the possibility that

Figure 1: Trajectories of Emissions from Shipping using IPCC SRES scenarios



Trajectories of emissions from shipping, in the absence of additional climate policies, under the "SRES scenarios" developed by the Intergovernmental Panel on Climate Change (IPCC) to illustrate alternate global futures characterized by differences in population, land-use, and political and economic trends. The figure includes the principal scenarios and the maximum and minimum for all 162 scenarios.

Source: IMO 2009

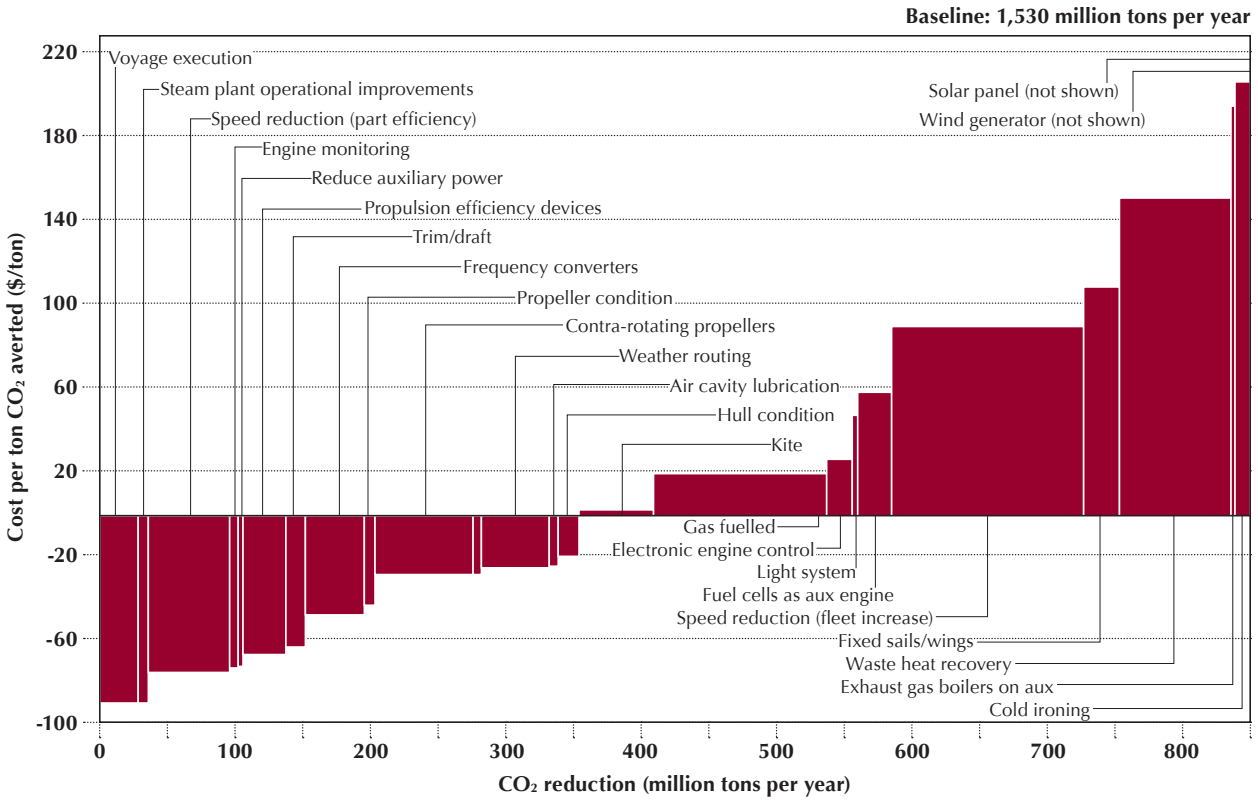
vessels will register in countries that are not parties to MARPOL, the very high level of ratification of MARPOL by maritime states has made MARPOL applicable to virtually all of the world's merchant fleet.[18] Moreover, MARPOL parties have an obligation to apply regulations to ships, even of non-parties, as a condition of entering their ports or internal waters under the principle of "no more favorable treatment," and may inspect foreign ships in port to ensure that they meet MARPOL's requirements.[19] One measure of IMO's success in addressing marine pollution problems is that oil spills were reduced by 85 percent from 1985 to 2006, even as seaborne trade increased by about 135 percent.[20]

In addition to its regulatory work, IMO provides technical assistance to developing countries to help them comply with international rules and standards through its Integrated Technical Co-operation Programme.

Emissions from Maritime Shipping

A 2009 IMO study estimated that, in 2007, maritime shipping emitted 1,046 million tons of CO_2, or 3.3 percent of total global CO_2 emissions, of which 870 million tons, or 2.7 percent, came from international shipping.[21] Although this is a relatively small fraction of total global greenhouse gas emissions, it represents approximately the same level of emissions as a country such as Germany—not an insignificant amount. Moreover, maritime emissions are expected to grow substantially over the next 50 years as a result of the projected doubling of maritime shipping by mid-century (see Figure 1). According to mid-range scenarios, maritime shipping emissions will double or even triple by 2050 in the absence of mitigation policies, representing 12 percent to 18 percent of the overall carbon budget in 2050 compatible with the 2°C temperature goal.[22]

Figure 2: Average Marginal Abatement Costs for World Shipping Fleet in 2030



Source: DNV, *Pathways to Low Carbon Shipping: Abatement Potential Towards 2030,* February 2010

The 2009 IMO study estimates that technical and operational measures could reduce emissions from maritime shipping by 25 percent to 75 percent below current levels per ton mile through efficiency improvements, thereby offsetting at least some of the increased emissions that would otherwise occur. These measures include:

- Design changes, including changes to the hull, propulsion systems, engine, and fuel sources. For example, replacing two ships by one larger ship could increase energy efficiency by as much as 30 percent.
- Operational changes relating to speed management, routing, logistics, and power management. For example, decreasing speed reduces resistance on the hull and thereby reduces fuel consumption and CO_2 emissions. Similarly, increasing the load factor reduces the number of voyages necessary to carry a given amount of cargo. The 2009 IMO study estimates that the mitigation potential from operational improvements could be as high as 27 percent.
- Use of alternative fuels, such as modified diesel oil or liquefied natural gas, rather than heavy fuel oil, which is more carbon-intensive.

Many of these measures could be implemented at negative or low costs (see Figure 2).

Action to Date

Due to the global nature of maritime shipping, attributing ship-based emissions to a particular country is difficult. For example, a ship flying the Panamanian flag could be owned by a company incorporated in Greece, operated from Singapore, with crew from India and the Philippines, and carrying goods from China to the United States. In cases such as this, emissions could be allocated to countries in many different ways.[23]

Given the difficulty in attributing emissions from fuels used for international shipping (usually referred to as

"bunker fuels"), the Kyoto Protocol does not include these emissions in its national emissions targets. Instead, the Kyoto Protocol directs Annex I parties to pursue limitation or reduction of emissions from international bunker fuels through the relevant specialized agency: IMO in the case of international maritime shipping and ICAO in the case of emissions from international civil aviation.[24]

IMO began its work on climate change in 1997, when the same MARPOL conference that adopted Annex VI also adopted a resolution on "CO_2 emissions from ships." The resolution invited IMO to undertake a study of emissions from marine shipping and to consider what CO_2 reduction strategies might be feasible.[25] The study was completed in 2000 and was updated in 2009.

In 2003, the IMO Assembly adopted Resolution A963(23), which urged the MEPC to identify and develop mechanisms to limit or reduce GHG emissions from international shipping. In 2006, MEPC approved a work plan to identify and develop emission reduction mechanisms, consisting of three "building blocks":

- *Technical measures relating to the design of new ships*—Pursuant to this building block, the Working Group on Greenhouse Gas Emissions from Ships developed an Energy Efficiency Design Index (EEDI) for new ships, which specifies a minimum energy efficiency level per capacity mile for different types and sizes of ships. The EEDI is a non-prescriptive, performance-based standard that allows ship designers and builders to choose whatever technology is most cost-efficient to achieve the standard. It will apply to oil and gas tankers, bulk carriers, general (and refrigerated) cargo and container ships, and will cover 72 percent of emissions from new ships. Initially, the EEDI will require reductions of 10 percent in the energy efficiency of new ships above 400 GT (gross tonnage), as compared to ships built between 2000 and 2010. The standards will be ratcheted up every five years, leading to reductions of 30 percent for the 2025 to 2030 period for most ships.
- *Operational measures for all ships*—The Working Group developed guidelines to assist the shipping industry in improving energy efficiency through the development of Ship Energy Efficiency Management Plans (SEEMP). As noted earlier, the 2009 IMO GHG study estimated that operational measures could improve energy efficiency by more than 25 percent on a ton mile basis. IMO also developed an Energy Efficiency Operational Indicator (EEOI), in order to provide a standardized monitoring tool and benchmark to evaluate operational efficiency.
- *Market-based mechanisms*—IMO is considering a range of options for a market-based mechanism, including an emissions trading scheme, a levy on emissions from ships not meeting the EEDI standards, and a levy on all CO_2 emissions from international shipping.

In 2009 the MEPC approved the EEDI, the SEEMP and the EEOI for voluntary use and embarked on developing treaty text. In accordance with IMO's practice of developing uniform regulations for ships, irrespective of their nationality, the EEDI, SEEMP and EEOI standards apply to ships of all nationalities, and are not differentiated as between developed and developing countries. In this connection, the IMO Legal Office concluded that the provisions of the UNFCCC and the Kyoto Protocol do not limit the outcomes of IMO's decision-making process. As an IMO presentation on the legal aspects of IMO's work on climate change observes, "If IMO technical rules were limited to certain countries, then ship owners could simply change flag to avoid the impact of any regulations which they might regard as too onerous, a result which would frustrate the objective not only of MARPOL (or other IMO treaties) but also of Article 2.2 of the Kyoto Protocol."[26]

In 2011, the parties to MARPOL adopted an amendment to Annex VI, adding a new Chapter 4 regulating energy efficiency for ships, which makes the EEDI, SEEMP and EEOI mandatory for ships over 400 GT.[27] The EEDI requirements will apply to new ships for which the building contract is placed on or after January 1, 2013, while the SEEMP and EEOI requirements will apply to all ships. The amendment includes a Singapore proposal allowing countries to give their ships a four-year waiver from the new requirements. Despite this provision, the amendment was opposed by China, Brazil, and Saudi Arabia, among others, and Saudi Arabia called for a roll-call vote. Ultimately, the amendment was approved by a vote of 49 in favor and 5 against (Brazil, Chile, China, Kuwait and Saudi Arabia), with 2 abstentions.[28] The amendment will be deemed to have been accepted on July 1, 2012, unless prior to that date at least one third of the parties, representing at least 50 percent of the world's merchant tonnage, objects. The amendment will then enter into force on January 1, 2013.[29]

The MARPOL Annex VI amendment is significant in several ways. First, it sets forth the first mandatory standards for a sector relating to greenhouse gas emissions. Second, its regulations apply uniformly, with

no differentiation between ships flagged in developed and developing countries. Instead, the issue of differentiation was addressed through the inclusion of a provision to promote technical cooperation and assistance for developing countries. Third, the amendment's adoption by a majority vote represents the first time that a decision relating to climate change has been taken over the objection of a significant group of countries.

Countries that voted against the MARPOL Annex VI amendment are free to opt out, but their ships will still need to meet the standards if they wish to call on ports of states that accept the amendments. Moreover, it is likely that shipbuilders will comply with the new standards for all new ships, regardless of where a ship is expected to be flagged, since failure to comply with the standards will lower the potential resale value of a ship. For these reasons, the new MARPOL standards are expected to be applied universally to all new ships, even if some countries legally reserve to the amendment.

Future Actions

Although the design and operational measures included in the Annex VI amendment represent an important step in addressing GHG emissions from ships, the MEPC has recognized that these measures are insufficient, particularly given the increase in emissions expected to result from growth in world trade. For this reason, MEPC agreed in 2009 on the need to develop a market-based mechanism (MBM) to limit GHG emissions from international shipping.

A number of types of MBMs have been proposed,[30] including:

- A levy on international bunker fuels, which would be collected by fuel oil suppliers and would go into a global fund for mitigation and adaptation purposes. (Proposal by Denmark, Cyprus, the Marshall Islands and Nigeria)
- A levy on bunker fuels used during a voyage, to be collected by port states and passed on to a central fund. (Proposal by Jamaica)
- A global levy on international bunker fuels used by ships not meeting the EEDI requirement. (Proposal by World Shipping Council)
- An emissions trading system for emissions from international shipping. (Proposal by Norway, the United Kingdom, Germany, and France)
- A Ship Efficiency and Credit Trading (SECT) program, for trading of efficiency credits by ships that beat the mandatory efficiency standards to those that fail to meet the standards. (Proposal by the United States)

For market-based mechanisms that generate funds (either through a levy on bunker fuels or through the auctioning of permits), the money could be used for mitigation and adaptation purposes in developing countries, and could thus help further reduce emissions from international shipping or other sectors. Alternatively, some proposals include mechanisms to provide rebates to developing countries, which could reduce the funds available for mitigation and adaptation activities.

According to MEPC's work plan, MEPC was to conclude its work on MBMs at its 2011 meeting. However, the 2011 MEPC meeting was mostly devoted to adopting the MARPOL Annex VI amendment, so work will continue on MBMs at next year's meeting. Despite overwhelming agreement on the need to develop a market-based mechanism, there is little agreement on what type of mechanism to adopt. The Danish proposal to impose a levy on international shipping has attracted perhaps the most support, but it is staunchly opposed by large developing countries such as China and Brazil. European countries generally support establishing an emissions trading system, but this is a non-starter for BASIC countries,[31] who refuse to accept a hard cap on their emissions, as well as for the United States (particularly if the trading system did not apply symmetrically to all countries). The U.S. efficiency trading proposal is intended as a possible middle ground, but has not gained much traction thus far.

Given the lack of any consensus about the type of MBM that should be adopted, it is unclear when the MEPC might be likely to adopt an MBM. One potential wildcard is the possible expansion of the European Union Emissions Trading System (EU ETS) to include emissions from maritime shipping, which the European Parliament has tasked the European Commission to begin working on next year.

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO)

Background

ICAO is the U.N. specialized agency responsible for governance of international civil aviation. Established in 1944 by the Convention on International Civil Aviation (often referred to as the Chicago Convention), ICAO develops policies, standards and guidance in the field of international civil aviation. ICAO is headquartered in Montreal and today has 190 member states. It is governed by an Assembly and Council. The Assembly, which meets every three years and includes all of the member states, is the highest body. The Council is composed of 36 states elected by the Assembly, and is the governing body between Assembly meetings. Within ICAO, the Committee on Aviation Environmental Protection (CAEP) has principal responsibility for environmental matters. CAEP includes 24 member states and has seven working groups, addressing noise, local air quality emissions and GHG emissions issues. In contrast to the IMO, where the MEPC has broad responsibility for environmental issues, the political dimensions of environmental issues are addressed in ICAO by the Council and Assembly, with the CAEP focusing on more technical issues.

Emissions from Civil Aviation

In many respects, civil aviation is similar to maritime shipping:

- Civil aviation is a highly international industry, making a global sectoral approach desirable.
- Currently, emissions from civil aviation are relatively low, accounting for less than 2 percent of global greenhouse gas emissions.[32] But aviation emissions are growing rapidly. From 2000 to 2006, air travel increased at an average rate of 3.8 percent per year, more than offsetting the reductions in emissions from increased efficiency. Over the next forty years, aviation emissions are expected to quadruple in the absence of new policies, despite continued improvements in efficiency.[33]
- Emissions from civil aviation could be reduced by increasing the fuel efficiency of aircraft design (for example, through the use of new lightweight materials and more efficient engines), by substituting lower-carbon fuels for existing sources, and to a lesser extent, by operating aircraft in ways that use less fuel. Together, these measures could reduce emissions from civil aviation by 50 percent as compared to business-as-usual projections by 2050.[34] While this would represent a significant improvement as compared to the no-policy case, it would still mean that aviation emissions double by 2050, given the expected quadrupling of air travel.

The primary greenhouse gas emitted by aircraft is CO_2. Aircraft also emit methane, nitrous oxide, hydrocarbons and particulate matter, and can affect the formation of clouds, but the non-CO_2 and cloud effects of international aviation are less well understood than the effects of carbon dioxide emissions.[35] Overall, the IPCC has estimated that civil aviation contributes about 3 percent of total radiative forcing from human activities.[36]

Action to Date

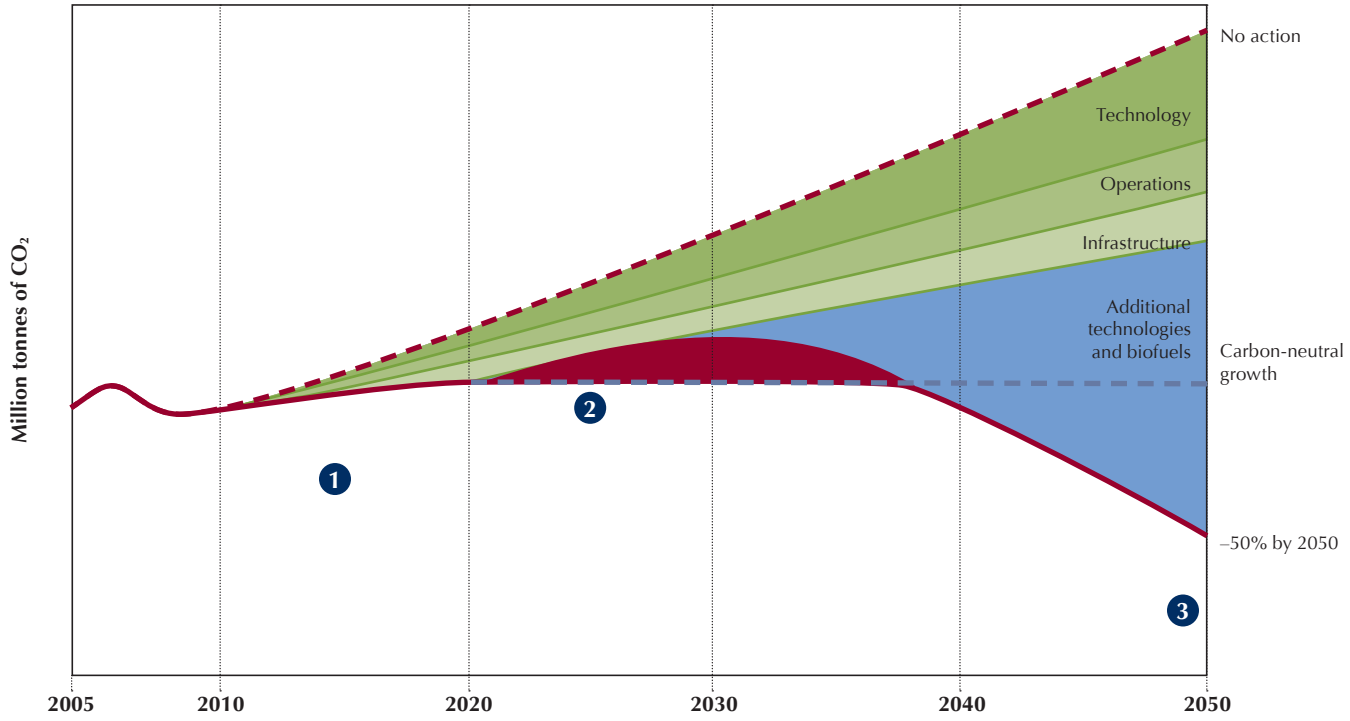
Given that fuel costs are a substantial part of total operating costs, the airline industry has been working for a long time to reduce its use of jet fuels. The next generation of aircraft will be significantly more fuel-efficient than the existing fleet, and some airlines are beginning to experiment with the use of alternative fuels. The relevant industry association, the International Air Transport Association (IATA), has set a goal to use 10 percent "alternative" fuels by 2017.[37] And the international aviation industry has adopted a long-term aspirational goal of reducing net aviation carbon emissions by 50 percent from 2005 levels by 2050 (see Figure 3).

In 2007, the ICAO Assembly requested the Council to establish a Group on International Aviation and Climate Change (GIACC), composed of fifteen senior government officials. The GIACC met four times between 2008 and 2009, and developed a Program of Action on International Aviation and Climate Change, which the Council accepted in 2009. Later that year, ICAO convened a High-Level Meeting on International Aviation and Climate Change to review ICAO's Program of Action, as well as a Conference on Aviation and Alternative Fuels that adopted a Global Framework for Aviation Alternative Fuels.

On the basis of the work by GIACC and the High-Level Meeting, the ICAO Assembly adopted a consolidated resolution on climate change in October 2010.[38] Important elements of the Assembly resolution include:

- A global goal for international aviation of improving average fuel efficiency by 2 percent annually (slightly

Figure 3: Mitigation Potential in Civil Aviation: Indicative Diagram



1. Industry goal—improve fleet fuel efficiency by 1.5 percent per year from now until 2020

2. ICAO goal—cap net emissions from 2020 through carbon neutral growth

3. Industry goal—net aviation carbon emissions to decrease by 50 percent from 2005 levels in 2050.

Known technology, operations and infrastructure measures

Biofuels and additional new-generation technology

Economic measures

Net emissions trajectory

"No action" emissions

This schematic illustrates how goals set by the aviation industry and by the International Civil Aviation Organization can spur improvements in efficiency and operations, and new fuels and technologies, to reduce aviation's net carbon emissions 50 percent by 2050.

Source: *The Right Flight Path to Reduce Aviation Emissions: A Position Prepared by the Global Aviation Industry,* November 2010

higher than the industry goal of 1.5 percent annual improvement), and a medium-term global goal of carbon-neutral growth starting in 2020 (in effect, stabilizing global CO_2 emissions at 2020 levels). The resolution characterizes the goals as "aspirational" and the contributions of states to achieving the goals as "voluntary," and specifically notes that the 2 percent fuel efficiency goal and the 2020 stabilization goal do not "attribute specific obligations to individual states."

- Development by 2013 of a global CO_2 efficiency standard for aircraft (analogous to the EEDI standard developed by IMO for new ships).
- Development of a "framework for market-based measures in international aviation," based on agreed guiding principles, and exploration of the feasibility of a global MBM scheme.
- Language encouraging annual inventories by states of their international aviation CO_2 emissions and national action plans (preferably by June 2012) that identify measures to address emissions from international aviation as well as any assistance needs.[39]

Like IMO, ICAO allows decisions to be made by qualified majority voting. As a result, the ICAO Assembly was able to adopt the 2010 climate change resolution despite opposition by BASIC countries. A number of

countries entered reservations to particular aspects of the Assembly resolution, including China, which objected to the inclusion of developing country emissions in the 2020 stabilization goal; the European Union, which criticized the 2020 goal as too weak[40] and rejected any suggestion that market-based measures may not be implemented unilaterally; and the United States, which objected to language suggesting that developing countries might have lesser requirements.[41]

In comparing the ICAO resolution to the IMO amendment, the two differ in important respects. On the one hand, the ICAO resolution establishes global goals to limit emissions from international civil aviation, rather than focusing only on the efficiency of particular aircraft. The resolution thus makes international aviation the first sector with global goals to limit emissions. On the other hand, the ICAO goals are voluntary rather than legally-binding, and ICAO (through the CAEP) is still in the process of developing a global CO_2 standard for aircraft comparable to the EEDI standard for ships.

A complicating factor in the ICAO discussions has been a unilateral move by the European Union (EU) to include international aviation emissions in its Emissions Trading System (ETS) as of January 1, 2012, in response to what the EU sees as inadequate progress in ICAO. The threat of unilateral action by the EU has both politicized the climate change issue within ICAO and been an important driver of ICAO action. Under the EU directive, emissions for all flights into and out of EU member states are capped initially at 3 percent below average emissions in 2004-2006, and at 5 percent below from 2013. The EU will give airlines a limited number of tradable allowances for their emissions from flights into and out of EU member states. Airlines will be given 85 percent of their allowances for free, and then must either limit their emissions to no more than their allowances or buy additional allowances through the ETS market. Since only airlines will be able to use the aviation allowances, the allowances could potentially become a sub-market within the EU ETS, with a lower price than industry allowances.[42]

The EU plan to include international aviation in the EU ETS has provoked a strong international reaction. U.S. airlines sued in British courts to enjoin implementation of the EU directive, on the ground that it violates customary international law by regulating emissions outside the EU's airspace, violates the Kyoto Protocol's provision that directs Annex I states to address international aviation emissions through ICAO,[43] and violates the Chicago Convention through its imposition of additional charges. The case has been transferred to the European Court of Justice (ECJ). A preliminary opinion by the ECJ's Advocate General ruled against the airlines. A final decision is expected in early 2012. Meanwhile, China and Russia have reportedly indicated that they may challenge the EU action in ICAO. And a group of 26 countries led by India, including the United States, issued a joint declaration opposing the inclusion of aviation in the EU ETS and urging ICAO to continue efforts to reduce aviation emissions.[44]

Because the EU proposal would permit exemptions for countries with comparable requirements, a decision by the ECJ upholding its legality could prompt other countries to implement comparable policies and negotiate exemptions with the EU. The prospect that national policies would likely vary (particularly because not all countries have emissions trading programs) might prompt airlines to support the development of a single international system by ICAO. A single international system could also be more attractive to developing countries as compared to the EU system, since the revenues from an international system would likely go to mitigation and adaptation activities in developing countries, in contrast to the EU system, where the revenue from auctioned allowances will be collected by member states, who will decide on its uses.

Future Actions

The 2010 Assembly resolution acknowledged that its aspirational goals are "unlikely to deliver the level of reduction necessary to stabilize and then reduce aviation's absolute emissions contribution to climate change" and that "goals of more ambition will need to be considered."[45] Pursuant to the 2010 Assembly resolution, work will continue in a number of areas:

State Action Plans—The 2010 Assembly resolution called on ICAO to assist states in developing their action plans, thus giving ICAO implementation as well as policy-making responsibilities. Pursuant to this mandate, ICAO has developed guidance material and an interactive website, as well as held a series of training workshops in all ICAO regions so that states can meet the June 2012 goal for submission of their action plans to ICAO.

Global CO_2 Certification Standard for Aircraft—CAEP has been tasked to develop a global CO_2 efficiency standard for aircraft, similar to the EEDI standard developed by IMO for new vessels. The ICAO Assembly resolution

set a target deadline of 2013, but parties have yet to agree on the appropriate metric, let alone take up the question of stringency levels.[46]

Sustainable Alternative Fuels—The 2010 Assembly resolution calls on the Council to work with financial institutions to facilitate access to financing for sustainable alternative fuels. The ICAO Workshop in October 2011 on this subject provided an opportunity to enhance dialogue among various stakeholders regarding access to financing for sustainable alternative fuels projects. It also addressed the role of sustainable alternative fuels as part of the measures available to states for inclusion in their action plans to reduce CO_2 emissions.

Market-Based Measures (MBMs)—The 2010 Assembly resolution adopted principles for the design and implementation of market-based measures (MBMs) for international aviation, and directs the Council to develop a framework for MBMs and to explore the feasibility of a global MBM scheme. A Market-Based Measures Task Force (MBMTF) under CAEP prepared a number of preliminary reports addressing the linking of trading systems, offset mechanisms, and voluntary systems. In response to the actions requested by the 2010 Assembly resolution, a technical study is underway to provide information for further policy discussions by the Council, but work has not yet begun to consider concrete proposals for a market-based mechanism for international aviation. One possibility would be to establish a *de minimis* exemption for countries and airlines that emit less than 1 percent of global emissions. That would exempt most countries and airlines, including many developed countries (assuming the EU is not considered a single country).

Medium- and Long-Term Aspirational Goal—The 2010 Assembly resolution called on the Council to review the medium-term goal of stabilizing emissions at 2020 levels, and to explore the feasibility of establishing a long-term global goal.

MONTREAL PROTOCOL

Background

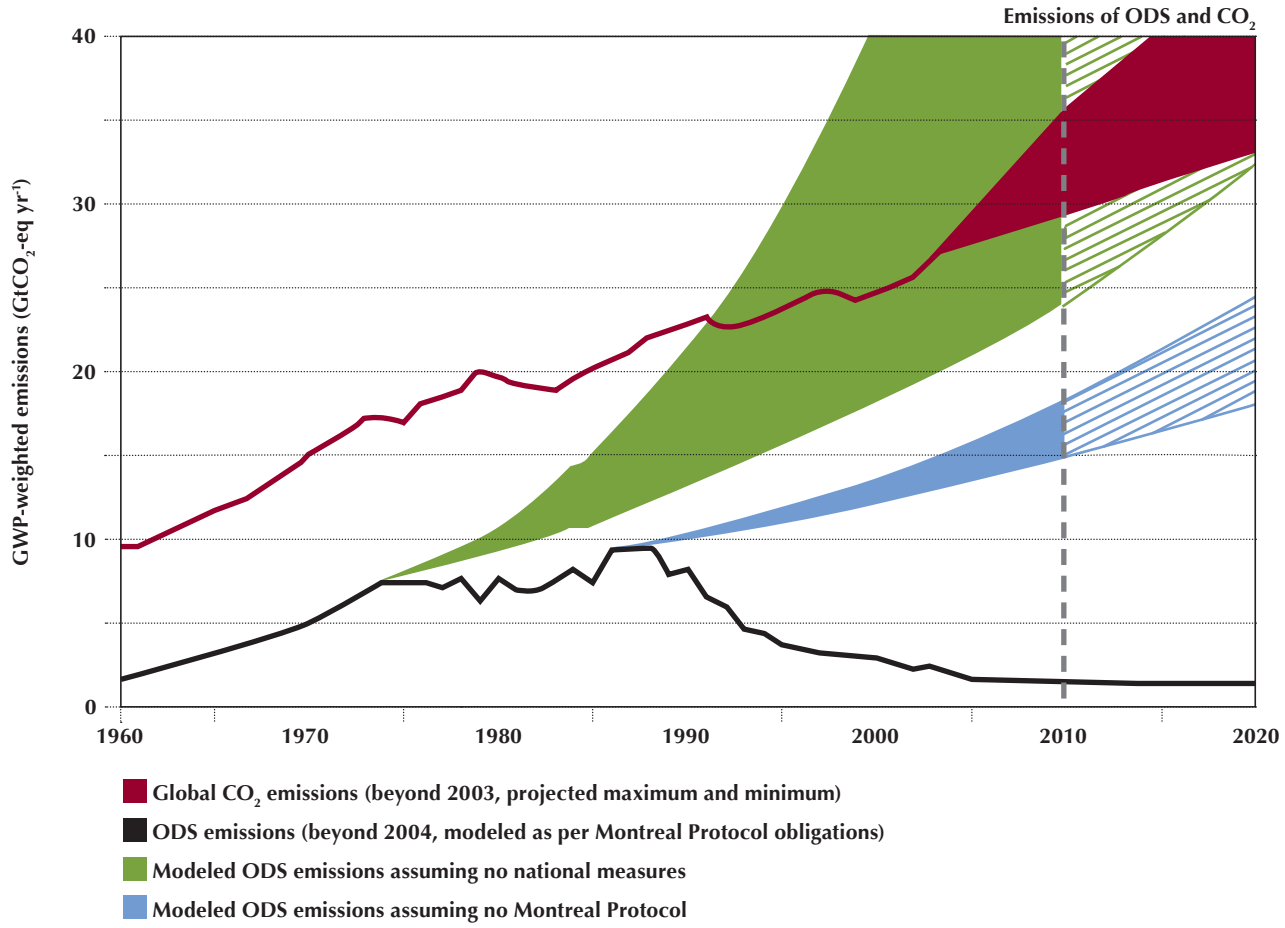
The Montreal Protocol on Substances that Deplete the Ozone Layer was adopted in 1987 and limits the consumption and production of ozone-depleting substances (ODS). Originally designed to cut the use of the primary chlorofluorocarbons (CFCs) and halons by 50 percent, the Montreal Protocol now provides for the reduction and phase-out of a wide range of ODS, including carbon tetrachloride, methyl chloroform, hydrochlorofluorocarbons (HCFCs), and methyl bromide. The Montreal Protocol is widely viewed as the world's most successful international environmental agreement.[47] It has 196 parties, including virtually every country in the world, and has resulted in the phase-out of more than 98 percent of all of the chemicals it controls.[48]

The Protocol provides two procedures for revisions: one to add new chemicals to its regulatory regime, the other to increase the stringency of controls on substances that are already regulated under the Protocol, either by strengthening the reduction target or advancing the timetable for achieving the required reductions. Adding new chemicals requires an amendment to the Protocol, which must be adopted by at least a two-thirds vote of the parties and then ratified by at least two-thirds of the parties.[49] This can be a time-consuming process and ends up binding only those states that ratify.[50] In contrast, increasing the stringency of control measures on substances that are already regulated requires only an "adjustment" to the Protocol, which can be adopted by a two-thirds vote of the parties, representing at least 50 percent of global consumption of ODS, and which binds all parties, whether they voted for the adjustment or not.[51]

Action to Date

Many ozone-depleting substances are also potent greenhouse gases,[52] so limiting the use of ODS also helps to address climate change. Nevertheless, the climate change regime, from the outset, did not attempt to regulate ODS, recognizing that they are already being addressed effectively under the Montreal Protocol. The UNFCCC's commitments apply only to "greenhouse gases not controlled by the Montreal Protocol,"[53] and the Kyoto Protocol emissions targets do not include any ODS.[54]

Figure 4: Effect of Reductions in Ozone-Depleting Substances (ODS) on Global Greenhouse Gas Emissions



In the absence of national measures and the Montreal Protocol, the climate impact of ozone-depleting substances could today exceed that of global carbon dioxide (CO_2) emissions.

Source: Velders et al. 2007

Instead, the global warming effects of ODS have been addressed indirectly through the limitations on their production and consumption imposed by the Montreal Protocol. Until recently, the Montreal Protocol's control regime has been driven primarily, if not exclusively, by the policy of protecting the stratospheric ozone layer. But recently the Montreal Protocol parties have begun to include climate considerations in their decision-making—in particular, in their 2007 decision to accelerate the phase-out schedule for HCFCs by ten years—from 2030 to 2020 for developed countries and from 2040 to 2030 for developing countries.[55]

The reductions in ODS resulting from the Montreal Protocol have already yielded a huge climate benefit, even if only as a by-product of the effort to save the ozone layer (see Figure 4). Even before the 2007 decision on HCFCs, the Montreal Protocol's control measures had committed countries to a substantially bigger reduction in CO_2-equivalent greenhouse gas emissions than the Kyoto Protocol's first commitment period.[56] The 2007 decision to phase out HCFCs completely by 2040 will result in an additional reduction of up to 25 $GtCO_2e$ between 2010 and 2050. Overall, including all of the offsetting effects, the Montreal Protocol's net contribution in 2010 to climate change mitigation is estimated to be five to six times larger than the Kyoto Protocol's first commitment period targets.[57]

Future Actions

The Montreal Protocol parties are now considering whether to use the Protocol to limit HFCs. While posing no threat to the ozone layer, HFCs are extremely potent greenhouse gases—depending on the gas, from 12-15,000 times more powerful per molecule than CO_2 over a 100-year time horizon.[58] Because they contribute to climate change but not ozone depletion, HFCs have been regulated under the Kyoto Protocol rather than the Montreal Protocol. Yet the two agreements may be working at cross-purposes, because the Kyoto Protocol is trying to reduce the use of HFCs, while the Montreal Protocol has served to encourage HFCs as ozone-friendly substitutes for HCFCs and other ozone-depleting substances.

Although HFCs today account for less than 1 percent of global greenhouse gas emissions, their use is projected to grow rapidly due to increased demand for air conditioning and refrigeration, particularly in developing countries as they phase-out HCFCs. According to one estimate, by mid-century, HFCs could contribute the equivalent of 5.5 billion to 8.8 billion tons of carbon dioxide per year (roughly comparable to total U.S. GHG emissions today), accounting for 9 percent to 19 percent of global GHG emissions.[59]

In recognition of their greenhouse effect, and the increasing availability of substitutes for HFCs, several groups of countries have proposed regulating HFCs through the Montreal Protocol. This would require a protocol amendment rather than an adjustment, because HFCs are not currently controlled under the Protocol. Thus far, two proposals have been made, one by the Federated States of Micronesia and Mauritius and the other by the United States, Mexico and Canada. Both proposals purport to complement rather than displace regulation of HFCs under the Kyoto Protocol. The North American proposal would apply to 20 specified HFCs, and would require a phase-down to 15 percent of 2004-2006 levels by 2033 for developed countries and by 2043 for developing countries. The Mauritius/Micronesian proposal is similar, but somewhat stricter for developed countries, requiring a phase-down to 10 percent of 2004-2006 levels by 2030, while not specifying a phase-down schedule for developing countries.

Proposals to regulate HFCs under the Montreal Protocol have prompted several objections. One objection is that HFCs cannot be regulated under the Montreal Protocol because they are not ozone-depleting substances. But the Montreal Protocol's "parent" convention, the Vienna Convention for the Protection of the Ozone Layer, directs the parties to "co-operate in harmonizing appropriate policies" to protect the ozone layer,[60] which gives them broad authority to take into account factors such as climate change in determining the "appropriate" policies. In deciding to phase-out the use of HCFCs, the Montreal Protocol parties can specify how this phase-out should be accomplished, including which substitute chemicals may be used. Since HFCs have been developed exclusively as substitutes for ozone-depleting substances, the Montreal Protocol parties' authority to specify how a phase-out should be accomplished arguably includes the authority to regulate the use of HFCs.[61]

Another objection to the proposed amendments is that, by imposing obligations on developing countries to limit their use of HFCs, the amendments would violate the principle of common but differentiated responsibilities and respective capabilities, enshrined in the UNFCCC. But even assuming that this principle is applicable to actions by states under the Montreal Protocol, proponents of the proposed amendments argue that they satisfy the principle through the method historically used by the Montreal Protocol to differentiate commitments, namely, to give developing countries an additional ten years in which to comply.

Finally, some developing countries may oppose regulation of HFCs under the Montreal Protocol because it would make it more difficult for them to get credits under Kyoto's Clean Development Mechanism for projects that reduce their use of HFCs.[62]

Despite these objections, support for proposals to amend the Protocol to regulate HFCs is growing. In 2010, more than 90 states joined a declaration calling for action under the Montreal Protocol,[63] and even stronger support is likely at this year's meeting. But objectors include key countries such as China, India and Brazil, and the tradition of consensus decision-making within the Montreal Protocol has made supporters of an amendment reluctant to force the issue through a vote.

Apart from direct regulation of HFCs under the Montreal Protocol, the Montreal Protocol parties have already begun to address the HFC problem through their funding decisions under the Protocol's Multilateral Fund. At recent meetings, the Multilateral Fund has sought to discourage projects relying on HFCs as substitutes for HCFCs and allowed a 25 percent increase in funding to support the use of alternatives with low global warming potentials.

CONVENTION ON LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Background

The Convention on Long-Range Transboundary Air Pollution (CLRTAP) is a regional agreement covering Europe, Russia and North America. Adopted in 1979 under the auspices of the U.N. Economic Commission for Europe (UNECE), it now has eight protocols addressing different types of pollutants, including sulfur dioxide (SO_2), nitrogen oxides (NO_X), volatile organic compounds (VOCs), ammonia, heavy metals, and persistent organic pollutants. In 1999, the parties to CLRTAP adopted the Gothenburg Protocol, which in contrast to earlier CLRTAP protocols adopts a multi-pollutant, multi-effect approach, addressing four pollutants (NO_X, VOCs, SO_2 and ammonia) as well as three effects (acidification, tropospheric ozone formation and eutrophication). The Gothenburg Protocol entered into force in 2005 and has 26 parties, including the United States and the European Community. The Executive Body serves as the governing body of CLRTAP, and is in essence a meeting of the parties.

In recent years, the climate change community has become interested in using CLRTAP as a forum to regulate emissions of black carbon and other short-lived climate forcers, which have largely regional impacts.

Black carbon is a carbonaceous aerosol that is a major component of soot. Although black carbon is not a greenhouse gas, it contributes to global warming by directly absorbing visible sunlight, darkening snow, and influencing cloud formation. According to some studies, black carbon is the second biggest contributor to global warming after CO_2. But there is still no scientific consensus concerning its quantitative contribution to climate change.[64]

Black carbon is emitted from the incomplete combustion of fossil fuels, wood, cow dung and other biomass. The biggest single source of black carbon globally is biomass burning in agriculture and forestry, which accounts for about 40 percent of the total. Domestic heating accounts for about one-fourth of global emissions, transportation about one-sixth, and industry about one-seventh.[65] Among CLRTAP countries, transportation appears to be the largest emissions source, although residential burning, agricultural burning and wildfires are also significant sources.

In contrast to CO_2 and the other gases regulated by the Kyoto Protocol, which stay in the atmosphere for decades or centuries, black carbon has a short atmospheric lifetime, ranging from days to weeks, and is often referred to as a "short-lived climate forcer" (SLCF). It is usually co-emitted with the precursors of tropospheric ozone, another SLCF, as well as organic carbon and sulfur dioxide, both of which tend to cool the atmosphere. Because measures to reduce black carbon would also reduce emissions of these other warming and cooling agents, their full effects remain uncertain.

The short atmospheric lifetime of black carbon has several important consequences. First, reducing emissions has a very immediate effect on concentration levels and hence on temperature. Controlling black carbon could thus play a particularly crucial role in slowing global warming in the near-term. Second, black carbon is not well mixed in the atmosphere, so its effects are largely regional. The climate effects are particularly intense in snow-covered areas, where deposition of black carbon darkens snow and ice, increasing their absorption of sunlight and hence making them melt more rapidly. In addressing black carbon emissions, what matters is not just the total amount of the reductions, but where the reductions occur. Reductions would be particularly beneficial in areas where the emissions are deposited in ice-covered areas such as the Arctic, and could potentially reduce warming of the Arctic by about two-thirds over the next 30 years.[66]

Emissions of black carbon from some sources could be reduced significantly at a relatively low cost using existing technologies. For CLRTAP member states, possible measures include the use of filters and electrostatic precipitators to remove black carbon from exhaust fumes, particle traps in vehicles, and better enforcement of bans on open biomass burning. The recent UNEP/WMO Integrated Assessment estimates that identified measures to reduce global emissions of black carbon and ozone precursors could reduce global warming by 0.5°C, half of the projected increase through 2050. Because black carbon and other particulate matters are linked with respiratory and cardiovascular problems as well as lung cancer, reductions in black carbon emissions would have significant co-benefits for human health.[67]

Current Actions

In 2009, the parties to CLRTAP established an Ad-Hoc Expert Group on Black Carbon, which issued a report in 2010 recommending improving emissions inventories of black carbon and consideration of amending the Gothenburg Protocol to include regulation of black carbon emissions.

At its December 2010 session, the CLRTAP Executive Body agreed that the negotiating body currently considering revisions to the Gothenburg Protocol should include consideration of black carbon as a component of particulate matter. The Executive Body also called for further work on other short-lived climate forcers in its work plan. An amendment to the Gothenburg Protocol concerning black carbon could include requirements for monitoring and reporting (a key element given the lack of accurate emissions inventories currently), country-specific emission limitation goals (for example, as a part of a national ceiling on emissions of particulate matter), and source category-specific emission limit values.[68] The negotiations had originally been intended to conclude in December 2011, but it now appears more likely that the text will be adopted by the Executive Body in spring 2012.

In addition to CLRTAP, black carbon emissions are currently being considered in a number of other forums. For example, the IMO is considering black carbon emissions from shipping in the Arctic region, which are expected to increase by a factor of two to three by 2050. Similarly, the Arctic Council established a Task Force on Short Lived Climate Forcers, which issued an assessment earlier this year of emissions and mitigation actions for black carbon in the Arctic.[69] The 2011 Nuuk Declaration of the Arctic Council calls on states to implement relevant recommendations from the task force report for reducing emissions of black carbon.

Future Actions

Although CLRTAP includes all of the Arctic circumpolar countries, as a regional agreement it lacks authority to regulate emissions of black carbon globally. In particular, it does not include any developing countries as member states, so it could not address emissions of black carbon by China, India, or the other major developing country economies.

Regional agreements addressing air pollution in other parts of the world are still at an early stage of development, but could potentially be used to address black carbon over the longer term. These include the Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia[70] and the ASEAN Cooperation Plan on Transboundary Air Pollution. As the 2011 UNEP/WMO Integrated Assessment suggests, black carbon emissions could also be addressed through various international funds and more general environmental initiatives.[71]

CONCLUSION

Initiatives in multilateral forums such as IMO, ICAO, the Montreal Protocol, and CLRTAP are not an alternative to the UNFCCC and cannot solve the entire climate change problem by themselves. But they could play an important role in supplementing the UNFCCC process, and enabling the global community to achieve the UNFCCC's ultimate objective, namely, the prevention of dangerous anthropogenic climate change.

Initial steps have already been taken to address emissions from international shipping and aviation, and work is currently underway to bring HFCs and black carbon into existing regulatory agreements. Although non-UNFCCC forums are not immune to the political rifts that have made progress in the UNFCCC difficult—including, in particular, the splits between developed and developing countries about how to differentiate commitments—these rifts have not precluded progress in IMO or ICAO, and action under the Montreal Protocol to address HFCs also appears likely.

Despite initial hopes that the climate change problem could be addressed through a single agreement that comprehensively regulates the gases and activities that contribute to climate change, it now appears likely that a more incremental, evolutionary approach will be needed, which breaks the climate change problem down into different parts and gives states greater flexibility in crafting their response.[72] Addressing the climate change problem on a number of fronts, in a number of different multilateral forums, could make a significant contribution to that evolutionary process, and thereby to the international effort to combat climate change.

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ENDNOTES

[1] Abbott 2011.

[2] Id. See also Keohane & Victor 2011.

[3] On sectoral agreements, see generally Bodansky 2007.

[4] Kyoto Protocol Art. 2.2.

[5] For example, the UNFCCC parties only took note of the report of the UN Secretary-General's High-Level Advisory Group on Climate Change.

[6] Van Asselt 2011.

[7] On differential treatment in international law, see generally Rajamani 2006.

[8] Some developing countries have attempted to give the principle of CBDR an extremely rigid definition, in terms of the distinction between Annex I and non-Annex I countries. But the UNFCCC itself created additional categories of countries (Annex II countries, countries with economies in transition, least developed countries) as well as a procedure by which the classification of countries could be reconsidered as circumstances change. UNFCCC Art. 4.2

[9] UNEP 2010.

[10] Because emission reductions resulting from action in other forums are not reflected in the Copenhagen and Cancún pledges, they would be additional to the pledged reductions and would help close the gap identified in the UNEP report. Personal communication with Niklas Höhne, one of the lead authors of the UNEP Gap Report.

[11] Pacala & Socolow 2004.

[12] Kaveh Zehedi, "The Emissions Gap and the Potential Role of Shipping," Presentation to the Third Intersessional Meeting of the Working Group on GHG Emissions from Ships, March 28, 2011. Available at: www.imo.org.

[13] IMO 2009, at 1. These figures do not take into account the emissions reductions that will result from the adoption of the mandatory energy efficiency measures adopted in July 2011, described in more detail below.

[14] Velders et al. 2009.

[15] The Convention and Protocol are often referred to as MARPOL 73/78.

[16] Note by the IMO to the 33rd Session of SBSTA, U.N. Doc FCCC/SBSTA/2010/MISC.14, paper no. 2, at p. 21, para. 36.

[17] Note by the IMO to the 34th Session of SBSTA, U.N. Doc FCCC/SBSTA/2011/MISC.5, Paper No. 2.

[18] MARPOL Annexes I and II have been ratified by 149 states representing 99 percent of the world's maritime tonnage, and MARPOL Annex VI, which entered into force only 6 years ago, already covers nearly 84 percent of the world merchant fleet.

[19] Note by the International Maritime Organization to the 33rd Session of SBSTA, U.N. Doc FCCC/SBSTA/2010/MISC.14, paper no. 2, at p. 19, para. 28.

[20] Id. at p. 20, para. 30.

[21] IMO 2009, at 3. The International Energy Agency (IEA) estimate of GHG emissions from international shipping is lower—about 1.7 percent of global GHG emissions—and there is debate about whether the IMO or IEA methodology is more reliable. See McCollum et al. 2009, at 6. The 2009 IMO report estimates that of overall GHG emissions, more than 99 percent were CO_2, mostly in exhaust gas.

[22] IMO 2009, at 8.

[23] In a 1996 report, the UNFCCC Secretariat identified eight options for how to allocate emissions from the use of international bunker fuels: (1) no allocation; (2) allocation in proportion to national emissions; (3) allocation based on where the bunker fuel is sold; (4) allocation based on the nationality of the shipping company or the ship registration; (5) allocation based on the country of departure or destination of the vessel; (6) allocation based on the country of departure or destination of the cargo; (7) allocation based on the country of origin of the cargo owner, and (8) allocation based on all emissions generated in a state's national space. UNFCCC, Note by the Secretariat: Possible Revisions to the Guidelines for the Preparation of National Communications by Parties Included in Annex I to the Convention, FCCC/SBSTA/1996/9/Add.1, October 24, 1996.

[24] Kyoto Protocol Art. 2.2.

[25] IMO Doc. MP/CONF.3/34.

[26] Christopher Young, "Legal Aspects of the Organization's Work on GHG Emissions from Ships in the Context of the UNFCCC and the Kyoto Protocol," Presentation to the Third Intersessional Meeting of the Working Group on GHG Emissions from Ships, March 28, 2011. Available at: www.imo.org.

[27] Report of the Marine Environment Protection Committee on its Sixty-Second Session, MEPC 62/24/Add.1, Annex 19, July 26, 2011.

[28] Brazil, China, India, Saudi Arabia, and Venezuela made statements after the vote, objecting to the amendment. Id. Annex 20.

[29] MEPC Res. MEPC.203(62), paras. 2, 3.

[30] IMO, Summary of Market-Based Measures Proposals under Consideration within the Expert Group on Feasibility Study and Impact Assessment of Possible Market Based Measures, http://www.imo.org/OurWork/Environment/PollutionPrevention/AirPollution/Documents/Summary%20of%20MBM-EG%20proposals.pdf.

[31] BASIC is a political grouping consisting of Brazil, South Africa, India and China.

[32] IPCC 2007.

[33] Pew Center on Global Climate Change, *Global TechBook, Aviation Emissions Mitigation Strategies,* March 2010.

[34] McCollum, Gould & Greene 2009, at 14.

[35] IPCC 1999.

[36] IPCC 2007.

[37] International Air Transport Association, "Fact Sheet: Alternative Fuels," 2009.

[38] "Consolidated Statement of Continuing ICAO Policies and Practices Related to Environmental Protection—Climate Change," ICAO Assembly Res. A37-19.

[39] States below a *de minimis* threshold of less than 1 percent of total revenue ton kilometers of international aviation are not expected to submit action plans unless they have agreed to voluntarily contribute to achieving the global goals.

[40] The EU had sought a global goal of reducing emissions by 10 percent from 2005 levels by 2020.

[41] Reservations to Resolution A37/10, available at: http://www.icao.int/Assembly37/docs/DOCS_REF.html

[42] The converse is not possible—aviation allowances could not have a higher price than industry allowances—because airlines will be allowed to buy industry allowances to cover their emissions.

[43] Kyoto Protocol Art. 2.2.

[44] Press Information Bureau, Government of India, "International meeting of ICAO Council and Non-EU Member States on Inclusion of Aviation in EU-ETS held," at http://pib.nic.in/newsite/erelease.aspx?relid=76388

[45] ICAO Assembly Res A37-19, preamble para 14.

[46] Among the issues under debate are whether standards should be set for each individual model and whether the standard should apply to an entire flight or just to the cruise phase.

[47] In 2003, U.N. Secretary-General Kofi Annan called the Montreal Protocol "perhaps the single most successful international environmental agreement to date."

[48] UNEP, "Key Achievements of the Montreal Protocol to Date," at http://ozone.unep.org/Publications/MP_Key_Achievements-E.pdf.

[49] The amendment procedures for the Montreal Protocol are set forth in its parent agreement, the Vienna Convention for the Protection of the Ozone Layer, Art. 9.

[50] Kaniaru, Shende & Zaelke 2008. As they note, the Beijing Amendment took two years to enter into force and, as of 2008, had been ratified by only 135 of the 191 parties. Id. at 46.

[51] Montreal Protocol, Art. 2.9.

[52] For example, CFC-11 has a global warming potential (GWP) of 5000, meaning that it is 5000 times more potent, molecule for molecule, than CO_2, and CFC-12 has a GWP of 8500.

[53] UNFCCC, Art. 4.1(a), 4.2(a).

[54] Kyoto Protocol, annex A (listing gases covered).

[55] Montreal Protocol, Decision XIX/6.

[56] Velders et al. 2007 (estimating reductions of 135 $GtCO_2$-eq from 1990-2010).

[57] Fahey & Hegglin 2011, at Q61.

[58] IPCC 2007, table 2.14.

[59] Velders et al. 2009.

[60] Vienna Convention, art. 2.2(b).

[61] Moreover, the Montreal Protocol already recognizes the climatic effects of ODS in its preamble, Montreal Protocol preamble para. 4 ("Conscious of the potential climatic effects of emissions of these substances…").

[62] Although the European Union has decided not to accept such credits in the future, this will not affect the price so long as there are other potential buyers for the credits and the different credits created by the Kyoto Protocol are fungible in the international emissions trading market.

[63] Declaration on the Global Transition Away from HFCs and CFCs, November 2010.

[64] CLRTAP 2010, at 6. The IPCCC Fourth Assessment Report estimated that black carbon forcing is roughly 9 percent to 28 percent as large as carbon dioxide forcing. A more recent study by Ramanathan and Carmichael estimate black carbon forcing as 25 percent to 88 percent of carbon dioxide forcing. Ramanathan & Carmichael 2008.

[65] Bond et al. 2004.

[66] UNEP/WMO 2011, at 3.

[67] Id. at 2-4. The UNEP/WMO report estimates that full implementation of the measures that it identifies could avoid more than two million premature deaths and avoid crop yield losses of more than 50 million tons. Id. at 4.

[68] CLRTAP 2010, at 14-17.

[69] Arctic Council Task Force 2011.

[70] The Malé Declaration was adopted in 1998 under the auspices of the South Asia Cooperative Environment Programme, and includes Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan and Sri Lanka. Thus far it has focused mostly on capacity building, monitoring, and impact assessment.

[71] UNEP/WMO 2011, at 23.

[72] Bodansky & Diringer 2010.

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The Center for Climate and Energy Solutions (C2ES) is an independent nonprofit organization working to promote practical, effective policies and actions to address the twin challenges of energy and climate change.

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