Doc 9885

Guidance on the Use of Emissions Trading for Aviation

Approved by the Secretary General
and published under his authority

First Edition — 2008

International Civil Aviation Organization

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AMENDMENTS

Amendments are announced in the supplements to the *Catalogue of ICAO Publications;* the Catalogue and its supplements are available on the ICAO website at www.icao.int. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENTS		
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CORRIGENDA		
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FOREWORD

One of the ICAO environmental goals is to limit or reduce the impact of aviation greenhouse gas emissions on global climate. In striving to achieve this goal, ICAO has been exploring technological, operational and market-based measures. The 35th Session of the ICAO Assembly in 2004 requested, inter alia, that further guidance on emissions trading be prepared for incorporating international aviation emissions into Contracting States' emissions trading schemes, consistent with the United Nations Framework Convention on Climate Change (UNFCCC) process.

In response to this request, ICAO through its Committee on Aviation Environmental Protection (CAEP) prepared this guidance material. There was a high level of agreement on the technical issues, but CAEP could not reach a consensus on how aircraft operators from countries with and without emissions trading schemes might be treated. A majority of members argued that there should be mutual agreement before countries outside the scheme could be included; others said that to avoid discrimination all operators would need to participate in the scheme, the so-called "geographic scope" question. The debate thus centred on whether Contracting States could integrate international aviation emissions from aircraft operators from other Contracting States without agreement from these States.

When reviewing the guidance on the use of emissions trading for aviation after the Seventh Meeting of CAEP, the Council agreed that it provided valuable technical information to States interested in including international aviation in an emissions trading scheme, and that it should be published as draft guidance, pending further consideration on the issue of geographic scope by the Assembly in September 2007.

At its 36th Session, the Assembly adopted Resolution A36-22 – Consolidated Statement of Continuing ICAO Policies and Practices related to Environmental Protection including an appendix on market-based measures which calls for States to implement an emissions trading system only on the basis of mutual agreement between States. Forty-two States, however, expressed their reservation with this approach.

This *Guidance on the Use of Emissions Trading for Aviation* is intended to be a living document, and as more knowledge on this subject becomes available, it will be improved and updated accordingly. In line with the emphasis from the last Session of the Assembly on ICAO taking a leadership role in all aviation matters related to the environment, I believe that this guidance material is an important step in advancing our knowledge of possible alternative measures to address aviation emissions.

Roberto Kobeh González
President of the ICAO Council

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GLOSSARY

Note.— The terms contained herein are not intended to be universal definitions, but rather to clarify concepts as used in this document.

Accountable entity
A physical or legal person which, in a given emissions trading scheme, is responsible for emissions from international aviation under the scheme.

Aerial work operation
An aircraft operation in which an aircraft is used for specialized services such as agriculture, construction, photography, surveying, observation and patrol, search and rescue, aerial advertisement, etc.

Air Operators Certificate (AOC)
A certificate authorizing an operator to carry out specified commercial air transport operations.

Air navigation service provider (ANSP)
A body that manages flight traffic on behalf of a company, region or country.

Allocation
Method for initial distribution of allowances among States for a commitment period.

Allowance (Emission allowance)
An allowance is a tradable emission permit that can be used for compliance purpose in an emissions trading system. An allowance grants the holder the right to emit a specific quantity of pollution once (e.g. one tonne of CO_2).

Annex B countries
Annex B countries are the 39 emissions-capped industrialized countries and economies in transition listed in Annex B of the Kyoto Protocol.

Annex I countries
Annex I countries are the 36 industrialized countries and economies in transition listed in Annex I of the United Nations Framework Convention on Climate Change (UNFCCC).

Anthropogenic greenhouse gas emissions
Greenhouse gas emissions resulting from human activities.

Assigned Amount (AA) and Assigned Amount Units (AAUs)
A Kyoto Protocol unit equal to one metric tonne of CO_2 equivalent. Each Annex I party issues AAUs up to the level of its assigned amount, established pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol. Assigned amount units may be exchanged through emissions trading.

Auctioning
Auctioning is an initial distribution method in which allowances are sold in an auction.

Available Tonne Kilometres (ATK)
Available (offered) capacity for passengers and cargo expressed in metric tonnes, multiplied by the distance flown.

Baseline
Total amount of allowances distributed to a sector or an individual trading entity.

Benchmarking
An initial distribution method in which allowances are allocated free of charge based on a specific benchmark, for example emissions per unit of output.

Bunker fuels
A term used to refer to fuels consumed for international marine and air transport.

Cap and Trade
The Cap and Trade system involves trading of emission allowances, where the total amount of allowances is strictly limited or 'capped' by a regulatory authority. Allowances are created to account for the total allowed emissions. At the end of each compliance period each entity must surrender sufficient allowances to cover its emissions during that period. Trading occurs when an entity can reduce units of emission at a lower cost than another entity and then sells the allowance. A Cap and Trade system is generally based on those entities included in the cap.

CO_2
Carbon dioxide, a naturally occurring gas that is also a by-product of burning fossil fuels and biomass, land use changes and other industrial processes. Carbon dioxide is the reference gas against which the global warming potential of other greenhouse gases is measured.

CO_2 Equivalent (CO_2e)
The universal unit of measurement used to indicate the global warming potential (GWP) of a greenhouse gas.

Cost(s)
Direct cost for buying emission permits. Indirect cost for operation of an Emissions Trading System.

Certified Emission Reductions (CERs)
A Kyoto Protocol unit equal to one metric tonne of CO_2 equivalent. CERs are issued for emission reductions from CDM project activities.

CH_4
Methane, a greenhouse gas.

Cirrus cloud
A type of cloud composed of ice crystals and shaped like hair filaments. May partly be aviation induced.

Clean Development Mechanism (CDM)
A mechanism under the Kyoto Protocol through which developed countries may finance greenhouse gas emission reduction or removal projects in developing countries, and receive credits for doing so which they may apply towards meeting mandatory limits on their own emissions.

Closed emissions trading
An emissions trading scheme that is designed to limit or reduce emissions within one sector only without providing access to allowances or credits outside the scheme.

Code sharing
Code sharing refers to a practice where a flight operated by an airline is jointly marketed as a flight for one or more other airlines. Most major airlines nowadays have code sharing partnerships with other airlines, and code sharing is a key feature of the major airline alliances.

Commercial air transport operation
An aircraft operation involving the transport of passengers, cargo or mail for remuneration or hire.

Contrails
The condensation trail left behind jet aircraft. Contrails only form when hot humid air from jet exhaust mixes with ambient air of low vapour pressure temperature.

Credit
A term most commonly used in relation to emission reductions that have been achieved below a predefined, agreed baseline. Once the reduction has been verified by an accredited entity, the authority issues a credit. The credit grants the holder the right to emit a specific quantity of pollution once (e.g. one tonne of CO_2).

Distribution
Method for apportioning allowances among accountable entities.

Domestic flights (emissions)
Emissions from civil domestic passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.), including take-offs and landings for these flight stages.

Dry lease
A leasing arrangement in which only the aircraft is provided, without crew or maintenance guarantees. Under a dry-lease arrangement, the aircraft is operated under the AOC of the lessee.

Emission inventory
An emission inventory is a report on actual emissions.

Emission Reduction Unit (ERU)
A Kyoto Protocol unit equal to one metric tonne of CO_2 equivalent. ERUs are generated for emission reductions or emission removals from joint implementation projects.

Emissions trading
Emissions trading is a market-based system that in principle allows entities the flexibility to select cost-effective solutions to achieve established environmental goals. With emissions trading, entities can meet established emission goals by: (a) reducing emissions from a discrete emissions unit within an entity's boundaries; (b) reducing emissions from another place within the entity; or (c) securing emission reductions from the marketplace. Emissions trading encourages the implementation of cost-effective emission reduction strategies and provides incentives to emitters to develop the means by which emissions can inexpensively be reduced. Under the Kyoto Protocol, "emissions trading" is one of the three Kyoto mechanisms by which an Annex I party may transfer Kyoto Protocol units to or acquire units from another Annex I party. An Annex I party must meet specific eligibility requirements to participate in emissions trading.

European Union (EU)
The European Union (EU) is a supranational and intergovernmental union of 25 (27 as of 1 January 2007) independent, democratic member States. The European Union is the world's largest confederation of independent States, established under that name in 1992 by the Treaty on European Union (the Maastricht Treaty). However, many aspects of the Union existed before that date through a series of predecessor relationships, dating back to 1951.

Flexible mechanisms
The Kyoto Protocol has provisions that allow for flexibility in how, where, and when emissions reductions are made via three mechanisms: the Clean Development Mechanism, International Emission Trading and Joint Implementation.

Fungibility
The inter-changeability of emission units (allowances or credits) among the mechanisms.

Gateway
Instrument created to solve trading problems due to lack of AAUs for international aviation under the Kyoto protocol. The aviation sector obtains allocated allowances and can, as a maximum, sell as many allowances as it has already bought during the trading period from non-aviation sectors.

General aviation operation
All civil aviation operations other than commercial air transport operations or aerial work operations.

Geographic scope
Refers to the geographical coverage of aviation emissions under the trading scheme, i.e. specification of the countries, routes and type of flights/aircraft to be included.

Greenhouse gases (GHGs)
The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Less prevalent — but very powerful — greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6).

GTI
Global Temperature Index.

GTP
Global Temperature Potential, indicates global mean temperature change as a result of emissions of a greenhouse gas.

GWP
Global Warming Potentials (GWP) are calculated as the ratio of the radiative forcing of one kilogramme greenhouse gas emitted to the atmosphere to that from one kilogramme CO_2 over a period of time (100 years). Carbon dioxide has been designated a GWP of 1; Methane, for instance, has a GWP of 23.

Grandfathering
Method for the initial distribution of allowances free of charge to entities in an emission trading scheme according to historical emissions.

H_2O
Water (vapour).

HC
Hydrocarbons.

HFCs
Hydrofluorocarbons, a group of greenhouse gases subject to limitations under the terms of the Kyoto Protocol.

Integrated trading
An open emissions trading approach whereby international aviation emissions are incorporated into emissions trading schemes consistent with the UNFCCC process and the Chicago Convention.

Intergovernmental Panel on Climate Change (IPCC)
The Intergovernmental Panel on Climate Change (IPCC) has been established by the World Meteorological Organization (WMO) and the United Nations Environmental Programme (UNEP) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is open to all Members of the UN and of the WMO.

Joint Implementation (JI)
A mechanism under the Kyoto Protocol through which a developed country can receive "emissions reduction units" when it helps to finance projects that reduce net greenhouse-gas emissions in another developed country (in practice, the recipient State is likely to be a country with an "economy in transition"). An Annex I party must meet specific eligibility requirements to participate in joint implementation.

Kyoto commitment period
The Kyoto commitment period is the period in which Annex B countries that have ratified the Kyoto Protocol have committed to reduce their collective emissions of greenhouse gases by an average of 5.2 per cent (2008 to 2012).

Kyoto Mechanisms
Three procedures established under the Kyoto Protocol to increase the flexibility and reduce the costs of making greenhouse gas emissions cuts. They are the Clean Development Mechanism, Emissions Trading, and Joint Implementation.

Kyoto Protocol
An international agreement standing on its own, and requiring separate ratification by governments, but linked to the UNFCCC. The Kyoto Protocol, among other things, sets binding targets for the reduction of greenhouse gas emissions by industrialized countries.

Kyoto Unit
A unit, representing the equivalent of one tonne of carbon dioxide emissions, that a party to the Kyoto Protocol can surrender to meet its Kyoto obligations. These units are tradable between Kyoto parties and includes AAUs, CERs, ERUs, and RMUs.

Leasing
A commercial arrangement whereby one party (the lessor) agrees to provide an aircraft for use to another party (the lessee). (See also >> dry lease and >> wet lease).

Lessee
The party receiving an aircraft under a leasing arrangement.

Lessor
The party providing an aircraft under a leasing arrangement.

NO_X
Nitrogen oxides, a generic term for oxides of nitrogen (NO, NO_2, NO_3).

N_2O
Nitrous oxide, a greenhouse gas.

Non-Annex B countries
Countries not included in Annex B of the Kyoto Protocol. Non-Annex B countries currently do not have binding emission reduction targets.

Non-Annex I countries
Countries not included in Annex I of the United Nations Framework Convention on Climate Change (UNFCCC).

O_3
Ozone.

Offset
An emissions reduction achieved by undertaking a greenhouse gas emission reduction project.

Open emissions trading
An emissions trading system where allowances can be traded in and outside the given scheme or sector. For example, within an emissions trading scheme for aviation, participants would be allowed to buy allowances from sectors outside the aviation emissions trading scheme.

Operator
A person, organization or enterprise engaged in or offering to engage in an aircraft operation.

PFCs
Perfluorocarbons, a group of greenhouse gases.

Radiative forcing (RF)
A change in average net radiation (in Wm-2) at the top of the troposphere resulting from a change in either solar or infrared radiation due to change in atmospheric greenhouse gas concentrations; perturbance of the balance between incoming solar radiation and outgoing infrared radiation.

RFI
Radiative Forcing Index

Removal Unit (RMU)
A Kyoto Protocol unit equal to one metric tonne of CO_2 equivalent. RMUs are generated in Annex I parties by land use, land-use change and forestry (LULUCF) activities that absorb carbon dioxide.

Revenue Tonne Kilometres (RTK)
Utilized (sold) capacity for passengers and cargo expressed in metric tonnes, multiplied by the distance flown.

Soot
Substance emitted by aircraft; may have both warming and cooling climate impacts.

SBSTA
Established by the UNFCCC Conference of Parties (COP), the Subsidiary Body for Scientific and Technological Advice (SBSTA) provides advice to the COP on scientific, technological and methodological matters.

Sulphate
Substance emitted by aircraft, which may have a cooling impact.

SF_6
Sulphur hexafluoride, a greenhouse gas.

Surrendering
Handing in of allowances for emissions by the accountable entity in order to fulfil the obligations under the emissions trading scheme.

Tankering
The practice of aircraft operators taking up fuel at airports with lower fuel prices.

Trading entity
Entities obliged to surrender allowances for emissions generated that are allowed to trade.

United Nations Framework Convention on Climate Change (UNFCCC)
The Convention on Climate Change sets an overall framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The Convention enjoys near universal

membership, with 189 countries having ratified. Under the Convention, governments gather and share information on greenhouse gas emissions, national policies and best practices, launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries and cooperate in preparing for adaptation to the impacts of climate change.

Verification
Verification provides independent assurance that emissions reporting has been realized in an accurate manner. The verifiers are accredited. The level of assurance provided will depend on the scope of the verification which is usually agreed by the transacting parties and may include: adequacy of measuring and monitoring systems for emission reduction credits, reviewing the operations of the underlying emission reductions project, etc.

Wet lease
A leasing arrangement in which the aircraft is provided plus at least one pilot. Under a wet-lease arrangement, the aircraft is normally operated under the AOC of the lessor. A wet lease is typically utilized during peak traffic seasons or annual heavy maintenance checks, or to initiate new routes. When an air carrier provides less than an entire aircraft crew, occasionally the wet lease is referred to as a damp lease.

Chapter 1

GENERAL

Introduction

1.1.1 The 35th Session of the ICAO Assembly in October 2004 unanimously adopted Resolution A35-5 on both aircraft noise and aircraft engine emissions[1]. The Assembly adopted the environmental goal of limiting or reducing the impact of aviation greenhouse gas emissions on the global climate and endorsed "the further development of an open emissions trading system for international aviation".

1.1.2 In this context, the Assembly further requested the ICAO Council to prepare "guidance for use by Contracting States, as appropriate, to incorporate emissions from international aviation into Contracting States' emissions trading schemes consistent with the UNFCCC process [and that it] address the structural and legal basis for aviation's participation in an open emissions trading system, including key elements such as reporting, monitoring and compliance." This document has been prepared in response to that request.

1.1.3 It should be noted that this guidance is not of a regulatory nature; rather, it provides States with advice and information that they may need or find helpful. It cannot, and does not purport to, cover every conceivable issue that might arise: indeed ICAO recognizes that Contracting States have their own legal obligations, existing agreements, current laws and established policies. States should therefore consider how best to apply this guidance to their specific circumstances. The scope of this guidance material extends exclusively to international civil aircraft operations and does not include State aircraft, which covers military, customs and police services.

ICAO Resolution A35-5

1.1.4 Appendix I of ICAO Assembly Resolution A35-5 addressed market-based measures regarding aircraft engine emissions, which include emissions trading. Relevant to emissions trading, the ICAO Assembly noted the following points:

- that "market-based measures are policy tools that are designed to achieve environmental goals at a lower cost and in a more flexible manner than traditional regulatory measures";
- that "Principle 16 of the Rio Declaration on Environment and Development (1992) states that 'National authorities should endeavour to promote the internalization of environmental costs and the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment'"; and
- that "whereas the Kyoto Protocol treats international and domestic emissions from the aviation sector differently, the potential advantages of harmonizing treatment of the two categories of emissions have been noted …".

1. ICAO Assembly Resolution A35-5, *Consolidated Statement of Continuing ICAO Policies and Practices related to Environmental Protection*, available at http://www.icao.int/cgi/goto_m.pl?icao/en/assembl/a35/documentation.htm

1.1.5 Assembly Resolution A35-5 further encouraged "Contracting States and the Council, taking into account the interests of all parties concerned, including potential impacts on the developing world, to evaluate the costs and benefits of the various measures, including existing measures, with the goal of addressing aircraft engine emissions in the most cost-effective manner and … with Contracting States striving to take action in a consistent manner to both domestic and international aviation emissions".

ICAO Resolution A36-22

1.1.6 ICAO Assembly Resolution A36-22 – *Consolidated Statement of Continuing ICAO Policies and Practices related to Environmental Protection* was adopted in September 2007 superseding A35-5. Appendix L of ICAO Assembly Resolution A36-22 addresses market-based measures regarding aircraft engine emissions, which include emissions trading. Further to the points already stated in A35-5, the ICAO Assembly noted that "the majority of the [ICAO] Contracting States endorse the application of emissions trading for international aviation only on the basis of mutual agreement between States, and that other Contracting States consider that any open emissions trading system should be established in accordance with the principle of non-discrimination"; and that ICAO has issued *Draft Guidance on the Use of Emissions Trading for Aviation* (Doc 9885 – Provisional Edition).

1.1.7 Assembly Resolution A36-22 urges States not to implement an emissions trading system except on the basis of mutual agreement with other States and requests them to report on new developments, results and experiences in this area.

1.1.8 Assembly Resolution A36-22 further requests the Council to finalize and update the present guidance and to conduct further studies and economic analyses on various aspects of the implementation of emissions trading systems as well as to evaluate the cost-effectiveness of any systems put in place.

Background, purpose and scope

1.1.9 Aviation plays a key role in the world economy, providing the ability to move people and products all over the globe quickly and safely. Though there has been a history of increased fuel and performance efficiency, the nature of aviation limits the technology options available to directly reduce emissions. It is those technology limitations, along with the projected rate of growth in the aviation industry, that have contributed to ICAO's consideration of market-based options such as emissions trading as one possible approach to address aviation emissions.

1.1.10 An open emissions trading approach is considered preferable to a closed emissions trading approach as it provides for trading both within and between sectors. Because of the high relative costs of aviation technology and the lack of substitute energy sources, allowance prices for the open trading system would be substantially lower than under a closed trading system which is designed to limit emissions within one sector only without providing access to allowances or credits outside the scheme. Open emissions trading offers the economic advantage of achieving reductions in a more cost-effective way than closed emissions trading.

1.1.11 As noted above, this document was prepared at the request of the ICAO Assembly to provide ICAO Contracting States with advice and practical information they might be able to use when incorporating emissions from international aviation into emissions trading schemes. The inherent mobility of international aviation, however, challenges the ability to readily incorporate its emissions into traditional emissions trading mechanisms. To facilitate this process, the guidance focuses on those aspects of emissions trading that require consideration with respect to aviation-specific issues; it identifies options and offers potential solutions where possible.

1.1.12 The guidance does not describe or explain generic emissions trading mechanisms, design options or processes. However, to help facilitate broader understanding, relevant background information on emissions trading is available at the ICAO website (www.icao.int). Definitions of terms used in the guidance can be found in the Glossary.

1.1.13 The guidance addresses the aviation-specific options for the various elements of trading systems, such as accountable entities, emissions sources and species (gases) to be covered, trading units, base year and targets, allowance distribution, monitoring and reporting, and geographical scope. Since most emissions trading schemes define emissions sources in terms of fixed ground-based installations, the guidance addresses how emissions sources could be defined for aviation.

1.1.14 The guidance notes that emissions from international aviation are excluded from the national totals reported by Parties to the United Nations Framework Convention on Climate Change (UNFCCC) and provides options for including those emissions in trading schemes.

1.1.15 Many issues considered in this guidance will be interdependent on, or require knowledge of, other design criteria. It is unlikely that a full assessment of a trading scheme can be made until all of the elements have been taken into account. The order in which the design elements are presented in the guidance does not imply any specific hierarchy in their relative importance.

1.1.16 It is recognized that this guidance material may not provide the level of detail necessary to assist ICAO Contracting States in addressing every issue that might arise, given that there may be unique legal, technical or political situations for particular States. It is therefore advised that ICAO Contracting States use this guidance material as supporting material, to be shaped and applied to specific circumstances.

1.1.17 This edition of the guidance material has been revised following the directions given in Assembly Resolution A36-22, in particular with respect to the issue of geographical scope. Additional revisions may be warranted over time in light of emissions trading developments.

Chapter 2

OPERATIONAL BOUNDARIES

2.1 ACCOUNTABLE ENTITIES

2.1.1 This section provides guidance on the definition of accountable entities for the international aviation sector, describes the advantages and disadvantages of the several options available and establishes recommendations on the most suitable choice.

2.1.2 In the context of this guidance material, an accountable entity is a physical or legal person which, in a given emissions trading scheme, is responsible for emissions from international aviation under the scheme. A proper identification of the accountable entities is crucial for addressing aviation emissions in an effective and transparent manner.

Assessment of options

2.1.3 Paragraphs 2.1.5 to 2.1.19 provide more information associated with each possible choice of accountable entity, i.e. aircraft operators, fuel suppliers, air navigation service providers, airport operators and aircraft manufacturers. Each of these options is associated with particular advantages and disadvantages in terms of environmental effectiveness, possible distortions in competition and administrative and legal feasibility. These advantages and disadvantage are also summarized in Table 2-1.

2.1.4 Each option is likely to lead to cost increases for the accountable entities, either the cost of action to reduce emissions, the cost of acquiring allowances, or the costs relating to the administration of the trading scheme. This section compares the options in terms of how well those costs translate into price signals that will drive emissions reductions.

Aircraft operators

2.1.5 Under this option, aircraft operators will be required to hold the necessary number of allowances covering all relevant emissions of their aircraft engaged in international transport.

2.1.6 An important advantage of this option is that aircraft operators can in principle provide all the relevant data required to participate in a trading system. They also have a substantial degree of control over technical and operational measures to improve efficiencies in order to reduce engine emissions. Environmental benefit may accrue because of an added incentive for operators to further minimize fuel consumption.

2.1.7 Administrative difficulties might arise due to the number of aircraft operators included in the trading scheme. This can be solved by introducing a *de minimis* inclusion threshold. This is further addressed in section 2.2.

2.1.8 Another possible disadvantage would be the inappropriate burden placed on aircraft operators related to emissions resulting from Air Navigation Systems (ANS) inefficiencies such as delays, holdings and the use of non-optimized routes.

Table 2-1. Advantages and disadvantages of options for accountable entities.

Aircraft Operator	**Advantages** a) Can provide all the relevant data to participate in a trading system. b) Substantial degree of control over technical and operational measures to reduce engine emissions. **Disadvantages** a) ANS inefficiencies may place inappropriate burden on aircraft operators. b) Depending on the number of aircraft operators covered by the trading scheme, administrative difficulties might arise.
Fuel Suppliers	**Advantages** a) Relatively small number of fuel suppliers to include in the scheme. **Disadvantages** a) May be difficult to accurately distinguish between the fuel provided to international and domestic aviation. b) Unintended incentives for operators to increase tankering practices.
Air Navigation Services Providers	**Advantages** a) Additional incentive to reduce delays and holdings and to provide the shortest routes. **Disadvantages** a) Creating correct price signals could be challenging, particularly where ANSPs operate as monopolies.
Airport Operators	**Advantages** a) Closer to the concept of conventional emission trading schemes, since it would be managed in a way similar to that for stationary installations. **Disadvantages** a) Creating correct price signals could be challenging. b) Gaining access to the necessary data transfer of sensitive or confidential data between two private entities would be required.
Aircraft Manufacturers	**Advantages** a) Additional incentive to develop aircraft with superior engine characteristics, specifically fuel efficiency. **Disadvantages** a) No continuing incentives to improve operational efficiencies. b) Could result in unequal treatment among aircraft operators.

Fuel suppliers

2.1.9 If fuel suppliers are selected as accountable entities, they will have the obligation to hold the required allowances on the basis of the carbon content of the fuel sold to aircraft operators. The selection of fuel suppliers as accountable entities would provide an indirect incentive for emissions reductions as aircraft operators — and their customers — would be expected to respond to higher fuel prices. The relatively small number of fuel suppliers may also be an advantage.

2.1.10 Drawbacks of choosing fuel suppliers as accountable entities include the fact that it may be difficult for fuel suppliers to accurately distinguish between international and domestic aviation, and fuel tankering practices by operators might increase.

Air Navigation Services Providers

2.1.11 Under this option, Air Navigation Services Providers (ANSPs) will be obliged to hold allowances covering emissions from all international flights operated within the airspace under their control.

2.1.12 Choosing ANSPs as the accountable entities may create additional incentives for these entities to reduce delays and holdings and to provide the shortest routes for operators to fly. The way in which the costs are passed on is critical if the additional costs imposed on operators are to truly reflect the actual emissions. Defining appropriate mechanisms for providing correct price signals could be challenging, particularly where ANSPs operate as monopolies.

Airport operators

2.1.13 Under this approach, airport operators within the territory of the State will have to hold allowances to cover the emissions produced by the international flights arriving at or departing from their airports.

2.1.14 In terms of integrating aviation into an emissions trading scheme, this option would manage emissions in a way similar to that for stationary sources. However, airports do not have direct access to all relevant data, and defining appropriate mechanisms for providing correct price signals could be challenging. For example, an increase in landing fees is generally less effective than measures directly related to fuel use.

2.1.15 This option would require aircraft operators to monitor and report their emissions to the airport operators. Aircraft operators would therefore be actively involved even though they are not obliged to surrender allowances themselves. The rules under which aircraft operators would have to report emissions to airport operators might have to be defined centrally within each trading scheme and not left to the discretion of the airports.

Aircraft manufacturers

2.1.16 Under this option, aircraft manufacturers will be required to hold the relevant number of allowances when they deliver an aircraft to their customers. In this case the emissions produced by an aircraft would have to be calculated up-front.

2.1.17 This option would assign to each individual aircraft of a given aircraft type a specific amount of emission “credits” reflecting the desired amount of emissions during its projected useful life. In theory, this could provide manufacturers with an added incentive to develop aircraft with superior emissions characteristics

2.1.18 A drawback is that this may lead to higher production costs for manufacturers, translating into higher product prices for operators. Once an aircraft is sold there would be no further incentive under the emissions trading scheme to reduce the emissions resulting from the operation of the aircraft.

2.1.19 The assignment of a pre-defined amount of emissions credits to individual aircraft of the same aircraft type may result in the unequal treatment of aircraft operators who would pay for identical amounts of credits irrespective of the actual amount of emissions the aircraft would produce during their lifetime.

Guidance

2.1.20 To the extent that international aviation is to be covered within an emission trading system, the preferred option is to select aircraft operators as accountable entities, for the reasons described in this section.

2.1.21 For the purposes of the remainder of this document it is assumed throughout that the aircraft operator will be the accountable entity.

Determination of aircraft operator

2.1.22 The method for identifying the aircraft operator for emissions trading purposes would need to be sufficiently precise to enable aircraft operators and regulators to identify the entity responsible for emissions from any given flight whilst retaining flexibility to take into account the numerous types of commercial arrangements common in the aviation sector. Examples of such commercial arrangements include wet and dry leasing, code-sharing and the use of subcontractor airlines to operate portions of an airline network.

2.1.23 Indicators of who is the operator should be clearly specified and could include:

— the ICAO designator used in the flight plan; or

— the holder of an Air Operators Certificate (AOC) in which the aircraft is listed.

2.1.24 In order to ensure that it is always possible to identify an aircraft operator responsible for the emissions from a flight, there should be a clear default position. This could be achieved by providing that if the operator is unknown the owner of the aircraft would be considered to be the operator unless he can demonstrate that another person was the operator.

2.1.25 The administrative issues which arise in relation to the identification of the aircraft operator responsible for emissions from a particular flight have some similarities with those related to the identification of the aircraft operator for the purpose of billing en-route air navigation charges. States may already have systems in place for that purpose which have proved to be workable and are understood by aircraft operators. In order to avoid an additional administrative burden for operators and regulators, States may, therefore, wish to consider taking a similar approach to identifying the aircraft operators responsible in an emissions trading system.

Commercial arrangements

Contractual provisions

2.1.26 Potentially accountable entities may want to shift the burden of the responsibility for aviation emissions to another such entity. Such agreements between potentially accountable entities on who is responsible for emissions from the flight should be communicated to the relevant regulatory authority responsible for the administration of the trading scheme.

2.1.27 In the context of an emissions trading scheme for international aviation, leasing and code-share arrangements can create complexities with regard to assigning responsibility for surrendering emissions allowances and the monitoring and verification of emissions in order to avoid double-counting or omissions. The treatment of these arrangements must be addressed in order to unambiguously delineate responsibility for the emissions from each flight.

Leasing arrangements

2.1.28 In the case of a “dry lease” arrangement responsibility for emissions would rest with the lessee as the aircraft operator.

2.1.29 In the case of a “wet lease” arrangement responsibility for emissions might rest with the lessee, notwithstanding the fact that the lessee is not the AOC holder.

Code-share arrangements

2.1.30 Under code-sharing arrangements, one specific operator actually operates the aircraft, but this same flight is shared with one or more other carriers.

2.1.31 Responsibility for emissions would rest with the operator that actually operates the flight.

Guidance

2.1.32 The method for identifying the responsible aircraft operator would need to be sufficiently precise to enable aircraft operators and regulators to identify the entity responsible for emissions from any given flight whilst retaining flexibility to take into account the numerous types of commercial arrangements common in the aviation sector. Examples of relevant indicators could be the AOC under which the aircraft is operated or the ICAO designator used in respect of the flight.

2.1.33 To ensure that it is always possible to identify an aircraft operator responsible for the emissions from a given flight, there should be a clear default position to determine the final responsibility on objective grounds in case of disputes between the commercial entities involved in operating the flight.

2.2 EMISSIONS SOURCES

Background

2.2.1 This section considers the following two issues:

1) the level at which obligations under an emissions trading scheme should be applied in the aviation sector; and

2) whether the scheme should include a *de minimis* threshold.

Specific considerations

2.2.2 Current emissions trading schemes apply obligations separately to each fixed ground-based installation. This means that operators receive a separate allocation of allowances for each installation and are required to monitor and report emissions and surrender allowances separately for each installation. As aircraft are mobile sources of emissions and aircraft operators continually change routes, frequencies, and the aircraft fleets that fly those routes, this installation-based approach is deemed unsuitable for aviation.

2.2.3 Applying obligations at the level of an aircraft would result in a large number of separate sources and would increase the administrative burden of the scheme for aircraft operators and regulators. This would also be the case if the

obligations under the scheme were applied at the level of flight routes. It is therefore recommended that the obligations under the scheme should be applied on the basis of the total aggregated emissions from all covered flights performed by each aircraft operator included in the scheme.

Thresholds and exclusions

2.2.4 In order to determine a basis for inclusion in emissions trading, two aspects can be identified, namely the type of activity (i.e. commercial or general aviation) and the volume of activity (e.g. number of flights, available tonne-kilometres or amount of emissions).

2.2.5 Further, a definition of threshold may be considered in order to establish an adequate balance between emissions coverage on the one hand and administrative burden on the other. Key principles for defining a threshold are simplicity and avoidance of perverse incentives.

2.2.6 While it is recognized that it is sometimes desirable to exclude certain types of air transport activity from an emissions trading scheme, any exemptions would require a strong justification.

2.2.7 Generally, a *de minimis* threshold can be based on aircraft weight, number of operations or aggregate air transport activity.

2.2.8 In designing an inclusion threshold, care needs to be taken to minimize the incentive for aircraft operators to deliberately avoid inclusion in the scheme by operating just below the threshold. To minimize such avoidance, the inclusion threshold needs to be set at a level at which the potential economic benefits from operating beneath the threshold are either totally or mostly counter-balanced by the economic inefficiency resulting from operating at this level. Regular review and possible adjustment of the inclusion threshold would provide a further disincentive for aircraft operators to avoid inclusion.

Weight-based threshold

2.2.9 An example of a weight threshold in international legislation exists in ICAO Annex 16, Volume I (Aircraft Noise). It uses a limit of 8 618 kg to distinguish aircraft covered by Chapters 3 and 4 from those covered under Chapters 6 and 10. The same limit has also been used in charging systems for local emissions. For the purpose of technical regulations, the ICAO *Manual on the Regulation of International Air Transport* (Doc 9626) makes a distinction between large and small aircraft, using a limit of 5 700 kg.

2.2.10 Because small aircraft tend to fly shorter distances and consume less fuel per distance, their overall emissions contribution, relative to the number of operations, also tends to be small. The exclusion of small aircraft may therefore not significantly affect the environmental effectiveness of an emissions trading scheme.

2.2.11 An additional argument for setting a weight level is that the fleet mix for small aircraft is very diverse, and ex ante emission calculations are relatively unreliable.

Operations-based threshold

2.2.12 Setting a threshold based on the number of operations does not take account of the contribution of the operation to CO_2 emissions. The number of operations may be small, but the contribution to CO_2 emissions could be significant.

Activity-based threshold

2.2.13 An inclusion threshold may be based on the total activity of an operator. One possibility is to define the threshold based on the total CO_2 emissions. Another possibility is to define the threshold in terms of the Available Tonne Kilometres (ATK) associated with each source.

2.2.14 If a source were defined as all flights by an operator within the geographical scope, inclusion in the scheme would be determined by comparing the operator's actual activity within the scope with the inclusion threshold value. Care must be taken to prevent the creation of multiple separate sources that each fall below the inclusion threshold.

Guidance

2.2.15 It is therefore recommended that the obligations under the scheme should be applied on the basis of the total aggregated emissions from all covered flights performed by each aircraft operator included in the scheme.

2.2.16 It is recommended, however, that aircraft operators ensure appropriate systems for data collection and management prior to implementation of aviation into an emissions trading scheme.

2.2.17 States should seek to include all types of civil air transport operations in emissions trading, without exception, recognizing that small operations or small aircraft may automatically be excluded on the basis of an inclusion threshold.

2.2.18 States should consider applying an inclusion threshold based on aggregate air transport activity, aggregate CO_2 emissions and/or aircraft weight.

2.3 EMISSIONS SPECIES

2.3.1 Inclusion of aviation in an emissions trading system would require a decision regarding aviation emissions to be covered by the scheme.

2.3.2 The primary direct greenhouse gas emissions of aircraft are carbon dioxide (CO_2) and water vapour (H_2O). Other emissions are oxides of nitrogen (NO_x), particles containing sulphur oxides (SO_x) and soot. The total amount of aviation fuel burned, as well as the total emissions of carbon dioxide, NO_x, and water vapour by aircraft, are well known relative to other parameters such as aerosols. These gases and particles alter the concentration of ozone (O_3) and methane (CH_4), may trigger formation of condensation trails (contrails), and may increase cirrus cloudiness — all of which may contribute to climate change.

2.3.3 According to estimates produced in the Intergovernmental Panel on Climate Change (IPCC) aviation report (1999), the overall radiative forcing from aircraft effects (excluding that from changes in cirrus clouds) in 1992 was a factor of 2.7 larger than the forcing by aircraft carbon dioxide alone.[1] The IPCC concluded that there were varying levels of scientific understanding (e.g. ranging from "very poor" in the case of cirrus to "good" for CO_2)[2] associated with these effects. Further research into such non-CO_2 effects is ongoing, and IPCC is expected to provide an update in its fourth assessment report due in 2007. These radiative forcings represent the best estimate of the effects of aviation on climate for the reported year, i.e. 1992. However, for aviation's past, present or future emissions, the radiative forcing index should not be used to derive relationships between emissions and marginal changes in climate, as the Global Warming Potential (GWP) is intended to do.

1. The so-called RFI or radiative forcing index is defined by the 1999 IPCC Special Report on "Aviation and the Global Atmosphere" as the sum of all the forcings divided by the CO_2 forcing (Chapter 6, paragraph 6.2.3)
2. For further details see the 1999 IPCC Special Report on "Aviation and the Global Atmosphere" and the IPCC Third Assessment Report: Climate Change 2001.

2.3.4 The GWP metric was developed by the IPCC to compare the climate impacts of changes on emissions of long-lived well-mixed gases to that of CO_2 over a specific time horizon. It is used by the UNFCCC process in establishing emissions equivalencies for emissions reduction targets and activities. CO_2 impacts from aviation are the longest lived and most well-defined and are readily defined in terms of GWP. Formulating GWPs from non-CO_2 effects from aviation has conceptual difficulties, and the IPCC (1999) stated that such GWPs were not adequate to describe the climate impacts of aviation (see IPCC, 1999, Chapter 6, section 6.2.2).

2.3.5 For further information on emissions from the aviation sector, please refer to the most current IPCC Assessment Report and the IPCC Special Report on Aviation and the Global Atmosphere.

Guidance

2.3.6 CO_2 emissions from aviation are the largest and most certain sources of GHG emissions from the aviation sector; other non-CO_2 effects are potentially significant but there still exists a high degree of scientific uncertainty associated with them.

2.3.7 Given these uncertainties, it is recommended starting with an emissions trading scheme that includes CO_2 alone.

2.3.8 This does not preclude States from considering the inclusion of other aircraft emissions that contribute to climate change in a trading scheme, as scientific understanding evolves about the effects of non-CO_2 aircraft emissions.

Chapter 3

REGULATORY CONSIDERATIONS

3.1 INTERNATIONAL AND DOMESTIC EMISSIONS

3.1.1 The UNFCCC framework addresses greenhouse gas emissions differently, depending on whether they are generated by domestic or international operations. ICAO has developed, and is continuing to develop, approaches to address greenhouse gas emissions from international aviation. For countries with commitments under Annex B of the Kyoto Protocol, greenhouse gas emissions from domestic aviation are included in their Kyoto targets.

3.1.2 Consistent with their Kyoto obligations, some countries listed in Annex B to the Kyoto Protocol are developing policies and measures to address emissions from the domestic operations of their air carriers. This difference between the approaches for addressing domestic and international emissions makes it important to distinguish between international and domestic operations.

3.1.3 The need to define "international" versus "domestic" operations in the context of emissions trading is a unique situation for the international aviation (and international maritime) industries. Stationary sources, such as power plants, manufacturing facilities and the like, which are subject to greenhouse gas emissions reduction targets by virtue of their State's policies, are completely resident within the States imposing those targets on their industries.

3.1.4 In contrast, aircraft (and ships) that travel internationally may be registered in States that are not subject to greenhouse gas emission reduction targets and/or may travel to and from States that may or may not be subject to such targets. Moreover, to the extent that States have agreed to emission targets under the Kyoto Protocol, only the domestic portion of aviation and maritime operations, as defined in the UNFCCC framework, are subject to the State targets in the first Kyoto commitment period (2008-2012).

3.1.5 The IPCC produced its *2006 Guidelines for National Greenhouse Gas Inventories* at its 25th session. These guidelines represent the state-of-the-art technical guidance of experts in the aviation, maritime, and inventory fields.

3.1.6 The guidelines clarify how countries differentiate between emissions from domestic and international flights. Emissions from international aviation (International Bunkers) are defined as " Emissions from flights that depart in one country and arrive in a different country, including take-offs and landings for these flight stages" (partial quote)[1].

3.1.7 Emissions from domestic aviation are defined as "Emissions from civil domestic passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.), including take-offs and landings for these flight stages" (partial quote) [2,3].

1. The IPCC definition adds the following about military operations: "Emissions from international military aviation can be included as a separate sub-category of international aviation provided that the same definitional distinction is applied and data are available to support the definition." This is of no relevance to the discussion in this document.
2. The IPCC definition adds the following about military operations: "Emissions from military flights are excluded as these are reported under 1 A 5 b." This is of no relevance to the discussion in this document.
3. Note that this may include journeys of considerable length between two airports in a country (e.g. San Francisco to Honolulu).

3.1.8 ICAO's standard definition of "international" versus "domestic" flights is slightly different than the definition in the IPCC guidelines, in that the ICAO definition of a "domestic flight" does not include flights purely within one State that is not the principal place of business of the airline operator, while the IPCC guidelines do consider such flights as "domestic." For purposes of emission trading, however, the IPCC guidelines definition is preferred, as States' reporting obligations for greenhouse gas emissions are based on the IPCC definition.

Guidance

3.1.9 States should use the IPCC 2006 Guidelines definition of international and domestic emissions for the purposes of accounting GHG emissions as applied to civil aviation. It is important that States apply this definition for purposes of any carriers included in the emissions trading scheme. The IPCC approach is internationally accepted and will help ensure consistency between the various approaches of States addressing domestic and/or international greenhouse gas emissions.

3.2 GEOGRAPHIC SCOPE

Background

3.2.1 This section provides guidance to States in making decisions relating to the geographic scope of efforts to incorporate emissions from international aviation into their emissions trading schemes. As the basis for the discussion in this section, it is assumed that the accountable entities would be the aircraft operators (See Chapter 2, Section 2.1)

3.2.2 Including emissions from stationary sources is geographically simple, because emissions physically occur within the territory of a given State. However, this is not the case for emissions from non-stationary sources, such as from international aviation, which by definition are not geographically contained wholly within one State. This adds complexity to the inclusion of international aviation in an emissions trading scheme.

3.2.3 The UNFCCC Secretariat, in advice to the 179th ICAO Council, confirmed that the UNFCCC and the Kyoto Protocol confer no guidance in relation to emissions trading schemes not provided for in either of these agreements. The Kyoto Protocol does not provide for inclusion of international aviation emissions from either Annex I or non-Annex I parties. Article 2.2 of the Kyoto Protocol states that parties "included in Annex I shall pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation … bunker fuels, working through the International Civil Aviation Organization".

Options for including foreign aircraft operators

3.2.4 A key issue for international aviation emissions trading is how States might integrate emissions from aircraft operators of other States in a given emissions trading scheme. Generally there are two approaches States could take to the integration of emissions from foreign aircraft operators into an emissions trading scheme:

1) Mutual agreement; or

2) Alternative to mutual agreement.

Mutual agreement

3.2.5 Under this approach, a State or group of States operating an emissions trading scheme would seek to include foreign aircraft operators in the scheme through mutual agreement between the State(s) responsible for administering the scheme and the State in which the aircraft operator is based.

3.2.6 The scheme would only include flights operated by aircraft operators registered in the State(s) participating in the scheme. Aircraft operators from other States could only be obliged to participate in the scheme on the basis of bilateral or multilateral agreements.

Advantages

3.2.7 An advantage of mutual agreement is that it provides for certainty in relation to the participation of the covered foreign aircraft operators and facilitates the enforcement of obligations under the scheme.

3.2.8 A benefit of this type of approach would be equitable treatment in the sense that all carriers operating on a given route within the jurisdiction and geographic scope of the scheme would be subject to the same obligations.

3.2.9 This approach has the advantage of clear political acceptability in that explicit State by State consensus would minimize the risk of disputes between States.

Disadvantages

3.2.10 If a State wanted to include all airlines operating on a given route, the mutual agreement approach would have the disadvantage of requiring that State to negotiate agreements with all States whose carriers operate on that route. This could be time-consuming and may increase the risk of a fragmented approach.

3.2.11 The potential for State(s) to not accede to the inclusion of its carriers could result in unequal application of the scheme and competitive distortion between carriers on the same route.

3.2.12 There could be additional complications such as avoidance behaviour if airlines change leasing or code-share arrangements.

Alternative to mutual agreement

3.2.13 Under this approach, a State or group of States operating an emissions trading scheme would seek to mandate the inclusion of foreign aircraft operators in a given emissions trading scheme in the absence of specific mutual agreement.

3.2.14 Operators would be included in the scheme if they operate on the routes or within the airspace covered by the scheme without distinction as to nationality.

Advantages

3.2.15 Under this approach all carriers operating on the same route would be subject to the same rules regardless of their nationality. Also, competitive distortions could be avoided, as long as all operators have equivalent obligations.

3.2.16 This approach could provide for non-discriminatory treatment of carriers of other States.

Disadvantages

3.2.17 The approach has the disadvantage that it may be disputed, with potential consequential delays and/or lack of uniformity.

3.2.18 This approach could also encourage aircraft operators to avoid the scheme, which could also potentially lead to competitive distortion, trade disruptions and an increase in emissions.

3.2.19 The application of this approach, which may be appropriate for a State or group of States, may not be appropriate for other States given the divergent approaches and circumstances of different States.

Options for the architecture of geographic coverage

3.2.20 Once the matter of participation by foreign aircraft operators has been addressed, there are the following architectural elements for a State to consider in deciding how to delimit the geographic scope in an emissions trading scheme:

— Routes: those that delimit the geographic scope to incorporate emissions from flights operated on selected routes, including decisions regarding whether to incur obligations on departure and/or arrival.

— Airspace: those that use nationality of airspace as a criterion for delimiting geographic scope.

3.2.21 There are multiple considerations in choosing among the options for designating geographic scope such as administrative burden, total emissions covered, accuracy or equity in treating the source of emissions and potential compatibility with schemes adopted by other States. As States seek to include international flights within their respective trading schemes, and different States might do so at different times, it is preferable to have a common means of designating coverage so duplication is avoided and the potential for compatibility is enhanced.

Routes

3.2.22 This option corresponds to delimiting the scope of the scheme to incorporate emissions from flights operated on selected routes. State(s) participating in an emissions trading scheme will need to decide which international routes are covered by the scheme. It is not necessary to cover all routes to and from a country.

3.2.23 State(s) would need to decide whether to include in the scheme emissions from flights arriving or departing on predetermined routes. A combination of the two could also be formed, corresponding to 50 per cent of emissions from all arriving flights and 50 per cent of all departing flights (an apportionment would be necessary to avoid duplication). Given that most routes are generally operated with the same frequencies in both directions, the three variants are more or less equivalent in emissions coverage.

Advantages

3.2.24 A benefit of not initially including all routes would be the increased ease of implementation and administration.

3.2.25 An advantage of using solely the country of departure or arrival would be that should additional States cover international aviation emissions in their schemes over time, this would avoid duplication and would promote compatibility.

Disadvantages

3.2.26 A disadvantage to not including all routes would be the potential for inducing competitive distortion. To avoid competitive distortion, it would be desirable to include routes to locations that are geographically proximate.

3.2.27 The “50 per cent and 50 per cent” option would require for each flight an additional data report (of trip fuel and/or emissions) and essentially double the number of flights to be accounted for in a given scheme. This could create an additional administrative burden.

3.2.28 Another potential disadvantage is that it could encourage carriers to shift operations to neighbouring States not participating in the scheme, causing market distortions and potentially adding to flight distance and emissions.

Airspace

3.2.29 Under this approach only emissions within the national airspace of the State (or States) administering the scheme would be included.

Advantages

3.2.30 This option is similar to how emissions from stationary sources are handled.

3.2.31 It treats carriers on the same routes over a designated airspace equally, reducing possibility of market distortion.

3.2.32 It also averts political sensitivities about including emissions from operators outside of the airspace of the emissions trading scheme.

Disadvantages

3.2.33 Options defined solely on the basis of national airspace are inherently limited in their coverage as emissions over the high seas will never be included and have the complication that they would automatically include overflights, unless these were somehow exempted. This could create significant administrative problems and enforcement difficulties.

3.2.34 Also, delimitation of geographical scope based on national airspace appears impracticable. The inclusion of overflights is already complex to administer and the inclusion of other measures to complete the coverage is increasingly complex with the added risk of double counting emissions.

Guidance

3.2.35 States that wish to incorporate emissions from international aviation into their emissions trading schemes consistent with ICAO A36-22[4] (Appendix L) should not implement an emissions trading system on other Contracting States' aircraft operators except on the basis of mutual agreement between those States.

4. Forty-two States have expressed their reservation on the text contained in Appendix L of A36-22 from which the following guidance is quoted. In their view, the resolving clauses in this Appendix lack legal foundation in the Chicago Convention and cannot be used to diminish their rights; accordingly, they reserve the right to apply market-based measures of the type referred to in Appendix L on a non-discriminatory basis to all operators of all States providing services to, from or within their territories. The full text of their reservation is available in the Extracts of A36-MIN. P/9 (Minutes of the Ninth Plenary Meeting) at http://www.icao.int/icao/en/assembl/a36/docs/A36_MIN_P_9_en.pdf.

Chapter 4

TRADING UNITS

4.1 INCLUDING AVIATION IN EXISTING TRADING SCHEMES

4.1.1 Emissions trading relates to the trading of emission allowances. An allowance grants permission to emit a certain quantity of a substance into the air. These allowances can be defined by the regulator of the scheme. One allowance is generally defined as a permit to emit one tonne of CO_2-equivalent.

4.1.2 Emissions from international aviation are not included in the targets set by the Kyoto Protocol. Therefore unlike other sectors who might be involved in emissions trading, emissions from international aviation are not covered by Assigned Amount Units (AAUs).

4.1.3 Trading between companies is not directly affected by the presence or absence of AAUs, but trading between countries under the Kyoto Protocol uses AAUs as its currency. Some existing trading schemes (such as the EU emissions trading scheme) deal with this by backing a transfer of allowances in the scheme with a transfer of AAUs between trading registries in different countries, but this is not possible for international aviation where there are no AAUs.

4.1.4 The key issue is that inclusion of aviation in existing trading schemes should not undermine the Kyoto accounting system. In that context it should be clear which trading allowances are backed by AAUs and which are not. This clarity will allow those sectors who have to surrender AAU-backed allowances as part of their obligations under a scheme to do so and would also allow States to be clear about the extent to which they had met their Kyoto obligations. This chapter sets out a range of possible ways to do this. Most of the solutions here would also be appropriate for a State that had not ratified Kyoto but wanted to include aviation in a trading scheme consistent with the United Nations Framework Convention on Climate Change.

4.1.5 Because the international regulatory framework for addressing greenhouse gas emissions for the period post-2012 is currently unknown, the options for solutions presented in this chapter focus on the first Kyoto Protocol commitment period (2008–2012).

Options

4.1.6 The options fall into two categories. The first two options suggest ways to introduce aviation into a trading scheme using only AAUs, which would allow full trading between aviation and other sectors. Options 3 to 6 consider emissions trading with a combination of AAUs and separately defined aviation allowances, and any trading restrictions that might be necessary.

4.1.7 In Options 1 and 3 to 6 a baseline is used. There is more detail on setting baselines in Chapter 5.

AAUs only

Option 1. Borrowing of AAUs by the aviation sector

4.1.8 Under this option, AAUs allocated under the Kyoto Protocol to cover non-aviation sectors that are currently not in use could be borrowed temporarily by aviation. Aviation would be allocated such AAUs and take on an obligation to surrender these allowances to cover their emissions. When the allowances were surrendered, rather than being cancelled, they would become available again for use by States to cover emissions from the sectors they were originally supposed to cover.

4.1.9 This would give aviation entities (aircraft operators) allowances that are fully fungible in the trading market, so that the aviation sector would be free to buy and sell AAUs within the sector and to trade with other sectors without any restrictions.

4.1.10 States may want to assess the risk that not all the allowances distributed to aviation are surrendered back to them, e.g. if emissions are lower than the total amount of allowances distributed. If this occurs States would have to buy extra Kyoto units or, if still possible, take extra reduction measures in order to restore the balance between emissions and Kyoto units.

Option 2. No allocation of allowances to the aviation sector

4.1.11 In this option the aviation trading entity would have to buy all the allowances required for compliance from the market. This would increase the demand for Kyoto units and might put pressure on the price of these instruments. This option would also put a higher financial burden on the aviation sector than the other possible solutions. States considering this option may want to assess these effects.

AAUs and aviation allowances

4.1.12 Under Options 3 to 6 separate aviation allowances are created and brought into circulation. Because international aviation emissions are not included in the national Kyoto targets, aviation allowances cannot be treated as AAUs and cannot be counted against such targets. Special accounting arrangements can avoid this situation, as described under Options 3 through 6.

Option 3. Buy allowances to cover emissions above a non-tradable baseline

4.1.13 This option requires establishment of a non-tradable emissions baseline for aviation trading entities. Aviation allowances would be distributed to the aviation entities for emissions up to the baseline. They would not be able to trade these allowances, but could use them for compliance. If emissions reach levels above the baseline, additional Kyoto units would need to be purchased.

4.1.14 If aviation trading entities meet their obligations by buying and surrendering Kyoto units in addition to the aviation units initially distributed, States would have to cancel AAUs relating to the Kyoto units surrendered to avoid double counting.

4.1.15 The use of a non-tradable baseline means that the flexibility and efficiency of this system are limited. The system is however relatively simple and does not require a separate registry to trade aviation allowances. States may want to consider these two aspects.

Option 4. Buy allowances to cover emissions above a tradable baseline

4.1.16 As in Option 3, this option requires establishment of a baseline for aviation trading entities. The difference is that under this option, the aviation allowances distributed to the aviation entities would be tradable within the aviation sector. If emissions reach levels above this baseline, additional Kyoto units should be acquired. This option differs from Option 3 because of the tradability of the baseline, thus offering more flexibility.

4.1.17 Under this approach, aviation would effectively participate in two separate schemes: the Kyoto system and a specific aviation system. Kyoto units are valid under the Kyoto Protocol and can be used to cover aviation emissions. In contrast, the aviation allowances would not be valid to cover Kyoto obligations and therefore may not have a market value outside the aviation sector.

4.1.18 The existence in the same trading system of two kinds of allowances with different validity and price could result in economic inefficiencies. States should weigh this inefficiency against the complexity of setting up a registry to accommodate trading of aviation allowances.

Option 5. Gateway

4.1.19 In this option aviation allowances are distributed up to a baseline and are tradable within the aviation sector. Additional allowances could be purchased from other sectors through a gateway mechanism. Aviation entities would be able to sell allowances to other sectors as long as there was no net transfer of aviation allowances to other sectors. If trading were going to breach this condition, the gateway would close. This option offers more flexibility than Options 3 and 4, as it would limit trading only in those cases where aviation is a net seller. States considering this option will want to bear in mind that aviation is expected to be a net buyer of allowances in an emissions trading scheme, so the gateway may not need to close.

4.1.20 In practice, AAUs that are transferred from the Kyoto system to the aviation sector would be separated from the associated allowances and put in a dedicated account, while the allowances would be distributed to the aviation entities. If an aviation entity intended to sell an allowance to a Kyoto-covered sector, this transaction could only be completed if there are sufficient AAUs available in the dedicated account. If that is the case, the aviation allowance would be coupled to an AAU and thus be valid for Kyoto-covered sectors.

4.1.21 To guarantee integrity of the combined Kyoto Protocol and the aviation system, at the end of the trading period all the AAUs remaining in that specific account should be cancelled.

Option 6. Clearinghouse

4.1.22 In this option the aviation sector first uses any excess allowances amongst its entities before it buys Kyoto units to cover the remaining shortfall. Instead of individual aviation entities taking action, as in Options 3, 4 and 5, in this option a clearinghouse would assume responsibility for settling supply and demand of allowances among the aviation entities.

4.1.23 If certain aviation entities, due to emission reductions, hold excess allowances, the clearinghouse would buy the surplus and sell it to aviation entities that have a shortage.

4.1.24 If the emissions of aviation as a whole were low in a certain year, the excess allowances could be banked in the clearinghouse and (without a transfer of money) withdrawn in times of growth. If the aviation sector as a whole requires more allowances from other sectors, the clearinghouse would buy AAUs from these other sectors.

4.1.25 This option would avoid the possibility of aviation allowances flowing back into the Kyoto market.

Summary

4.1.26 Table 4-1 summarizes the most important aspects of the options described in this chapter. While all options are considered feasible, different States may favour different options depending on their own specific circumstances and policy preferences. For example, States that can achieve their Kyoto target relatively easily might favour Option 1. States that estimate the complexity of constructing a gateway as a relatively minor problem might favour that option.

4.1.27 In all options the financial burden for the aviation sector depends in most cases on the baseline level and AAU price. In Option 2 there is no baseline level, so the burden only depends on the AAU price. The AAU price may be influenced by the inclusion of aviation.

Guidance

4.1.28 States will need to make a choice about which option to pursue taking into account economic efficiency, environmental integrity, and equity and competitiveness issues. They may take into consideration that more economically efficient options, which offer the maximum flexibility to the aviation sector, will tend to be more complex to administer.

4.1.29 States are advised to put in place an accounting arrangement that ensures that emissions from international aviation are counted separately and not — whether deliberately or inadvertently — against the specific reduction targets that States may have under the Kyoto Protocol.

Table 4-1. Summary of key aspects

Option	*Description*	*Tradable aviation allowances?*	*Interaction with AAUs possible?*	*Financial burden on aviation sector?*	*Risk Kyoto Target*	*Point of attention*
1	Borrowing	No	Full	Depending on baseline level and AAU price	Some	Might risk Kyoto target
2	No allocation	No	Full	Maximum, but depending on AAU price	No	May influence AAU price
3	Non-tradable baseline	No	Limited	Depending on baseline level and AAU price	No	Simple, limited economic flexibility
4	Tradable baseline	Yes	Some limitation	Depending on baseline level and AAU price	No	Average complicated, some economic efficiency
5	Gateway	Yes	Up to a maximum	Depending on baseline level and AAU price	No	Complicated, maximum economic efficiency
6	Clearing house	Yes	Up to a maximum	Depending on baseline level and AAU price	No	Complicated, maximum economic efficiency

Chapter 5

TRADING SYSTEM ELEMENTS

5.1 TYPES OF TRADING SYSTEMS

5.1.1 Two families of tradable allowance systems are generally distinguished: cap and trade systems, and credit systems.

5.1.2 Under cap and trade systems (also referred to as tradable quota or allowance systems) entities must obtain and hold emission allowances sufficient to cover actual emissions during a stated compliance period.

5.1.3 Under credit systems (also referred to as baseline and credit) a baseline is used representing an implicit authorization of emissions for the compliance period. Emission reduction credits result when the actual performance — e.g. the actual emission level — is lower than the allowed performance.

5.1.4 A variant of a basic cap and trade system or a credit system could be a hybrid approach combining trading with a maximum price for allowances/credits (price-capped system).

5.1.5 The relationship between the base year (or base years) for setting the baseline as well as the setting of targets or caps for the aviation sector in any trading system are specific aviation-related issues to be considered.

5.1.6 However, for the aviation sector it would in any case be highly desirable to maintain a certain compatibility of the chosen system with other existing systems in order to allow the sector to take advantage of allowances from other sectors and from other greenhouse gas reduction mechanisms such as CDM or JI (see 5.1.18).

Cap and trade systems

5.1.7 Allowance caps — whether for the overall system or a specific sector — can be of a number of different types such as hard caps or ceilings on emissions, a rising or falling emissions path over time, formula-based caps, or caps or paths that are revised as circumstances warrant.

5.1.8 An important issue in choosing whether to use a sector-wide cap for aviation and in defining the type and level of such a cap is the variability of emissions and how well emissions — and costs — can be projected for the period during which the cap is binding.

5.1.9 If the sector-wide cap is too strict, then the sector as a whole may find meeting the cap to be financially onerous. In an open system, costs to participants will be limited by the selling price of the tradable instruments (allowances) in the market, e.g. Kyoto instruments (AAUs).

5.1.10 If, however, the sector cap is set too loosely, then it will not constrain emissions from the sector, and so the system may not provide an overall environmental benefit.

Credit systems

5.1.11 Two basic types of credit systems can be envisioned for aviation, namely a “binding credit system” and a “credit generation system”.

5.1.12 Under a binding credit system (also known as a “target system”), all participants are required to meet emission limits. They have an emissions target (essentially a baseline) that they commit to achieving and can sell emission reductions generated below the target. There are no allowances distributed initially to the entities, however.

5.1.13 Under a credit generation system, participants can voluntarily choose to generate emission reductions by reducing emissions below a fixed baseline, but are not required to limit emissions to the baseline. Only those participants that can reduce emissions at low costs would seek to generate credits within such a system. For this type of system to work, a market for credits must exist outside the system — e.g. entities with allowances requirements under another trading regime would be allowed to buy and use aviation-generated credits for compliance.

System variants and other trading mechanisms

Price-capped systems

5.1.14 In a price-capped system a State sets a limit on the total allowances and a limit on their market price. When the market price is below the limit, the system works as any trading system, giving incentive to pursue abatement opportunities. When the market price reaches the limit, instead of covering their emissions by surrendering allowances, accountable entities can cover their emissions by paying the price cap per allowance they are short of. This approach does not guarantee a particular level of net greenhouse gas emissions but it provides operators with cost certainty.

Dual target systems

5.1.15 Basically a dual target system is a variant of a credit system. In principle a dual target system could work in a baseline and credit system as well as in a cap and trade system.

5.1.16 Under such a system, participating entities face two targets. The higher target is binding in order to ensure the achievement of a minimum environmental goal. If emissions are above the higher target, participants have to purchase allowances or credits on the market in order to be compliant. If emissions are reduced below the lower target, the entity can generate tradable credits or allowances for sale. If emissions fall in the area between the two targets, the entity does not have to buy credits or allowances and it also does not generate tradable allowances.

5.1.17 This option might be of interest to the aviation sector as it tries to balance environmental and economic uncertainty. So far it has not been tested. Predictions about the administrative costs and related efficiency for monitoring and verification of compliance are not possible.

Project-based mechanisms: Clean Development Mechanism and Joint Implementation

5.1.18 Under a system which is open for project-based mechanisms such as Clean Development Mechanisms (CDM) or Joint Implementation (JI) under the Kyoto Protocol, participating entities would still be subject to whatever allowance caps or credit limits the system requires and would at the same time have access to credits from project-based mechanisms. In addition, however, participating entities would be allowed to purchase emission reduction credits generated by entities that are not subject to absolute emission targets. This would be an addition to the system, with its associated set of rules and requirements, to accompany the basic cap system.

Absolute and relative trading systems

5.1.19 From a methodological perspective, there are two choices for the units in which a cap or a baseline can be specified by the member States. The first method is to specify the cap or baseline in absolute terms (e.g. tons of CO_2) in each year to be considered.

5.1.20 The second method is a relative approach where the cap or baseline is specified in terms of a rate, such as carbon intensity (e.g. CO_2 per tonne kilometre), relative to an output variable that is linked to economic activity (e.g. aircraft kilometres, passenger or freight kilometres, payload kilometres).

5.1.21 The application of this method implies the development of an appropriate intensity and corresponding output measure. One feasible option would be the creation of a relative system based on fuel used (CO_2-emitted) per RTK (revenue tonne-kilometre).

5.1.22 Under this approach, it should, however, be recognized that the amount of CO_2-emitted per RTK may differ widely depending on the specific circumstances of different operators, varying by distance, fleet characteristics and load factor. For example, if such a system was introduced and a fixed target was agreed, operators of most shorter haul flights would have to buy credits while operators of the longer haul flights would be able to sell credits.

5.1.23 As a variant to the examples mentioned above, it would, for example, also be possible to impose individual targets (expressed as a percentage of the individual baseline) per city pair. In this case an individual baseline would have to be defined for each city pair by aircraft type serving these cities, which would make this alternative rather cumbersome.

Advantages and disadvantages of absolute and relative trading systems

5.1.24 The absolute approach provides greater environmental certainty, since emissions are capped, at least at the entity level. Both absolute and relative caps or baselines can allow for reasonable growth of emissions in line with existing plans.

5.1.25 From an administrative point of view the absolute approach is easier to design and monitor, since it requires only one piece of data (emissions) instead of two (a rate and output measure). However, depending on the rules governing its specification, the absolute emissions cap or baseline may require more review on a case-by-case basis than the relative cap or baseline.

Flexibility and stringency

5.1.26 The generally observed high degree of variability and the associated unpredictability in the aviation sector would suggest that emissions are difficult to predict on an entity level. States may wish to consider ways to increase flexibility while maintaining established rules, such as:

— Revisiting the distribution when output or other variables change;

— Banking and borrowing (to even out allowance requirements over time);

— Setting a multi-year budget period (such as the five-year period under the Kyoto Protocol);

— Using a credit system with a relative baseline; or

— Using a dual target system.

5.1.27 The key advantage of a credit or a dual target system is its ability to provide more flexibility than a cap and trade system. Depending on how baselines are set for participants, a credit or dual target system may be able to provide the necessary flexibility to enable compensation within the system for economic growth and contraction, without imposing severe cost burdens on the participants or allowing a detrimental effect on environmental quality. The integration of this type of system into an existing cap and trade may however prove to be difficult.

Compatibility with project-based mechanisms

5.1.28 When considering the inclusion of the aviation sector into an existing trading system, the compatibility of the system with project-based mechanisms such as CDM or JI under the Kyoto Protocol could be a key decision element as it may offer an important source of additional credits for a sector expected to be a net buyer. Aviation currently has no options to switch to other types of fuel, and it has already reached a significant level of fuel efficiency. This and the predicted growth-rates of the sector will lead to a situation where the aviation sector will most likely not be able to meet stringent caps or baselines through reduction activities within the sector. Thus the availability of allowances at a reasonable price and/or the availability of such offsets (CDM, JI, etc.) for aviation are of utmost importance to the sector.

Guidance

5.1.29 States may use three different approaches to generate a baseline or a cap:

1. Set the baseline or the cap with reference to historic emissions in a year or a set of years, or a set percentage below that historic level.

2. Use the baseline or cap to define an emissions performance standard — such as emissions per unit of output (e.g. RTKs or ATKs) — against which emission reductions can be measured.

3. An emission baseline or a cap can be viewed as a projection of what would, or could, have occurred, not what actually happened.

5.1.30 Choosing the assumptions for constructing a baseline (or an appropriate level for a target or a cap) by the States for a sector requires weighing a number of potentially competing considerations. Such considerations include the environmental effects of current and forecast emission rates and levels, as well as the effects on emissions of actions that have already been taken to reduce emissions, which may be taken into account either on a sector-wide basis or an individual-entity basis.

5.1.31 In determining allowance requirements, States should consider the potential contribution of air navigation service providers to levels of emissions generated by aircraft operators: e.g. terminal area holding patterns, indirect routing and en-route delays. Considering data on average system delays caused by air traffic would be an appropriate mechanism.

5.1.32 Considerations also include factors governing emissions reductions — the cost of further reducing aviation-related emissions, available technologies and the potential for emission reductions within the sector or the individual entity.

5.1.33 Other factors include projected rates of growth in the industry and variability in growth over time, the likely cost of allowance or credit purchases in an open system, and profitability in the industry and impacts on competitiveness, i.e. the ability of the aviation industry to remain viable and competitive. Many of these factors are uncertain, further complicating the process of setting an equitable cap or baseline.

5.2 DISTRIBUTION OF EMISSION ALLOWANCES THROUGH BENCHMARKING

5.2.1 Participation in an emissions trading scheme requires trading entities (aircraft operators) to hold emissions allowances in order to cover their emissions and to be able to trade. Accountable entities may receive their allowances at the start of the trading period either from auctioning or by being distributed a given amount by the authority. Auctioning or grandfathering allowances from historic emission do not bear aviation-specific issues. This section therefore focuses on benchmarking as a distribution method applied to aviation.

5.2.2 Under a benchmarking approach allowances are distributed according to a specific formula based on a benchmark parameter that reflects the amount of emissions in relation to a level of activity representative of the sector.

5.2.3 In order to design a cost-effective and efficient distribution system based upon benchmarking, particular attention has to be paid to the following points:

- Technical feasibility/verifiability
- Standardization/simplicity
- Transparency
- Minimizations of perverse incentives
- Provision of incentives for best practice and clean technology
- Network and operational efficiencies
- Avoidance of excessive distributional impacts between operators.

5.2.4 In addition it has to be considered that benchmarking and grandfathering approaches do not have the same data requirements. While a grandfathered distribution system would require historic emissions data, a benchmarked distribution system requires the collection of appropriate activity data.

5.2.5 Although the air transport sector has a number of common characteristics, such as the use of a homogeneous fuel type, it provides a wide range of services as reflected in the large variation in operators' business models. For benchmarking to be used successfully as a method for distributing emissions allowances, the activity parameter will need to avoid unintended distributional effects between different business models as much as possible.

Basic design options

Definition

5.2.6 In order to determine how the fuel (or energy) efficiency performance of an operator compares with that of other operators in the sector, a benchmark parameter must be defined. This can be achieved in different ways, for example by comparing the operator's performance against a sector average, a percentile value, or a theoretically "best achievable" level. In this respect two operators producing the same amount of activity will receive the same number of permits but the one with the better performance (i.e. lower energy consumption) will have to surrender fewer permits than its competitor at the end of the trading period.

5.2.7 A benchmark parameter is typically defined in terms of emissions per unit of output, 'activity' or as a technology factor applied to historic emissions. Activity levels in air transport can be expressed by way of different variables, such as the number of operations, flight distance, capacity offered, or payload transported.

5.2.8 The combination of these variables for a particular operator will reflect its geographic location and the product characteristics in the markets in which it operates.

Choice of reference year

5.2.9 Distribution of allowances will be proportional to the production of a chosen reference year. The most recent year of available data could be considered an appropriate reference year. However, in the airline industry, it may be preferable to include several consecutive years in the base period, as this would level out the effects of economic cycles, short-term differences in investment cycles and unusual events.

Potential benchmarking methods

5.2.10 A range of potential benchmarking methodologies and parameters can be considered.

5.2.11 One possibility would be to define the benchmark parameter as an average value of emissions per payload kilometre, using Revenue Tonne-Kilometres (RTK) as a measure for an entity's accountable activity, according to the following formula:

$$A_i = \frac{(\sum^{n} E_i - T)}{\sum^{n} RTK_i} \times RTK_i$$

in which

A_i	=	Amount of emission allowances distributed to each entity for the commitment period
n	=	Total number of entities
$\sum RTK_i$	=	Total revenue tonne kilometre of all flights considered in the trading scheme in the reference period
RTK_i	=	Revenue tonne kilometres performed under the scheme by entity i in the reference period
$\sum E_i$	=	Total emissions of all flights considered in the commitment period
E_i	=	Emissions considered for entity i in the commitment period
T	=	Emission reduction target

5.2.12 Another possibility would be to characterize the activity level in terms of transport capacity. In this case, the benchmark parameter could be expressed as an average value of emissions per unit of available capacity, using Available Tonne Kilometers (ATK) as a measure, using basically the same formula by substituting ATK for RTK.

5.2.13 Other benchmarking methodologies are also possible, such as using technology factors expressed in terms of specific fuel consumption and applied to historic emissions.

5.2.14 Any benchmarking approach should try to minimize undesirable effects for operators that are active in the same market. For instance, emissions per RTK tend to be lower for long-haul flights than for short-haul flights because of the higher fuel efficiency achieved during cruise. On the other hand, on very-long-haul flights efficiency may be lower due to the fact that more fuel is burned in order to carry the extra fuel needed for the longer flight.

5.2.15 Therefore, an approach based on traditional airline activity measures such as RTK may lead to different reduction burdens for short-, middle- and long-haul flights. An approach using categories of aircraft families or ranges or using a standardized measure based on transport capacity (e.g. a standardized ATK based upon a common calculation methodology) could be used to avoid unintended distributional effects between different business models as much as possible.

Guidance

5.2.16 For benchmarking to be used successfully as a method for distributing emissions allowances, the benchmark parameter should be designed to reward previous investments in new technology and provide incentives to operate the most emissions-efficient aircraft in the most efficient way into the future, whilst avoiding unintended distributional effects between different business models as much as possible.

5.3 TREATMENT OF NEW ENTRANTS AND CHANGES IN OPERATION

5.3.1 The treatment of new entrants and changes in operation is relevant to emissions trading schemes where allowances are distributed free of charge on the basis of a grandfathering or benchmarking method. There may be a greater need to make provision for new entrants if the allocation periods are long.

5.3.2 One option would be not to make any special provision for new entrants or changes in operation. Operators could simply be required to buy allowances on the market. Alternatively States may decide to create a reserve of allowances for allocation to new entrants and/or changes in operation. States considering whether to create some sort of new entrant reserve will need to consider the administrative complexity of developing and implementing such a reserve.

5.3.3 If it were decided to make some form of special provision, it would be necessary to define the terms “new entrants” and/or “changes in operation”. In the context of aviation, a new entrant could be defined as any aircraft operator (as defined in Chapter 2, 2.1) that starts flight operations under the scope of the trading scheme for the first time. Examples of a change in operation might be the introduction of a new flight route or an increase in the frequency of flights on an existing route. In order for the scheme to be workable, any changes in operation would need to be identifiable and capable of independent verification.

5.3.4 It would also be necessary to define how any allowances would be allocated to new entrants/changes in operation for which no historical data would be available.

5.3.5 The creation of a reserve of allowances for new entrants could help provide access to the market for new operators. However, the total of allowances available to existing entities in the system plus the allowances assigned to the new entrants reserve may in such a case not exceed the overall amount of allowances available for allocation to the aviation sector. A new entrants reserve would therefore reduce the amount of allowances available to entities already operating in the scheme.

5.3.6 If it is decided to make provision for the allocation of allowances to new entrants and/or changes in operation, States will need to consider how to treat aircraft operators that cease to operate, stop operating on certain routes or decrease the number of flights operated.

Guidance

5.3.7 Under allowance distribution methods based on grandfathering or benchmarking, States may wish to consider whether to make special provision for new entrants. The two main options are:

1. New entrants are required to buy allowances on the market until the next distribution period. Operators can retain allowances if they stop operating or reduce their operations.

2. A proportion of the allowances allocated to the aviation sector are used to create a new entrant reserve to enable allocations of allowances to be made to new entrants on a similar basis to allocations to existing operators.

Chapter 6

ADMINISTRATIVE PROCEDURES

6.1 MONITORING AND REPORTING

6.1.1 A basic feature of emissions trading schemes is the requirement for emissions to be monitored and periodically reported. The accountable entity, the entity responsible for monitoring and reporting emissions, as well as the methodology to be used for calculating emissions must be defined prior to inclusion of a sector in an emissions trading scheme.

Monitoring and reporting obligations

6.1.2 To establish emission inventories for accountable entities such as individual aircraft operators, States can rely either on self-reporting by trading participants or reporting by third parties. It is important to note that there is a distinct difference between monitoring and reporting at a State level versus a trading entity level. Additional information regarding the former can be found in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*.

Monitoring and reporting data

6.1.3 For monitoring purposes, emissions can either be calculated based on actual trip fuel or based on flight movement data.

6.1.4 If monitoring of emissions is calculated on the basis of actual trip fuel, CO_2 emissions can be derived from the carbon content of that fuel. Aircraft emissions would be calculated according to the generic formula:

< Emissions > = < Fuel Consumption > * < Emissions Factor >

6.1.5 CO_2 emission factors depend on the fuel type, the carbon content and the fraction of the fuel oxidized. They should roughly be within a range of ±5 per cent of actual emissions. IPCC default values for the CO_2 emission factors as published in the *2006 IPCC Guidelines for National Greenhouse Gas Inventories* can be used by States. For jet fuel (based on mass) the IPCC default value is 3.16. In other words, the burning of 1 tonne of jet fuel produces 3.16 tonnes of CO_2. The same value is used by ICAO.

6.1.6 Because the use of actual trip fuel would provide information relating to each individual flight, both the accuracy of the reported data as well as the environmental effectiveness of the emissions trading system would benefit.

6.1.7 If actual trip fuel data cannot practicably be obtained, emissions modelling techniques can be used to calculate estimates. The detail available can range from origin and destination (OD) data to actual flight movement data with full flight trajectory information.

6.1.8 The method based on origin and destination data involves the calculation of average fuel consumption and emissions for a range of representative aircraft categories for the origin-destination flight distance. Examples include the EMEP/CORINAIR (Core Inventory of Air Emissions in Europe) Emission inventory guidebook.

6.1.9 The method based on actual flight movement data involves the calculation of fuel consumption and emissions throughout the full trajectory of each flight segment using aircraft and engine-specific aerodynamic performance information. Compared to the method based on the origin-destination flight distance this method offers increased accuracy since the estimation is based on individual flights and therefore would improve the environmental and economic effectiveness of the system. Examples include the System for assessing Aviation's Global Emissions (SAGE), by the United States Federal Aviation Administration, and AERO2k, by the European Commission.

Guidance

6.1.10 Two basic options for monitoring and subsequent reporting of CO_2 emissions can be considered: (i) calculation based on the carbon content of the actual trip fuel, and (ii) estimation based on actual flight movement data or origin and destination (OD) data.

6.1.11 When possible the method with the highest accuracy based on actual trip fuel data should be applied, and perhaps incentivized. For those trading entities (aircraft operators) that cannot meet high reporting standards, a minimum reporting standard based on emissions modeling techniques could be set that is consistent across the sector.

6.2 VERIFICATION

6.2.1 To ensure environmental integrity of the trading system, effective and independent verification procedures should be defined. Such procedures will also help to ensure equitable treatment of all participants and identify the need to correct data or calculation errors.

6.2.2 An entity that meets the auditing capabilities required by the State shall carry out a predefined verification procedure. ICAO could be considered along with State accredited verification entities to facilitate or assist such verification.

6.2.3 Several methods exist to verify the emissions reported. Firstly, aircraft operators could submit emissions data to the verification entity, based on actual fuel use.

6.2.4 Secondly, air navigation service providers could in cooperation with the verification body calculate estimates of actual emissions using best available data with regard to flight paths, aircraft and estimated aircraft weight.

6.2.5 Thirdly, aviation authorities could provide the verification body with calculated emissions based on actual individual flight data submitted by aircraft operators. Annex 6 to the Chicago Convention requires an operator to maintain fuel and oil records, to be retained for a period of three months. Such requirements exist, for example, under the US Federal Aviation Regulations (FAR) and the Joint Aviation Requirements (JAR) in Europe.

6.2.6 Flight-specific information needed for reporting and verification purposes may be subject to concerns regarding commercial confidentiality. States should ensure that appropriate arrangements are in place to protect confidentiality. For example, it may be possible to secure confidentiality by reporting data in aggregated form over a predefined period.

6.2.7 In addition, fuel use data collected by States and regulatory authorities outside the emissions trading system could be used to compare against data submitted by the reporting entity or against modelled estimates.

6.2.8 Consideration must be given to the fact that flight recorder data may not be easily obtainable which could increase the administrative burden of this approach.

6.2.9 A fourth approach may be envisaged in which a calculated estimate of the emissions is used as the basis for verification but where the reporting entity is allowed to demonstrate with actual fuel use data that its emissions are below

the calculated estimate. In order to reduce the administrative burden, the verification body can use this data to adjust the calculated estimate for the subsequent year if it accepts the actual fuel use data submitted by the reporting entity.

Guidance

6.2.10 Verification should be carried out by an accredited organization independent of the organization whose data are being verified, with the aim of verifying the reliability, credibility and correctness of the data. The State is responsible for the accreditation of such entities.

6.3 ENFORCEMENT

6.3.1 Effective enforcement of emission reduction obligations is required to assure the environmental integrity of the trading system and to protect the interests of compliant participants.

6.3.2 The effectiveness of enforcement depends upon several factors, including the frequency and quality of verification, government attitude, and legal constraints on the types of penalties that can be imposed.

6.3.3 Deterrence of non-compliance is key to designing an effective enforcement mechanism. This may involve establishing penalties for non-compliance at meaningful levels and providing for public disclosure of information on the compliance status of trading participants.

6.3.4 Various types of penalties for non-compliance can be considered. Among these are:

— Monetary penalties, set at a level higher than the market price of an allowance times the number of allowances exceeded;

— Trading restrictions within the trading system; and

— Reduction of the number of allowances distributed for subsequent compliance periods.

6.3.5 States could also consider the penalty system in use for other sectors and apply similar penalties as far as possible to international aviation as well.

Guidance

6.3.6 Various options are available for the penalties that might be used. Among them are:

— Monetary penalties;

— Restricting a noncompliant participant’s rights under the trading system;

— Reducing the number of allowances assigned for subsequent periods.

— END —

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