COMMISSION OF THE EUROPEAN COMMUNITIES

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COMMISSION STAFF WORKING DOCUMENT

Accompanying document to the

Proposal for a

DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community

Impact Assessment:

**{COM(2006) 818 final
SEC(2006) 1685}**

UNOFFICIAL ADVANCE VERSION

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1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Background to development of the proposal

On 27 September 2005 the Commission adopted a Communication entitled "*Reducing the Climate Change Impact of Aviation*"[1] (in the rest of this document referred to as "the Communication"). The key conclusion drawn in the Communication was that, in view of the likely future growth in air traffic, further policies and measures are needed to address the climate impact of aviation. Having analysed a number of options, the Commission decided to pursue a new market-based instrument at Community level in preference to other financial measures such as tax and charges and considered that "*…the best way forward from an economic and environmental point of view, lies in including the climate impact of the aviation sector in the [Community] scheme*". On the basis of this conclusion, the Commission announced that it intended to present a legislative proposal to this effect and invited the other Community institutions to consider the policy and design recommendations made in the Communication. Accordingly, a legislative proposal was included in the Commission's Legislative Work Programme (CLWP) for 2006[2]. The present proposal aims at implementing this key pillar of the strategy without affecting its other means of addressing climate change through a comprehensive approach based on improved technology and utilisation of aircraft (including improvements in air traffic management, research etc.)[3].

The conclusions in the Communication were reached after having carried out an extensive web consultation and in the light of a study into the feasibility of including aviation in the EU Emissions Trading Scheme (the EU ETS) carried out on behalf of the Commission (the "feasibility study")[4]. The Communication was accompanied by an Impact Assessment (referred to in this document as the "initial impact assessment")[5], which evaluated different policy options potentially available to reduce aviation's impact on climate change. On the basis of this analysis it was concluded that, for a fixed reduction in emissions, the economic costs for the aviation sector and the EU as a whole would be lower if this reduction is achieved through the inclusion of aviation in the EU ETS than if it were achieved through the imposition of a tax or charge, or the introduction of a trading scheme for aviation alone.

This impact assessment builds upon the initial impact assessment by considering the specific design options and policy choices for including aviation in the EU ETS.

1.2. Inter-institutional process so far

European Union:

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1 COM(2005)459 final, 27.9.2005.

2 Item 2006/ENV/017 in the "roadmaps": http://ec.europa.eu/atwork/programmes/docs/wp2006_roadmaps.pdf

3 See in particular section 5 of COM(459) final.

4 CE Delft: "Giving Wings to Aviation - inclusion of aviation under the EU emission trading system: design and impacts" published in July 2005. See http://europa.eu.int/comm/environment/climat/pdf/aviation_et_study.pdf

5 SEC(2005) 1184, 27.9.2005 http://ec.europa.eu/environment/climat/pdf/ia_aviation.pdf

On 2 December 2005 the **Environment Council of Ministers** adopted conclusions[6] recognising that the inclusion of the aviation sector in the EU ETS seemed to be the best way forward and urged the Commission to bring forward a legislative proposal by the end of 2006 which is both environmentally meaningful and economically efficient. It also set out a number of preliminary guiding principles which largely mirrored the recommendations from the Commission and emphasised the need for a further detailed impact assessment. At its meeting on 15-16 December 2005[7], the **European Council** confirmed the key conclusions reached by the Environment Council and echoed the request for a legislative proposal accompanied by an impact assessment addressing the specific aspects requested in the conclusions of the 2 December 2005. On 21 April 2006, the **European Economic and Social Committee** adopted an Opinion[8] on the Communication expressing the opinion that additional policy measures are needed to control the impact of aviation on climate change and that, depending on specific design elements, inclusion of aviation in the EU ETS could be a very feasible option. On 4 July 2006, the **European Parliament** adopted a Resolution[9] welcoming the Communication and recognising that emissions trading has the potential to play a role as part of a comprehensive package of measures to address the climate impact of aviation, provided it is appropriately designed. It further set out detailed views on a number of issues, including aspects of the potential design of a trading scheme for aviation.

International fora:At international level, the limitation and reduction targets adopted under the Kyoto Protocol include emissions from domestic aviation but not emissions from international flights. Instead the Kyoto Protocol places an obligation on the parties to "*pursue limitation or reduction of emissions of greenhouse gases…from aviation…bunker fuels, working through the International Civil Aviation Organization…*". At the sixth meeting of the ICAO Committee on Aviation Environmental Protection in 2004, it was agreed that an aviation-specific emissions trading system based on a new legal instrument under ICAO auspices "*…seemed sufficiently unattractive that it should not be pursued further*". However, Resolution 35-5 of the ICAO Assembly instead endorsed open emissions trading and requested the development of non-binding guidance for use by states, as appropriate, to incorporate emissions from international aviation into their emissions trading schemes. The Commission and Member States are participating in and supporting this work which is scheduled for finalisation by ICAO in 2007. The ICAO Assembly in September 2007 will discuss this issue. In any case, this proposal is not expected to enter into force before that date. The final ICAO guidance will be taken into account, as appropriate, during the co-decision procedure. The objective of this proposal is to provide a model for aviation emissions trading that can be a point of reference for the EU's contacts with key international partners and be extended or replicated worldwide. The Commission also supports the objective of a global agreement aimed at effectively tackling aviation emissions at global level.

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6 See http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/envir/87368.pdf and Annex 2.

7 See http://ue.eu.int/ueDocs/cms_Data/docs/pressData/en/ec/87642.pdf and Annex 2.

8 See http://eescopinions.eesc.europa.eu/eescopiniondocument.aspx?language=en&docnr=598&year=2006 (NAT/299 - CESE 598/2006).

9 See http://www.europarl.europa.eu/sides/getDoc.do?Type=TA&Reference=P6-TA-2006-0296&language=EN and Annex 2.

1.3. Stakeholder participation

The Communication was based on extensive stakeholder consultation to which 5564 citizens and 194 organisations responded[10]. However, once the decision was taken to focus on emissions trading, further considerations were needed on the detailed design options for a trading system in consultation with stakeholders. Accordingly an **Aviation Working Group (AWG)** was set up under the second phase of the European Climate Change Programme (ECCP II). The terms of reference for the group, as annexed to the Communication, were translated into a work plan which was approved at the stakeholder conference launching the ECCP II, held on 24 October 2005 in Brussels. The role of the group was to consider and discuss issues on which the Commission had identified a need for further expert advice. The purpose was not to take final decisions but rather to consider options and identify the advantages and disadvantages of various design and policy choices.

The Commission invited representatives and experts from Member States and key stakeholder organisations including industry, consumer and environmental organisations to participate in the working group. Additional experts were invited to meetings where their expertise was particularly relevant. The Commission chaired the meetings and acted as secretariat for the group. Before each meeting a background paper summarising relevant parts of the Communication, initial impact assessment and feasibility study was distributed and used as a common reference for the discussion. After each meeting draft minutes were circulated to the participants for comments before a final version was reached. This final report of the working group was published in April 2006 and consists of a compilation of the agreed minutes of the 4 meetings (of which the 3rd was a 2-day meeting). The **final report**, the **agendas**, **background papers** and **presentations** from each meeting **are publicly available on the internet** on the CIRCA website for ECCP Aviation WG[11]. Also available on this website are **position papers submitted by stakeholders** to complement the views recorded in the minutes.

The consultation of stakeholders was undertaken in accordance with the minimum standards for consultation set out in the Commission Communication entitled "*Towards a reinforced culture of consultation and dialogue - General principles and minimum standards for consultation of interested parties by the Commission*"[12].

2. PROBLEM DEFINITION

The rationale for Community action was analysed and explained in detail in the Communication from September 2005 and the accompanying initial impact assessment. **In summary, to date, policies instituted at international, regional and national level to mitigate climate change have not required any substantial contribution from the aviation sector**. While air transport accounts for about 0.6%

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10 See http://ec.europa.eu/environment/climat/pdf/report_publ_cons_aviation_07_05.pdf
The responding organisations included 79 NGOs, 60 private companies or industry associations and 30 public authorise plus a number of other organisations. No trade unions responded.

11 http://forum.europa.eu.int/Public/irc/env/eccp_2/library?l=/work_group_aviation&vm=detailed&sb=Title

12 COM(2002)704.

of the EU's value-added[13], it accounts for about 3% of the EU's direct greenhouse gas (GHG) emissions. If indirect impacts[14] such as NOx emissions are included, which produce the strong GHG ozone (O_3) under the influence of sunlight, aviation's impact on the climate is even more substantial. Further policy action is needed to prevent the projected rapid future growth in air traffic from leading to continued growth in the climate impact of aviation.

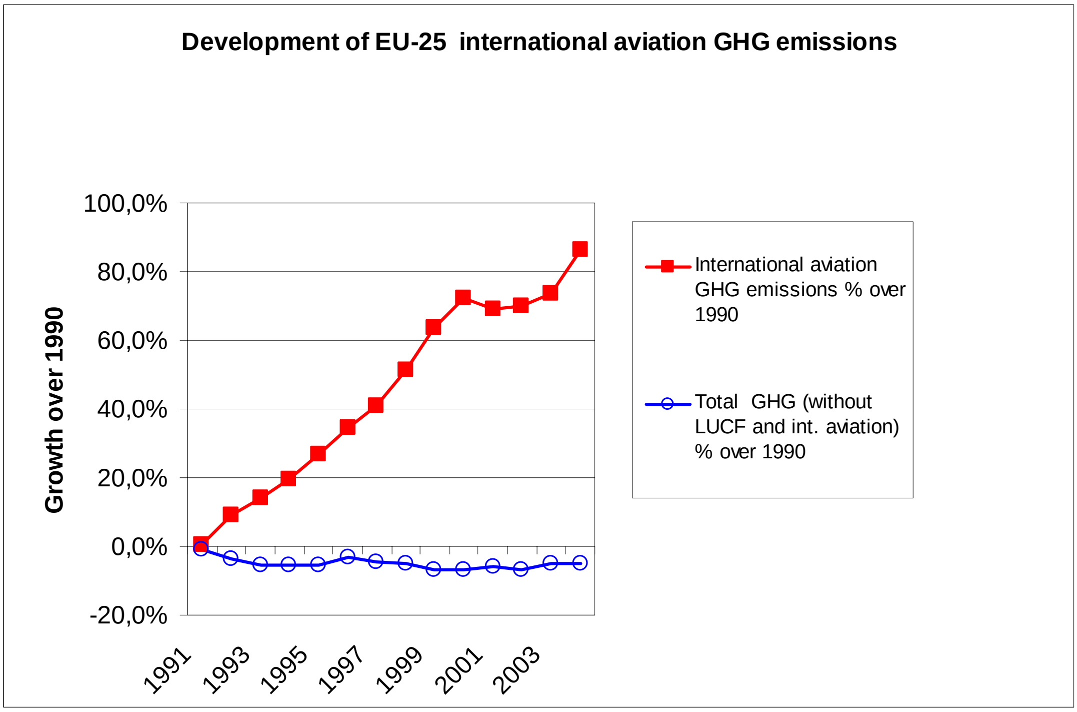

Figure1 : Development in EU (international aviation) GHG emissions (Source: EEA)

As can be seen from figure 1, GHG emissions from international aviation in the EU have grown rapidly since 1990. At the same time policy action in other sectors has led to a reduction in overall emissions from those sectors.

The latest available figures released in 2006, after the adoption of the Communication, show a further increase in emissions: **In 2004 greenhouse gas emissions from EU international aviation had increased by a further 7.5% compared to 2003, resulting in an accumulated growth since 1990 of 87%**. As noted in the Communication, if this trend continues, growth in the EU's international aviation emissions will offset more than a quarter of the environmental effect of the reductions required by the Community's target under the Kyoto Protocol. In the longer run, international aviation emissions would become an ever-greater contributor to the EU's total emissions. Since international aviation is not yet covered by the Kyoto Protocol, this growth currently does not have legal implications. Nonetheless, this does not detract from its environmental implications which will have to be addressed as part of any effective forward-looking climate policy.

13 EUROSTAT: "The air transport sector in the European Union": Statistics in focus, 37/2005.
14 See summary in Annex 12.

3. OBJECTIVES

The overall objective remains the one identified in the initial impact assessment: to address the growing climate change impact from aviation and ensure that aviation contributes to the achievement of the Community's overall objective of limiting the global annual mean surface temperature increase to a maximum of 2°C above pre-industrial levels. As stated in the Commission's 1999 strategy on air transport and the environment,[15] "*[t]he long-term policy target must be to achieve improvements to the environmental performance of air transport operations that outweigh the environmental impact of growth*".

To achieve that long-term policy target, the initial impact assessment identified a number of specific objectives:

- Including the air transport sector in efforts to mitigate climate change.
- Better internalisation of the external costs of climate change.
- Stronger incentives for air transport operators to reduce their impact on the climate.

Based on the analysis set out in the initial impact assessment, the Communication proposed a comprehensive approach to fulfil these objectives under which a number of existing policies and actions would be continued and strengthened[16]. It also outlined a strategy for complementing such action by implementing a new market-based instrument at EU level. In this respect, and having analysed a number of options, the Commission concluded that "*…the best way forward, from an economic and environmental point of view, lies in including the climate impact of the aviation sector in the EU emissions trading scheme*". This conclusion was reached on the basis of assessing emissions trading on its environmental effectiveness, economic efficiency and potential for wider application. Feedback received from the other EU institutions and stakeholders generally confirmed this conclusion. The operational objective therefore is to include aviation in the EU ETS.

In terms of environmental outcome, a number of options of varying ambition have been examined for the legislative proposal. These are described in further detail below. The core basis for examining these options is the long-term goal of achieving "*improvements to the environmental performance…that outweigh the environmental impact of growth*". This implies that emissions attributable to aviation will have to be de-coupled from aviation growth in order that emissions stabilisation can take place, followed by emissions reductions. The differences between the options relate mainly to how this objective is met and by whom within the aviation sector.

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15 Communication from the Commission entitled "*Air Transport and the Environment: towards meeting the challenges of sustainable development*", COM(1999) 640 final.

16 These included higher priority to be accorded to EU aeronautics research aimed at reducing the negative impacts of air transport on climate change and timely progress to be made on the processes already begun with the Single European Sky to enhance the performance of the European air traffic management system.

4. POLICY OPTIONS

4.1. Introduction

This section discusses the most important design parameters that together define the effectiveness, the efficiency, the consistency and the practical workability of a system to incorporate aviation into emissions trading.

In considering the specific design of an emissions trading scheme for aviation, consideration must be taken of the specific characteristics of the aviation sector and the way in which it differs from other sectors currently included in the EU ETS. These include:

- the mobile nature of the emissions sources;
- the international nature of the aviation sector;
- the total climate effect of aviation being significantly higher than the effect of its direct GHG emissions (primarily CO_2 emissions) alone;
- the main trading currency under the Kyoto Protocol, Assigned Amount Units, not being granted for international aviation emissions due to their not being included in the emissions commitments.

It is also important to maintain equal treatment of operators regardless of their nationality consistent with the requirements of the Chicago Convention and to take into account lessons learned to date from the existing EU ETS. Therefore, more harmonised solutions for aviation have been considered as being more practical and desirable.

A non-regulatory approach will not be considered as the inclusion of aviation emissions in the EU ETS could not be achieved in a harmonised way without amending the legislative framework[17]. For some of the design parameters, a best option was identified and the alternatives discarded at an early stage on the basis of qualitative analysis. In these cases, the key arguments are briefly summarised below. For other parameters, a range of options were maintained throughout the analysis while at the same time identifying a set of choices as the "main variant" against which variants were compared. This approach was taken to 1) keep the number of combinations of possible options analysed manageable and 2) to make it possible to isolate the effect of a change in any single design parameter.

The list of parameters discussed below is as follows:

- Accountable entity.
- Geographical scope.
- Consideration of treatment of remote and isolated regions.

[17] See roadmap for item 2006/ENV/017 in the Commission's Legislative Work Programme for 2006, http://ec.europa.eu/atwork/programmes/docs/wp2006_roadmaps.pdf

- Other delimitations of the scope (including thresholds).
- Coverage of non-CO_2 emissions.
- Open or closed system (extent of integration with existing EU ETS).
- Interplay with Kyoto Protocol (lack of AAUs for international aviation).
- Treatment of domestic aviation.
- Use of credits from the Kyoto Protocol's project mechanisms.
- Overall quantity of allowances issued for aviation's climate impact.
- Method of allowance allocation and distribution.
- Treatment of new entrants and closures.
- Monitoring, reporting and verification.
- Timing aspects.

4.2. Accountable entity

Different agents could conceivably be held responsible for complying with obligations under the EU ETS in respect of aviation emissions. The feasibility study looked at the options of aircraft operators, airports, fuel suppliers, air traffic management providers and aircraft manufacturers. In the Communication, the Commission stated its view that **aircraft operators** should be the responsible entities as they have the most direct control over the type of aircraft in operation and the way in which they are flown. This option was also preferred by a large majority of the organisations responding to the internet stakeholder consultation[18] (receiving support from more than 5 times as many respondents as the second-most advocated option). It also received preliminary support from the Council.

Despite the broad support expressed in favour of this option, the Commission has again reviewed two of the alternative options which have continued to receive limited support: airports or fuels suppliers.

The airport option would imply that each EU airport would surrender allowances for the emissions from flights to and/or from that airport. This option would have the advantage that an airport provides a possible "point of aggregation" for the polluting activity. However, although airport managers may take certain decisions that have an influence on aircraft emissions (in particular at congested airports) they cannot directly influence investment decisions or the actual operation of aircraft and therefore do not exercise any direct control over the emissions from the aircraft operating to and from their facilities. While the economic signal that emissions trading is designed to establish could conceivably be transferred to aircraft operators via airport landing charges, defining and agreeing on sufficiently accurate and

[18] See http://ec.europa.eu/environment/climat/pdf/report_publ_cons_aviation_07_05.pdf

harmonised mechanisms for providing correct price signals to those actually in control could be very difficult given the wide variety of approaches to airport charging that exists in the Community. If airports failed to pass on the costs or failed to pass on the costs by reference to emissions, then the scheme would not provide the right incentives and the objective of the policy would not be achieved.

The fuel supplier option would imply putting the obligation to surrender allowances on suppliers of aircraft fuel. This option would have the advantage that there are fewer fuel suppliers than aircraft operators and therefore it might be administratively simpler to keep track of suppliers delivering fuel at EU airports. However it would represent a departure from the current EU ETS approach in which obligations are imposed on the entities with direct control over emissions. It would also risk generating incentives for tankering and limit the possibility for increased coverage of non-fuel related emissions and effects over time. Finally it would be difficult to distinguish between aircraft fuel used within the scheme and that purchased for other purposes, since fuel suppliers do not hold the information required.

On balance, the aircraft operator option is considered to be by far the most effective and practical approach. The other options listed above were therefore discarded at an early stage and the analysis of remaining design options performed on this basis.

4.3. Geographical scope

This issue concerns the types of flights which would be included in the scheme. The geographical scope will partly determine the effectiveness of the scheme in meeting its objective because the greater the geographical scope of the scheme, the greater the amount of emissions covered by the scheme and consequently the greater the reductions.

The geographical scope could be defined by reference to a number of different parameters including flight routes, airspace or parameters relating to the aircraft operator or aircraft itself.

In considering the options for the geographical scope of the scheme, as well as considering the environmental impacts and range of economic impacts, it is also important to consider the aim for the scheme to provide a model for expansion.

For mobile sources, the actual physical location of the emissions is not necessarily the best way to establish a unique link from a given source to one particular State for the purpose of defining the responsibility to report (or to control) those emissions. This has been explicitly acknowledged both in the Revised IPCC guidelines[19] and by SBSTA – the UNFCCC's Subsidiary Body for Scientific and Technological Advice (see below). At its fourth session in December 1996, SBSTA ruled out a number of

[19] With regard to the question of allocation of road transport emissions, the IPCC guidelines explicitly acknowledge that there may be countries with a big disparity between emissions from fuel sales and fuel consumption, but while they have the option of estimating true consumption and reporting the emissions from consumption and trade separately, national totals (and thus the responsibility to report and/or control) must be on the basis of fuel sales.

options including *allocation according to emissions generated in national airspace*[20]. This option has the key disadvantage that even if applied globally, it could not secure coverage of emissions emitted over the high seas. A scheme delimited based on principles which have been disqualified by SBSTA could be seen as inconsistent with the UNFCCC, and thus with ICAO policy which only supports integrated trading "*consistent with the UNFCCC process*". **An airspace-based approach was therefore ruled out at an early stage.**

Among the remaining options a route-based approach (defined on the basis of country of departure and/or destination) is most simple and workable. **The ECCP Aviation Working Group advised the Commission to focus on three options**. Two of these were considered in the feasibility study, and one (the third listed below) was put forward in subsequent discussions by low-cost air carriers and by environmental NGOs:

(1) Intra-EU flights only.

(2) All flights departing EU airports.

(3) All flights arriving at and all flights departing from EU airports.

As a consequence of ruling out an airspace-based approach, a fourth option representing option (3) plus emissions from aircraft that fly through EU airspace without stopping has been discarded. In any case, emissions from these "over-flights" are relatively speaking very low, whilst the complexity of accurately monitoring emissions from aircraft flying through EU airspace would be relatively high. In addition, an incentive would be introduced to avoid EU airspace, thereby increasing fuel burn and CO_2 emissions for certain flights where such deviations could become attractive. In summary, the costs from including over-flights would far outweigh the environmental benefits and so their inclusion has not been further analysed in this impact assessment.

In the Communication, the Commission indicated that from an environmental perspective the preferred option would be for the scheme to cover emissions from all flights departing from EU airports. This was reflected in the preliminary guiding principles set out by the Council in its conclusions of December 2005. The European Parliament expressed a preference for option 3. The different implications of the choice among these options are further examined in section 5.

4.4. Consideration of treatment of remote and isolated regions

In considering the options for the scope it is also necessary to consider how this would be applied to the most isolated and remote areas of the EU. The Council Conclusions urged the Commission to include in its impact assessment "*analysis of the effects of the inclusion of the aviation sector on the diversity of situations in various regions of the Community including islands, the Outermost Regions and the Overseas Countries and Territories*". The European Parliament also asked "*that special attention be paid to the situation of the most isolated territories which are*

[20] Report of the Subsidiary Body for Scientific and Technological Advice on the work of its fourth session, Geneva 16-18 December 1996, Item IV.B.2. – conclusions.

particularly dependent on air transport services, and especially to insular or outermost regions, where alternative solutions are limited, or do not exist." These views were also reflected in the Aviation Working Group.

"Overseas countries and territories" (OCTs) are a group of islands and areas which are associated with the Community in accordance with Part 4 of the EC Treaty, but to which the EC Treaty in its entirety is not directly applicable. **The proposed measure would therefore not apply to the Overseas Countries and Territories.**

As regards the "outermost regions" (also known as "ultra-peripheral" regions or UPRs, namely the French overseas departments, the Azores, Madeira and the Canary Islands), Article 299(2) of the Treaty recognises the special position of these regions by reason of their "*structural social and economic situation … which is compounded by their remoteness, insularity, small size, difficult topography and climate, economic dependence on a few products, the permanence and combination of which severely restrain their development*". It also provides for the possibility of adopting "*…specific measures aimed, in particular, at laying down the conditions of application of the present Treaty to those regions…*". Concern has been expressed about the impacts on such areas if flights to these regions are included in the scheme whilst flights to neighbouring islands are not included. **This special position and the fact that UPRs constitute a short, well-defined list of territories means an option for consideration could be to treat them as if they were third countries for the purpose of the scheme.**

In addition, arguments have been made about the need to consider the special situation of other islands or areas disadvantaged in terms of their dependence on, or incapacity to secure provision of, air transport services.

In summary, the following options have been considered:

(1) Make no special provision for any type of regions.

(2) Make special provisions for outermost regions defined in Article 299(2) of the Treaty.

(3) Define further types of regions for which special provisions could be made.

4.5. Other delimitations of the scope (including thresholds)

In addition to defining the geographical scope of the scheme, it is also necessary to consider whether other exclusions and thresholds should be applied. These might be used to exclude particular types of flights which it may not be appropriate to cover or for which the administrative costs of inclusion would be disproportionate to the environmental benefits achieved.

In the Aviation Working Group, there was general agreement that military and other types of State aircraft[21] should be excluded from the scheme. This reflects the fact

[21] Defined as flights performed exclusively for the transport, on official mission, of a reigning monarch and his immediate family, Heads of State, Heads of Government and Government Ministers; military flights and customs and police flights.

that the Chicago Convention does not apply to such flights and flights by state aircraft are largely excluded from en-route charges. The vast majority of EC legislation regulating the internal air transport market applies only to civil aircraft which represent by far the biggest share of aviation emissions. **It was therefore at an early stage decided to exclude flights by State aircraft from the scheme**.

In the Aviation Working Group there was also general agreement that flights performed exclusively under Visual Flight Rules (VFR), as opposed to Instrument Flight Rules (IFR)[22], should be excluded. Emissions from such flights amount to a very small percentage of total emissions from aviation and as Eurocontrol does not keep data on such flights it would be difficult to cross-check emissions reported for such flights. **It was therefore decided at an early stage to exclude flights under VFR from the scheme.**

The Aviation Working Group further discussed the option of excluding flights for **testing navigation equipment or for training purposes**. These types of flights are infrequent and produce a very small percentage of total aviation emissions. They are also largely excluded from en-route charges. Similar reasoning could be applied to **circular flights**, i.e. flights which take-off and land at the same airport without intermediate stops, the inclusion of which could add considerable complexity to any benchmarking system used for calculating the allocation of allowances given that the distance between origin and destination would be zero. It was therefore decided to exclude flights for testing navigation equipment or for training purposes and circular flights.

In addition to these exclusions, it may also be necessary to have additional limitations in order to ensure that the administrative burden of the scheme, both for aircraft operators and regulators, is not disproportionate. Such exclusions could be applied at the level of the **aircraft size** (expressed in terms of aircraft weight threshold and/or a maximum certified passenger capacity). This option has been analysed in further detail as described in section 5.

4.6. Coverage of non-CO_2 emissions

Aviation's impact on the climate is higher than the effect of its direct GHG emissions (essentially those of CO_2), because a number of **indirect effects** also play an important role. Scientific research indicates that the non-GHG effects of most concern are **NO_x emissions** (because they are particularly strong precursors for ozone – a greenhouse gas – when emitted at altitude), and the effects due to potential **enhancement of cirrus cloud coverage** (triggered by contrail formation and other emissions of particles around which water in the atmosphere can condensate – for more details see annex 12).

[22] Instrument Flight Rules (IFR) are a set of regulations and procedures for flying aircraft without the assumption that pilots will be able to see and avoid obstacles, terrain, and other air traffic; it is an alternative to visual flight rules (VFR). Since navigation and control of the aircraft under IFR is done by instruments, flying through clouds is allowed; under VFR it is not. Commercial traffic (a flight carrying paying passengers or cargo) operates under IFR almost exclusively. For further details, see: http://en.wikipedia.org/wiki/IFR.

At an aggregate level the Intergovernmental Panel on Climate Change (IPCC) has estimated that the total impact of aviation currently is about 2 to 4 times higher than the effect stemming from its past CO_2 emissions alone. Recent EU research results indicate that this ratio may be closer to double the impact. These estimates do not take into account the highly uncertain but potentially very significant cirrus cloud effects.

The Kyoto Protocol, and likewise the EU ETS, compares the potency of different GHGs using the metric Global Warming Potential (GWP). However, GWPs have not been defined for aviation's indirect warming effects, nor have alternative metrics, so there is currently no scientific consensus on how to compare the marginal/additional climate impact of these effects with the effects attributed to a marginal/additional emission of a greenhouse gas such as CO_2.

In the Communication the Commission stated the view that "…*both the CO_2 and non-CO_2 impacts of aviation should be addressed to the extent possible*" but that "*[p]ending scientific progress in developing more suitable metrics for comparing the different impacts, a pragmatic approach would be needed"* and that in the short term, "*…this could be based either on:*

- a requirement for aviation to surrender a number of allowances corresponding to its CO_2 emissions multiplied by a precautionary average factor reflecting other impacts; or

- an approach where initially only CO_2 is included, but ancillary instruments are implemented in parallel such as differentiation of airport charges according to NOx emissions."

The views expressed on these issues by the Council, the European Parliament and the EESC are summarised in Annex 2.

The Aviation Working Group considered the issue in great detail but did not reach full agreement on which approach was preferable. There was general consensus that many measures to reduce CO_2, at least in the relatively short-term, would also result in lower emissions of NO_x (examples include technological measures such as the use of lighter aircraft construction materials and more aerodynamic aircraft designs, and operational measures such as flying more slowly and reducing holding over airports).

An implication of this is that <u>in the shorter term,</u> a system providing incentives only with respect to CO_2 emissions would also imply reductions of NO_x emissions. However, <u>in the medium-to-long term</u>, potential trade-offs between NO_x and CO_2 exist with respect to design of new engines and combustors. If a market-valuation of CO_2 was not combined with a price signal valuing NO_x reductions, engine manufacturers and their customers, airlines, would be likely to prioritise reductions in CO_2 (and fuel consumption) exclusively as long as the ICAO NO_x minimum standards can be met.

The two options above have been considered in further detail in the analysis.

4.7. Open or closed system

The Communication concluded that "*…the best way forward, from an economic and environmental point of view, lies in including the climate impact of the aviation sector in the EU emissions trading scheme*". This envisaged an open system under which all sectors covered by the scheme would collectively need to meet the emission reduction goal. The equilibrium market price would then reflect their combined marginal abatement cost of meeting that goal.

An alternative to including aviation in the existing EU ETS would be to develop a separate emissions trading scheme for aviation (a closed system). This approach was advocated by the European Parliament in its resolution, at least during the second phase of the EU ETS (2008-12). Under this approach, aviation would need to meet the emission reduction goal on its own. This means that the equilibrium market price would reflect aviation's marginal abatement cost of meeting the goal.

Whilst the Commission strongly favours the creation of an open trading scheme, in section 5 modelling has been done to demonstrate the impacts of a closed system.

4.8. Interplay with Kyoto Protocol (absence of AAUs for international aviation)

From the second phase of the EU ETS, which runs from 2008-2012, Commission Regulation 2216/2004/EC ("the Registries Regulation") provides for allowances in the EU ETS to be created from Assigned Amount Units (AAUs being the main international currency provided for under the Kyoto Protocol). Allowances will be created by adding an allowance identifier to an AAU. The effect of this is that every time an allowance is transferred between two accounts in the registries system, an AAU is simultaneously transferred. The transfer of the allowance enables the operator to emit an additional tonne of CO_2 under the EU ETS and the transfer of the AAU ensures that the Member State is able to emit an additional tonne of CO_2 in accordance with the Kyoto Protocol.

This approach creates a difficulty for the inclusion of aviation in the EU ETS because international aviation (including flights between Member States) is not included in the targets under the Kyoto Protocol or Decision 2002/358/EC (the "burden sharing agreement"). Member States will not therefore hold AAUs in respect of international aviation.

The position is different for domestic aviation which is included in the targets. AAUs will be issued in respect of emissions from domestic aviation and Member States will be required to retire AAUs to cover such emissions (see section 4.9 below).

Both the Communication and the Council conclusions of December 2005 recognised that "*the inclusion of aviation should not adversely affect the accounting system established by Commission Regulation (EC) No 2216/2004 to ensure consistency between trading under the EU ETS and trading under the Kyoto Protocol*".

The feasibility study and the Aviation Working Group considered a number of options for dealing with the interaction between the EU ETS and the Kyoto Protocol, namely extending the scope of the Kyoto Protocol, borrowing AAUs from sectors not covered by the EU ETS, no allocation of allowances to the aviation sector, obligations to surrender allowances for emissions growth above a certain baseline, semi-open trading for aviation and a gateway mechanism.

The AWG considered that the option of extending the Kyoto Protocol was only an option in the longer term. The option where no allocations are made to the aviation sector would increase the pressure on other EU ETS sectors as the aviation sector would have to buy allowances to cover all its emissions from other sectors in the EU ETS without a corresponding increase in the amount of allowances available. A system in which aviation was only required to surrender allowances above a baseline would provide no incentive to reduce emissions below the baseline. The semi-open trading option placed a blanket restriction on aviation selling allowances to the rest of the EU ETS which was felt to be overly limiting. A borrowing system would require allowances issued to the aviation sector to be backed by AAUs borrowed from those held by Member States to cover emissions from sectors which are not included in the EU ETS. Member States indicated this option was unlikely to be acceptable for Member States, and it would increase the complexity of the scheme because rules for borrowing and returning AAUs would have to be agreed and applied.

The single remaining option plus a new option have therefore been shortlisted:

(1) Open trading with surrender restriction: under this option two types of allowances would be created: aviation allowances allocated to the aviation sector and allowances allocated to other EU ETS sectors. Both types of allowances can be traded freely. Aviation operators would be permitted to surrender both types of allowances but operators from other sectors would not be permitted to surrender aviation allowances.

(2) Gateway: under a gateway system there would also be two types of allowances as above. The selling of allowances from the aviation sector to the core-EU ETS sectors would be limited to ensure that there is no net transfer of allowances from the aviation sector to the core-EU ETS.

The first option does not place any restrictions on trading in the market. The only restriction made is on the point of surrender. The price of an aviation allowance should follow the price of a normal allowance unless the aviation sector receives an over-allocation of allowances. This is because i) both types of allowances are in demand by the aviation sector and ii) anyone will be able to trade both types of allowances. As a result, arbitrage in the market should move to ensure that the price of an aviation allowance is the same as that of a normal allowance. The second option does place restrictions on trading in the market through a gateway system. Here, in theory, the price of an aviation allowance should follow the price of a normal allowance unless the aviation sector receives an over-allocation of allowances, in which case the gateway would close and the market would be split into two. However, the risk that a gateway system can close in an unpredictable fashion, thereby preventing the settlement of a trade through the transfer of allowances, would be expected to inhibit trading, and as such it is less likely that arbitrage in the market would move to ensure that the price of an aviation allowance is the same as that of a normal allowance.

As a result, avoiding any restrictions on trading, and thereby avoiding the creation of market barriers, is a primary consideration. In this context, the first option is preferred. Secondly, the first option is simpler and therefore cheaper to implement through a registries system linking up a different IT system for each Member State. **Therefore, the Commission has concluded that an open system with the single restriction that non-aviation operators cannot surrender aviation allowances is the most effective system.**

In addition, the proposal allows aircraft operators to request the Member State administering their participation in the EU ETS for aviation allowances to be exchanged for normal allowances. This exchange would use AAUs issued to that Member State to cover emissions from sectors which are not included in the EU ETS. Since this provision only increases the number of normal allowances, it does not raise issues of compatibility between the Kyoto Protocol and the EU ETS.

4.9. Treatment of domestic aviation

In view of the fact that domestic aviation emissions are included in targets under the Kyoto Protocol whereas international aviation emissions are not, there is a question as to whether domestic and international aviation should be treated differently under an emissions trading scheme.

Options are:

- Treat domestic and international aviation in the same way.
- Treat domestic aviation in the same way as existing sectors in the EU ETS through the national allocation plan process either determined by each Member State at its discretion or based on a harmonised EU methodology.
- Exclude domestic aviation emissions from the scheme.

At an early stage the Commission considered that domestic and international aviation emissions should be treated in the same way and that the trading currency allocated in respect of domestic and international aviation emissions should be the same. Consistent treatment of international and domestic operations makes sense from an operator's perspective and was supported by most participants in the Aviation Working Group on the basis that any difference in treatment could create distortions in competition. ICAO policy on market-based measures also recommends that Contracting States strive to take action in a consistent manner for both domestic and international emissions. The reasons for this decision are set out in further detail in Annex 4.

4.10. Use of credits from the Kyoto Protocol's project mechanisms

In principle, the aviation sector should be able to surrender project credits for compliance purposes from the Kyoto Protocol’s project mechanisms: Joint Implementation (JI) and the Clean Development Mechanism (CDM). So far as possible this should be consistent with the use of such credits permitted under the existing EU ETS. Under the existing scheme, installations are allowed to use project credits subject to a limit set by Member States in their national allocation plans (NAPs). In order to ensure that there is no discrimination between aircraft operators, there is a need for a harmonised approach in relation to aviation. This could be achieved by setting a limit for use representing the average of the limits imposed by Member States in their NAPs for the period.

The analysis in section 5 therefore considers two options:

- The use of project credits subject to a limit representing the average of the limits imposed by Member States in their national allocation plans.
- Unlimited access to project credits.

4.11. Overall quantity of allowances issued to aircraft operators

The emission reduction goal for the EU ETS is defined through the total quantity of CO_2 allowed to be emitted. This is implemented through the total quantity of allowances allocated, each allowance representing a single tonne of CO_2. Incorporating aviation into the EU ETS means that the sector will receive a quantity of allowances representing its individual emission reduction goal, which can be altered through trading.

In evaluating possible emission reduction goals for the aviation sector, the Commission has considered the possibility of two theoretical scenarios occurring beyond 2012:

(1) "Kyoto Protocol freeze scenario": under this scenario, the assumption is that the international community does not agree upon a post-2012 climate change agreement. The EU ETS emission reduction goal between 2013 and 2030 therefore remains at the level set for the 2008-2012 period. Since the 2008-2012 emission reduction goal has not yet been fully established through the system of national allocation plans, an assumption would be made based on two factors: the requirement for the sectors covered by the EU ETS to make a proportionate effort towards Member States meeting their Kyoto Protocol commitments and the requirement for the 2008-2012 emission reduction goal to take account of aggregate 2005 verified emissions figures[23]. For the sectors not covered by the EU ETS, the policies and measures put in place to reduce greenhouse gas emissions in order to achieve the Kyoto Protocol target would also be assumed to continue between 2013 and 2030.

(2) "Post-2012 agreement scenario": under this scenario, the assumption is that the international community agrees upon a post-2012 climate change agreement which sets emission reduction goals consistent with limiting global annual mean surface temperature increases to 2°C above pre-industrial levels. In this context, the European Council[24] has stated that *"without prejudging new approaches for differentiation between parties in a future fair and flexible framework [...] reduction pathways for the group of developed countries in the order of 15-30% by 2020, compared to the baseline envisaged in the Kyoto Protocol [...] should be considered"*. Therefore, all

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23 For further information, see: http://ec.europa.eu/environment/climat/pdf/nap2006/20061128_communication_en.pdf

24 See European Council Presidency Conclusions, Brussels 22-23 March 2005.

sectors of the economy, both within and outside of the EU ETS, would have an emission reduction goal lying midway between 15-30% by 2020. For the purposes of modelling out to 2030, further emission reductions would be undertaken at the same linear rate between 2020 and 2030.

This impact assessment concentrates on the "Kyoto Protocol freeze scenario" being the background scenario for establishing an emission reduction goal for the aviation sector. **Looking at the emission reduction goals established for the existing EU ETS sectors under this scenario for both the first period (2005-7) and the second period (2008-12) onwards, the emissions caps are driving emissions to stabilise at, and then fall below, 1990 levels.** However, data submitted under the UNFCCC shows that emissions from international aviation grew by 87% between 1990 and 2004. Data from Eurocontrol indicates that emissions increased again between 2004 and 2005 by 4.2%. **Therefore, requiring aviation to stabilise its emissions close to 1990 levels would be a challenging task.** In this context, the Commission has assumed an emission reduction goal for the aviation sector which requires it to **stabilise its emissions at a level for which the most recent emissions data is available: 2005 levels.** Hence an emissions cap at 2005 emissions levels is used throughout the modelling explained in section 5 of this impact assessment.

A consistent and accurate data set for aviation is available going further back in time than that available for the existing EU ETS sectors. Therefore, in order to take account of any concern regarding taking a single year of emissions data from a trend line in order to set an emissions cap, the mean average emissions data figure from the years 2004-2005-2006 has been used in the legislative proposal itself.

A possible option at this point would have been to divide the total emissions cap set at 2005 emissions levels for the EU-25 into 25 Member State caps. However, this would mean that, even with a harmonised method of allowance allocation (see section 4.12 below), two aircraft operators with exactly the same operations in two different countries might receive different quantities of allowances. The aviation sector to date has strongly supported a single EU-25 cap being directly distributed in a harmonised manner in order to avoid this situation occurring. Moreover, a harmonised approach will ensure equal treatment of operators regardless of their nationality consistent with the requirements of the Chicago Convention. This would not be the case if an EU-25 cap was divided into 25 Member State caps. Therefore, the Commission has proposed a single EU-25 cap.

4.12. Method of allowance allocation and distribution

An allowance allocation methodology encompasses two different factors: firstly, whether allowances are issued against payment or granted for free, and secondly, how allowances granted for free are distributed amongst the entities covered by a scheme.

The following options were explored in the feasibility study and then discussed by stakeholders within the Aviation Working Group and in other fora: no allocation (no allowances granted so all emissions must be covered by purchasing allowances on the market), auctioning (allowances issued against payment), grandfathering (allowances granted for free and distributed according to historic emissions data), and benchmarking (allowances granted for free and distributed according to an efficiency parameter).

A majority of stakeholders did not support the "no allocation" option because it would treat the aviation sector differently from those sectors already covered by the EU ETS. Additionally, as mentioned in section 4.8, it would increase the pressure on other EU ETS sectors as the aviation sector would have to buy allowances to cover all its emissions from other sectors in the EU ETS without a corresponding increase in the amount of allowances available. The "grandfathering" option was also criticised by a majority of stakeholders because it can be seen as rewarding the polluter, does not always favour early action (and can even incentivise a delay in the introduction of measures to reduce emissions), and is economically less efficient.

To date, grandfathering has been used reasonably widely as an allocation methodology for the sectors already covered by the EU ETS. However, one of the main reasons for this wide usage has been that Member States have lacked the sometimes extensive data requirements for implementing the other main methodology for granting allowances for free: benchmarking. For the aviation sector, the data requirements are fewer due to the relative mechanical homogeneity of carrying passengers or freight between two airports.

Therefore, the Commission has chosen not to further consider the "no allocation" or "grandfathering" options for the aviation sector, but to concentrate upon the "auctioning" and "benchmarking" options.

4.13. Treatment of new entrants and closures

Any methodology for allocating allowances for free can only upfront calculate specific quantities of allowances for incumbent companies, because only these exist. However, in any market there is some degree of change since new companies can establish themselves either in place of, or in addition to, incumbent companies, whilst incumbent companies sometimes close. Therefore, one of the design choices for incorporating aviation into the EU ETS is how to treat new entrants and closures.

To guarantee equal treatment of aircraft operators, new entrants and closures within the aviation sector must also receive consistent treatment. This means that the current system for new entrants and closures for sectors already covered by the EU ETS, where the rules can differ from country to country, cannot be applied to the aviation sector.

Guidance on allocation issued by the Commission in 2004[25] stated that: *"A Member State has at least three options to enable participation of new entrants: it may have any new entrants buy all allowances on the market, it may make use of the possibility to set aside some allowances for periodic auctioning, or it may foresee a reserve in the national allocation plan to issue allowances to new entrants to free of charge".* **This guidance also noted that each of these three options is consistent with the principle of equal treatment of new entrants vis-à-vis incumbents.**

25 COM(2003)830 final, published 7 January 2004.

In determining how to treat new entrants and closures in a consistent manner within the aviation sector, the Commission has looked in detail at each of the above three options and explored the practical issues raised by applying these to the aviation sector.

(1) New entrants buying allowances on the market: It is always possible for new entrants or incumbents to cover emissions through purchasing allowances from the market. However, this option would not foresee withholding any proportion of the total quantity of allowances for new entrants in order to provide an additional option for sourcing allowances. This means that the entire total allocation would be received by incumbents. It is possible that new entrants may perceive this as unfair. Regarding closures, the corollary of this option is that allowances are kept on closure up to the end of a period, but no further allocation would be made for the next period.

(2) New entrants buying allowances through an auction: This option would foresee the withholding of a proportion of the total quantity of allowances in order that new entrants and incumbents have an additional source for purchasing allowances to cover emissions which is through an auction. Regarding closures, the corollary of this option is that allowances are kept on closure up to the end of a period, but no further allocation would be made for the next period.

(3) New entrants receiving an allocation through a reserve: Under this option, the additional source of allowances is a proportion of the total quantity being set aside as a new entrant reserve which is accessible only by new entrants and not by incumbents. Managing a new entrant reserve means addressing the following points: how to define new entrants and closures, how to determine the size of a reserve, how to allocate allowances out of the reserve when no historic data for a new operator is available, and how to deal with any remaining allowances in a reserve at the end of the period.

   (a) A particular difficulty would be how to define a new entrant in the aviation sector. For the sectors already covered by the EU ETS, a new entrant is defined as a new installation, or a substantially changed/extended installation. The existence of such a change is recognised by the issue of a new regulatory permit or the update of an existing permit. This installation-based concept cannot be translated directly to the aviation sector. Due to individual aircraft being able to move in and out of the scope of the scheme and new aircraft commonly being added or used on different routes, a new entrant system focusing on aircraft would simply not work.

   (b) A new entrant within the aviation sector might alternatively be defined as a new route within the covered geographical boundaries of the scheme. However, the opening and closing of routes is a relatively fluid part of the aviation industry. This means that managing a new entrant reserve operating on this basis would be expected to increase the complexity of the scheme and lead to high administrative costs both for the operators and the regulators.

(c) Finally, an alternative concept might be to define a new entrant as a new operator. If a new operator is undertaking commercial operations, then the granting of an Air Operating Certificate (AOC) could become the basis for managing a new entrant reserve. However, there is not always a clear link between new aircraft operators and new aircraft activity. For example, for business restructuring purposes, an existing aircraft operator could be re-defined as being two different aircraft operators. Furthermore, not all aircraft operators covered by the EU ETS are undertaking commercial operations. Therefore a further metric would need to be developed for non-commercial operations.

After considering all of the above arguments, the Commission has concluded that operating a new entrant reserve for the aviation sector is neither practicable nor cost-effective. However the Commission recognises that a source of allowances additional to purchasing on the market could be helpful to both new entrants and incumbents. **Therefore, the option contained within the legislative proposal is that new entrants can purchase allowances through an auction or via the market. From the point of view of a new entrant, this is only a temporary measure: new entrants will be able to apply for an allocation of allowances as incumbents when allowances for the subsequent period are allocated.**

4.14. Monitoring, reporting and verification

The ECCP Aviation Working Group considered possible approaches for monitoring, reporting and verification of emissions.

There was general agreement in the group that reporting of actual fuel use by airlines would be the most accurate method and that it would provide the broadest possible range of incentives to implement reduction measures including operational measures. Representatives of airlines confirmed that major airlines already collect detailed data for internal purposes and the experience from the UK emissions trading scheme demonstrated that operators have access to accurate fuel and operational data. While concern was expressed that smaller airlines may not currently have the systems in place to provide actual data on a flight by flight basis, the Association of European Airlines indicated its support for the use of actual data and explained that this position had been also agreed by its smaller members knowing that it would require them to put in place additional procedures. In fact, fuel consumption is already monitored and recorded routinely for safety purposes and financial reasons. Where actual fuel data is not available a standardised tiered method could be used to estimate emissions. All participants agreed that if the future rules made recourse to estimated data as a lower tier e.g. in cases where operators have failed to submit data, such estimates should be conservative (higher than actual consumption) to prevent operators from gaining by using low estimation methods. This would also provide an incentive for all operators to put in place adequate and accurate monitoring systems.

Concerning emission factors, there was wide agreement that emissions factors are not a complex issue in the aviation sector as the fuel used is relatively homogenous compared to many other industries including some of those already subject to the EU ETS. However, as is the case in the current EU ETS, the emission factors used should be able to vary according to the net CO_2 content to stimulate the use of low carbon fuels. For this purpose, the emission factor for fuel produced from biomass will be zero.

4.15. Timing aspects

As highlighted above, aviation emissions are growing fast and therefore measures to reduce the climate change impact of aviation should in principle be introduced as soon as possible. The main issue of relevance for determining when aviation can enter emissions trading is the time required to implement the scheme.

The point **at which it would be practically feasible to expect different obligations established by the scheme to enter into force** depends on the time needed to a) complete the co-decision process b) complete the transposition and implementation process c) collect and verify data necessary for determining the distribution of allowances to the aviation sector. To provide certainty for aircraft operators and the wider market, decisions on allocation should take place at least 12 months in advance of the beginning of the first period for which operators need to surrender allowances. As indicated in the table below, the earliest year in which the scheme could start is 2010, and the earliest year when caps could be applied is 2011.

Process	**Minimum time required**	**Realistic start/end**
Co-decision; national implementation	1-2 years	2007/2008
Reporting, verifying and collating benchmark data; calculating and deciding allocations	3 years	Jan. 2008/Dec. 2010
First calendar year with data reporting obligations in effect	1 year	2010
Lead-time for allocations to be known before caps take effect	1 year	Jan. 2010
First year of caps in effect	n.a.	Jan. 2011

Table 1: Outline of possible timetable required for implementation

In conclusion, the options for entry into force will depend on timely progress in the co-decision procedure, but the earliest realistic outlook seems to be a scheme starting in 2010, with reporting obligations taking effect as from 2010 and emission caps taking effect from 2011 onwards.

5. ANALYSIS OF IMPACTS

5.1. Introduction

5.1.1. Structure of the approach and presentation of impacts

This section presents analysis of the impacts of the various options for the design of the scheme that have been presented in section 4. Here, a "main variant" scenario has been defined and the impacts arising from the main variant will be described in the sections 5.2 and 5.3. The impacts of each of the alternative options will be addressed one by one in section 5.4.

Design parameter	Main variant	Alternatives
Geographical scope	All departing flights	• Intra-EU flights only • All departing and all arriving flights
Coverage of non-CO_2 impacts	CO_2 in EU ETS, other impacts addressed by specific measures	Multiplier of 2 on monitored CO_2 emissions as proxy for internalising external costs from other effects
Allowance allocation	20%/40% auctioning in 1st/2nd period, remainder allocated free of charge	• Consideration of different benchmarking parameters • Different degrees of auctioning
Aircraft size threshold	Exclude aircraft with MTOW<20.000 kg	Various alternative MTOW values and combinations with max certified passenger capacity limit of 19
Amount of allowances issued (cap)	Stabilisation at 2005 levels	Considerations of different levels of access to JI/CDM
Treatment of remote and isolated regions	Treat outermost regions defined in Article 299(2) as third countries	• No special treatment • Define further types of regions for which special condition be made
Sensitivity analysis parameter	**Main analysis**	**Alternative assumption**
Aviation baseline emissions	AERO baseline based on ICAO FESG traffic scenario and 1% annual ATM improvements in 2013-2019	Low aviation emissions growth scenario calculated by PRIMES on basis of traffic data from mid-term review of common transport policy white paper.

5.1.2. Methodologies used

The analysis undertaken has required the use of a number of models as no single model exists that would be capable of assessing all aspects of incorporating aviation in the EU ETS.

Therefore, three **formal models – AERO, PRIMES and TREMOVE** - have been used. AERO is an aviation-specific model used to quantify any economic and environmental impacts of possible measures related to the air transport system. This model was used for the preliminary impact assessment underlying the Communication of September 2005 as well as for the feasibility study, and has also been used within ICAO. The geographical coverage of the AERO model for this exercise was the EU-25, Bulgaria, Romania, Norway, Iceland and Liechtenstein (coverage of the EU ETS from 2008 onwards). PRIMES is a modelling system that simulates a market equilibrium solution for energy supply and demand in the EU-25.

This model is used across the Commission in order to quantify any impact of possible measures related to the EU's energy markets, and therefore has long been used in impact assessments supporting proposals related to the EU ETS. Finally, TREMOVE is a transport and emissions simulation model developed for the European Commission. It is designed to study the effects of different transport and environment policies on the emissions of the whole transport sector. The geographical coverage of the TREMOVE model is the EU-15, Czech Republic, Hungary, Poland and Slovenia. **For this impact assessment, new modelling runs were undertaken in all three models.** A short description of the models and references to their documentation is given in Annex 6.

In addition to the modelling work described above, a significant amount of **air-traffic analysis** has been performed, notably on the basis of data provided by Eurocontrol, the European Organisation for the Safety of Air Navigation. As central manager of the air traffic flow in Europe, Eurocontrol is in possession of a unique source of data which can be used to estimate the environmental impacts of aircraft operations in the area for which Eurocontrol is responsible for the reception, validation and subsequent distribution of flight plan messages. Every flight is recorded with planned or actual trajectory, aircraft type etc. Combined with the AERO, PRIMES and TREMOVE models, this kind of data can be used to produce consistent and high-quality estimates of, for instance, greenhouse gas emissions. The basic data used are the “flight plans” submitted by aircraft operators to Eurocontrol[26]. For most parts of the analysis, Eurocontrol estimates for flights to/from the EU25 (excluding UPRs), Bulgaria, Romania, Norway and Iceland have been used.

Finally, the results of the AERO model were compared to similar simulations made by a new aviation module to the POLES[27] under development by the Institute for Prospective Technological Studies (IPTS) of the Commission's Joint Research Centre (JRC). The comparison showed that the results of the POLES model were very much in agreement with the results of the AERO model which indicated that the conclusions based on the AERO model were not model dependent.

Clearly, the equilibrium allowance price in the EU ETS is a critical input for many parts of this impact assessment. As described in further detail in section 5.3.5 below, a number of scenarios within PRIMES have been run, making different assumptions most crucially regarding access for all operators to Joint Implementation and Clean Development Mechanism project credits. These model runs give a range of possible equilibrium allowance prices. Rather than use this entire range within the AERO and TREMOVE models, which could complicate understanding the results, instead a value from the lower end of the PRIMES results (equilibrium allowance price of €6) and a value from the higher end of the PRIMES results (equilibrium allowance price of €30) have been used for these model runs.

26 For more information see: http://www.eurocontrol.int/environment/public/subsite_homepage/homepage.html

27 The POLES model is a world simulation model for the energy sector. It works in a year-by-year recursive simulation and partial equilibrium framework, with endogenous international energy prices and lagged adjustments of supply and demand by world region. Developed under EU research programmes, the model has been used in multiple policy analyses by the Commission.

5.2. Environmental impacts

5.2.1. Greenhouse gas emissions from aviation and the EU ETS sectors

The environmental effect of an emissions trading scheme is directly dependent on the cap, since this corresponds to the number of allowances issued. Thus, the more allowances issued, the smaller the environmental impact is and vice-versa.

For a given cap the GHG reductions that can be expected depend on the assumptions in the alternative scenario, i.e. what would have happened if the cap had not been introduced. In the present case the reductions therefore depend on the assumptions about the growth of emissions in the business-as-usual scenario. In the analysis, direct emissions of greenhouse gases other than CO_2 (i.e. methane: CH_4 and nitrous oxide: N_2O) have not been assessed since they are negligible. The effects of non-GHG impacts are discussed in section 5.2.2.

The main modelling scenarios assume a baseline growth of aviation emissions with average growth rates as presented in table 2.

	Average growth rates of emissions		
	2005 – 2010	**2010 - 2015**	**2015 - 2020**
Intra EEA flights	5,1%	3,9%	3,1%
All departing flights from the EEA	5,2%	3,9%	3,3%

Table 2: Emissions growth in FESG baseline scenario

The baseline growth in CO_2 emissions was computed by the AERO model on the basis of a set of assumptions about traffic growth produced by ICAO's Forecasting and Economic Analysis Support Group (FESG). These underlying traffic growth assumptions are presented in Annex 5. The PRIMES model's baseline for growth in aviation emissions was adjusted to follow this scenario as closely as possible.

This FESG scenario forecasts passenger-kilometres for the global aviation industry (thus including a forecast for routes to, from and within Europe). It is supplemented with assumptions regarding the baseline developments of aircraft technology (especially assumptions regarding fuel efficiency improvement are relevant). Furthermore for the period 2013-2019 an air-traffic management (ATM) efficiency improvement of 1% per year is assumed[28].

The expected CO_2 reductions attributable to the cap on aviation emissions depend - in addition to the cap itself and the baseline growth assumptions – also on the geographical scope considered. The table below gives an overview of the absolute and percentage annual GHG reductions under the different scenarios considered. As would be expected for a given percentage reduction linked to historical emissions, the reduction increases the wider the scheme is.

[28] See Annex 11 for details.

Geographical coverage	Reduction by 2015		Reduction by 2020	
	%	Mt CO_2	%	Mt CO_2
Intra EU flights	36%	31	45%	44
EU - All departing flights	36%	77	46%	115
EU - All arriving and all departing flights	36%	122	46%	183

Table3: Absolute and percentage annual reductions: stabilisation at 2005 emissions levels compared to business-as-usual emissions levels

The exact extent to which the CO_2 reductions required by the cap are actually made by the aviation sector, or are made by other sectors already covered by the EU ETS, is explored in section 5.3.5. However, the environmental benefits from CO_2 reductions are accrued irrespective of which sector or company undertakes the emission reductions.

5.2.2. Other environmental and health impacts

Apart from the environmental benefits from CO_2 emission reductions quantified in section 5.2.1 above, some other environmental and health benefits may occur. These benefits broadly fall in the following categories:

(1) Impacts from changes in air transport volumes.

(2) Impacts from changes in air transport technologies.

(3) Impacts from other modes of transport substituting air transport.

(4) Impacts on public health.

It is not possible to assess the net effect of all these possible changes reliably in quantitative terms, but each of the categories are discussed qualitatively below.

Impacts from changes in air transport volumes:

The modelling in section 5.3.1 shows that even assuming a full pass through of EU ETS compliance costs onto air transport users, this will only have a modest effect on transport demand and thus traffic, compared to business as usual growth. Other things being equal, this will still lead to some reductions in other nuisances associated with aviation, notably noise around airports and emissions of other substances such as NOx which affect local air quality. However, since the effect on transport demand is very limited, the improvement in other nuisances will also be modest and to some extent offset by increases in other modes of transport – see section 5.3.4. For the "all departing flights" scenario and an allowance price of €30, AERO forecasts a reduction of around 2% of CO_2 emissions compared to business-as-usual emissions of around 1 million tonnes, corresponding to some 20,000 tonnes of NOx.

Impacts from changes in air transport technologies and operations:

In the short to medium term, aircraft operators have a range of - mostly operational - means of optimising their operations and fleet taking into account the additional price signal provided by the EU ETS[29]. Apart from measures such as replacing engines or retrofitting new engine combustors which tend to be difficult to justify economically, most other short term measures aimed at reducing CO_2 emissions will also reduce other impacts such as NO_x emissions. An example is the retrofit of winglets[30], which reduce drag and therefore also reduce both fuel burn and NO_x emissions.

In the longer term, fleet renewal and changes in engine and combustor designs are of greater importance for the overall impacts in particular concerning NO_x emissions and noise. Aircraft and engine design are characterised by trade-offs between different performance parameters. To the extent that the EU ETS will increase the value of fuel burn reductions (by putting a value on CO_2 emissions), this will further strengthen the economic incentive for airlines (and thus aircraft and engine manufacturers whose clients are airlines) to reduce fuel burn. Compared to a business as usual scenario it will therefore increase the relative economic advantage of choosing fuel burn reductions over the reduction of other environmental impacts where trade-offs exist. See also section 5.4.4.

Impacts from other modes of transport substituting air transport:

See section 5.3.4.

Impacts on public health:

The estimated reduction in NOx emissions of some 20,000 tonnes would be expected to provide some benefits to public health through improvements in local air quality, although these are difficult to estimate and quantify. However, the reductions in CO_2 emissions of 115 Mt compared to business-as-usual levels, assuming a scope of all departing flights, will contribute to reducing the adverse health effects of climate change such as: injuries and deaths caused by extreme weather events; increased mortality from heat stroke in vulnerable population groups such as children, the elderly and those suffering from cardiovascular diseases; and increased mortality from air pollutants due to the synergic effects of high temperatures and the dissemination of new infectious diseases.

5.3. Economic and social impacts

5.3.1. Economic impact on airlines

On routes covered by the EU ETS, all airlines, irrespective of nationality or business model, will be subject to the scheme. On any of these routes, broadly speaking, airlines can be expected to operate similar types of aircraft that are suited to the route's mission characteristics in terms of aircraft capacity and stage length. Fuel

[29] For a review of the options see for instance ICAO Circular 303 on "Operational Opportunities to Minimize Fuel Use, February 2003, International Civil Aviation Organization.

[30] A winglet is a device used to improve the efficiency of aircraft by lowering the lift-induced drag caused by wingtip vortices. The winglet is a vertical or angled extension at the tips of each wing. Some types of aircraft have winglets as standard, for example the Airbus A340, and the Boeing 747-400. For some other aircraft such as Boeing 737 or 757, winglets can be retrofitted.

consumption per flight by route will therefore only differ between airlines according to the fuel efficiency of the aircraft used, operational practices and the extent to which more passengers and freight are carried. **Therefore, it follows that airlines will incur a similar additional operating cost per flight performed once incorporated into the EU ETS. A more efficient airline will incur a lower cost, and a less efficient airline a higher one.**

Airlines' economic performance is determined mainly by the profit margin per unit transported (revenue minus both fixed and variable costs) multiplied by the number of units transported. This means that profitability is closely linked to the ability of an aircraft operator to pass on cost increases deriving from all sources (e.g. oil prices, security measures, airport charges etc.) to the consumer, an operator's market share, and the type and size of market in which it is operating.

When companies are operating within a market where *all* competitors are covered by the EU ETS, e.g. European power markets, they have the ability to pass on the costs of participating in the scheme to consumers, whether these costs stem from surrendering allowances received through the allocation process or purchasing allowances in the market. In this competitive environment, whether companies surrender allowances received free of charge or against payment during the allocation process does not make any difference to this cost pass-through decision[31].

Since the EU ETS will be covering all aircraft operators on all covered routes, aircraft operators would also be expected to have the ability to pass on the costs of participating in the scheme to consumers. In effect, this means that the cost of supplying air services to consumers has risen across the market. In theoretical terms, this means a shift upwards in the supply curve. **Therefore, given the fact that the EU ETS will cover all aircraft operators on all covered routes, the AERO model assumes that aircraft operators fully pass on the costs of participating in the scheme to consumers.**

However, a price increase to consumers would be expected to have some impact on the number of units transported - in other words, on demand for air services. In theoretical terms, the upwards shift in the supply curve means a new price equilibrium between demand and supply has been reached. The extent to which demand reacts to the increased cost of air services depends, in turn, on its elasticity i.e. how sensitive consumers are to price increases. The AERO model has estimated the extent to which future forecasted demand might be reduced relative to the business as usual scenario, calculated for the period 2005 to 2020.

The AERO results are as follows. For an allowance price of €6 and a geographic coverage of all departing flights, by 2020 payload carried by aircraft multiplied by the number of kilometres between airports ("revenue tonne kilometres") decreases by 0.3% for domestic flights, 0.4% for flights between Member States, and 0.3% for flights to and from third countries compared to business as usual levels. This breaks down into reductions of 0.3%, 0.4% and 0.3% respectively for passenger demand, and 0.6%, 0.4% and 0.3% respectively for cargo demand. For an allowance price of €30 and a geographic coverage of all departing flights, by 2020 revenue tonne

[31] For further detail, see section 5.4.6.

kilometres decrease by 1.7% for domestic flights, 1.9% for flights between Member States, and 1.5% for flights to and from third countries compared to business as usual levels. This breaks down into reductions of 1.6%, 1.9% and 1.6% respectively for passenger demand, and 3.1%, 2.0% and 1.4% respectively for cargo demand.

It can clearly be seen that, for both scenarios, there is a greater impact on cargo demand for domestic flights, where consumers can more easily substitute air travel for other modes of transport. However, the figures become more similar as flight lengths become longer. More detail on shifts to other modes of transport is given in section 5.3.4.

To place all these figures on reductions in future forecasted demand into context, the business as usual increase in revenue tonne kilometres between 2005 and 2020 is estimated by the AERO model to be 138%. Therefore, a percentage reduction of the order of 0.3%-0.4% for an allowance price of €6 and 1.5%-1.9% for an allowance price of €30 (the percentage varying with the type of flight) is modest. In essence it means that, **taking the maximum reduction figure of 1.9% across <u>all</u> flights (i.e. an over-estimate), the increase in revenue tonne kilometres would still be a minimum of 133%.**

Therefore, the picture for the industry as a whole is aircraft operators being able to pass on the costs of participating in the EU ETS on to consumers, with only a modest impact on future forecasted demand being the reaction. The final step is to consider how this picture across the industry might differ at route level or company level.

Firstly, the analysis above has assumed that competition across routes functions well. The reality is that some routes are more open to competition than others, in particular between Europe and third countries. If a route is less open to competition, an operator may be able to raise prices to a level higher than that justified by cost increases.

Secondly, even if all operators function within the same competitive environment, some operators will find ways of further reducing costs and gaining a price advantage over competitors. For example, in the wake of oil price rises, some operators benefited from hedging strategies where fuel was purchased at rates reflecting lower oil prices. Regarding the EU ETS, operators that have invested in more fuel-efficient fleets, run more fuel-efficient operational practices, travel fuel-efficient distances and attract more passengers or cargo, will be affected to a lesser extent than other operators. The latter category may therefore not be able to fully pass on the costs of participating.

Finally, the actual impact on demand, as opposed to the modelled impact on future forecasted demand, depends on the extent to which it can be minimised by airlines through the types of customers they cater for. Aviation is a good example of a sector within which price discrimination is applied. Therefore, airfares for particular categories of customers e.g. business class passengers would be expected to increase by more than airfares for cheaper tickets. This means that the actual impact of incorporating aviation into the EU ETS on demand will in reality be lower than that modelled by AERO.

To conclude, the overall picture for airlines indicates that the impact on the sector from being brought into the EU ETS is expected to be marginal. This picture may vary from operator to operator depending on the number of companies competing on each route, efficiency levels, and the types of customers catered for, but all would be expected to be able to pass on, to a large extent or in full, the cost of participating in the scheme to their customers with the resultant price increase meaning only a modest impact on future forecasted demand.

5.3.2. *Economic impact on airports*

Alongside airlines, airports' future profitability levels are also correlated to future demand growth from consumers. However, as discussed in section 5.3.1 above, reductions in future forecasted demand growth from business as usual levels are projected to be modest. Therefore, the main impact on the competitive position of airports would rather be based on non-EU airports becoming more attractive because journeys starting <u>and</u> ending outside of the EU would have lower airfares, and journeys starting <u>or</u> ending outside of the EU would have lower airfares under a scheme covering all departing flights, all other factors being equal (because only one leg of the journey is covered, instead of both legs).

Three cases have been evaluated:

(1) Passengers or freight being transported directly from or to the EU, or within the EU, where the airport of departure or destination (or both) could be changed to a non-EU airport.

(2) Passengers or freight being transported from one non-EU country to another non-EU country and are currently transferred at an EU hub. There could be an incentive to re-route journeys in order to either fly directly, or to transfer at a non-EU hub.

(3) Passengers or freight being transported from or to the EU and are currently transferred at an EU hub. Again, there could be an incentive to re-route journeys in order to either fly directly, or to transfer at a non-EU hub meaning, in turn, that airlines have an incentive to re-locate their hub to a non-EU airport.

With regard to the first category: Since there are very few major airports just outside EU territory, **the option to change the airport of departure or destination from an EU airport to a non-EU airport often does not exist.** The main exception is Swiss airports. However, the scale of existing air traffic in Swiss airspace is such that there is little room for substituting flights from surrounding airports towards Swiss airports.

In addition, the benefit from potentially lower airfares would have to be balanced against increased travel time (across EU borders). On a typical intra-EU flight of 1,500 kilometres and an allowance price of €30, approximately €4.5 would be saved for a one way trip and €9 for a round trip. **It seems unlikely that these price increases would divert significant amounts of business**, be it passengers or freight.

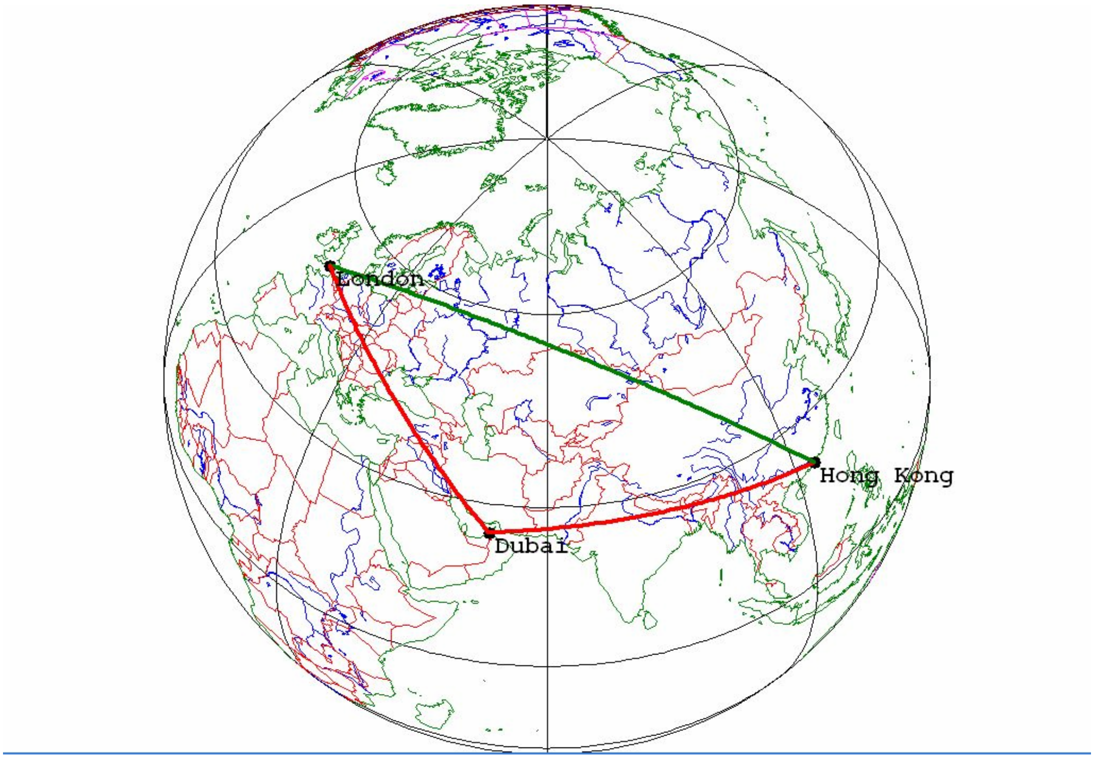
With regard to the second category: An incentive would exist for the transfer point of passengers or freight in this category to be changed from inside the EU to outside the

EU. However, any impact on EU airports is likely to be extremely small. Currently, **only an estimated 1.0% of all passengers at EU airports are travelling from a point of origin outside the EU to a destination outside the EU. It is estimated that only about 2.6% of these passengers (0.03% of all passengers) would choose to transfer at a non-EU airport when the allowance price is at €30.** Taking the other alternative of flying directly would be expected to be more expensive than any increase in ticket prices deriving from aviation's inclusion in the EU ETS, and is not always possible, in particular for long haul flights where aircraft need to re-fuel[32].

With regard to the third category: Airlines choose the hub at which they break a flight, and therefore the route options they offer for transporting passengers and freight, based on the merits of its geographical location. Primarily, there needs to be a well-developed home market supplying large numbers of customers. Here, the concentration of economic activity in the catchment area of a hub is a vital indicator. **The size of the EU economy means that it would not make sense for an airline to consider re-locating a hub to outside of the EU, since the potential to maximise revenues from EU-based clients would then be forgone. Finally, an airline changing its hub is by no means straightforward or inexpensive: traffic rights and slots must be acquired.** For all these reasons, a change of hub airport is highly unlikely.

Secondly, the change in distance travelled when switching from an EU hub to a non-EU hub is a relevant consideration, since longer distances mean more fuel being burnt in order to reach the hub, more fuel needing to be carried (which in turn raises fuel consumption rates) and, if an extra stop was introduced, more fuel being burnt through the landing and take-off cycle. In this context, one of the most frequent examples cited by airline stakeholders has been analysed below, relating to direct air services from the EU to the Far East versus services operated via a hub in the Middle East. The concern is that a competitive disadvantage would be introduced as the latter would not be covered by the EU ETS for the entire journey.

32 For further details, see Annex 9.



The extent of this difference has been assessed taking air services from London Heathrow to Hong Kong International, with the alternatives being a direct flight and a flight via Dubai. The difference in impact was assessed by comparing the EU ETS costs to the extra fuel costs implied by the necessary detour via Dubai, assuming an exchange rate of 1,3 $/€, current jet fuel prices and the use of aircraft typically operating on these routes (B747, A330 and B777).

The results indicate that EU ETS allowance prices would have to exceed some 75 €/tCO_2 before the extra cost per seat imposed by the full EU ETS coverage of non-stop services (compared to the partial coverage of stopover services) would fully outweigh the advantage in fuel costs that non-stop services enjoy. This calculation assumes 40% auctioning and a doubling of traffic meaning that only 30% of required allowances are received for free. It is based on current fuel prices and takes into account the lower fuel costs in Dubai.

In other words, the advantage in terms of lower EU ETS compliance costs associated with stopovers in Dubai is small compared to the disadvantages in terms of extra fuel costs and longer flight times implied. The difference in impact of the EU ETS on the two alternatives is therefore unlikely to significantly affect the respective competitive positions of operators competing on the basis of these two alternatives. The main reason for this is the significant detour that a stop-over in Dubai implies – this is illustrated by the picture above. The stop-over flight is almost 20% longer than the direct one.

5.3.3. Economic impact on consumers

In section 5.3.1, taking into account both economic theory and experience from the EU ETS to date, the conclusion is reached that aircraft operators would be expected to be able to pass on, to a large extent or in full, the cost of participating in the scheme to their customers with the resultant price increase meaning only a modest impact on future forecasted demand.

In this section, these cost increases, and therefore price increases, at both flight level (relevant for both passenger and freight prices) and ticket price level (relevant only for passenger prices) are calculated for a return journey in 2020. The first figure in the range is the price increase when assuming an allowance price of €6 per tonne CO2 and the second figure in the range is the price increase when assuming an allowance price of €30 per tonne[33].

Per flight costs	**Intra EU**	**All departing**	**Arriving & departing**
Without multiplier			
Short haul	96 – 481	96 – 481	96 – 481
Medium haul	190 – 948	190 – 948	190 – 948
Long haul	0	942 – 4,711	1,884 – 9,422
With multiplier = 2			
Short haul	193 – 963	193 - 963	193 - 963
Medium haul	379 – 1,895	379 – 1,895	379 – 1.895
Long haul	0	1,884 – 9,422	3,769 – 18,844

Table 4: Impact at flights level (in € per round trip)

Per ticket costs	**Intra EU**	**All departing**	**Arriving & departing**
Without multiplier			
Short haul	0.9 – 4.6	0.9 – 4.6	0.9 – 4.6
Medium haul	1.8 – 9.0	1.8 – 9.0	1.8 – 9.0
Long haul	0	4.0 – 19.8	7.9 – 39.6
With multiplier = 2			
Short haul	1.8 – 9.2	1.8 – 9.2	1.8 – 9.2
Medium haul	3.6 – 18.0	3.6 – 18.0	3.6 – 18.0
Long haul	0	7.9 – 39.6	15.8 – 79.2

Table 5: Impact on ticket prices (in € per round trip)

Note: Figures indicate the expected increase in ticket prices for round trips in 2020. The first figure in the range is the price increase at an allowance price of € 6 per tonne CO_2 and the second figure in the range is the price increase at an allowance price of € 30 per tonne.

Ticket price increases depend linearly on the allowance price. Therefore, the inclusion of a multiplier of 2 (to account for non-CO_2 emissions) also doubles the expected ticket price increases.

Assuming no multiplier, it can be seen from the tables that with an allowance price of €30 and a coverage of all departing flights, ticket price increases vary from €4.6 on a short haul round trip to €19.8 for a long haul flight. As a proportion of the total ticket price, these ticket price increases are modest. Their modesty is also demonstrated by the very limited impact they have on reducing future forecasted demand as explained in section 5.3.1 above.

[33] A full explanation of the calculations made is given in Annex 8.

In interpreting these results, the following points should be noted:

(1) The results are very sensitive to the load factor, which is assumed to be 70%. Therefore, if the load factor for an aircraft operator is higher than 70%, the price increase per ticket decreases proportionally.

(2) The calculations assume that aviation does not make any emission reductions but instead covers 100% of the increase in emissions by purchasing allowances representing emission reductions in other sectors. In reality, however, there exists some potential for the aviation sector to reduce its emissions at a cost lower than that of purchasing allowances, e.g. operators can save money by implementing measures to improve fuel efficiency, which would cost less per unit of emissions saved than the allowance price. Therefore, in this respect, all of the figures are potentially slight over-estimates.

(3) The figures represent the average ticket price increase for a particular flight route, assuming that all passengers on a flight pay equally for aviation's participation in the EU ETS. In reality, ticket prices for business customers are likely to increase to a greater extent than ticket prices for economy class customers.

The figures differ from the estimates given in the Communication published in September 2005, preliminary impact assessment and feasibility study for three reasons. Firstly, the background analysis assumed that (opportunity) costs would not be passed on to consumers, which is now not considered to be a realistic outcome. Secondly, the background analysis only provided results for a multiplier for one scenario (intra-EU), whereas the full set of results is provided in this impact assessment. Thirdly, the background analysis assumed allowance prices of €10 and €30 instead of €6 and €30.

Social aspects of consumer impacts:

An argument frequently put forward against measures to internalise the external costs of air transport is that this would go against the trend of "democratisation" of air transport brought about by the growing market shares of low-cost carriers. In other words, these measures would make it more difficult for the less wealthy parts of society to enjoy the benefits of air travel. However, the few data on the socio-economic distribution of air transport users that are publicly available do not support this argument.

According to analysis by Eurocontrol, the market share of low-cost carriers reached 16.3% of all Instrument Flight Rule (IFR) flights in May 2006[34] in the Eurocontrol statistical reference area[35]. In the UK, which is the only Member State where the

[34] Eurocontrol Low-Cost Carrier Market Update - May 2006.

[35] Currently includes the following countries: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, FYROM, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, Moldova, Netherlands, Norway, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

market share of low-cost carriers is higher than 25%, Cairns and Newson[36] in a recent review of data from existing surveys concluded that "*…available evidence suggests that flying is largely undertaken by those in richer households, and that most of the growth in flying is coming from people in such households flying more often*". This was confirmed in a subsequent report authored by the UK Civil Aviation Authority[37]: "*The report shows that the average annual rate of growth of short-haul traffic is similar to that before the arrival of no-frills airlines. Most of the no-frills airlines' growth seems to have been at the expense of other carriers. The report also finds that there has been little impact on the income or socio-economic profile of passengers. The profile of UK no-frills and full-service leisure passengers is similar, and has changed little over the last decade.*" These results are contrary to the common perception that the growth in flying is primarily due to more people from lower income groups enjoying the benefits of international travel. In fact, even though lower income groups have benefited to some extent, **the reality seems rather to be that the majority of the growth in aviation has occurred because wealthier people are flying more often** - in some instances influenced by the existence of a second home or in other instances due to the general trend in tourism towards more frequent trips of shorter duration. While this conclusion is based on UK data, there are no indications that this should not also be the case in other Member States where low-cost services are not as developed as in the UK.

At global level, it is clear that the overwhelming majority of the Earth's population does not use air transport regularly. In fact, most are unlikely to ever have set foot onboard an aircraft. ICAO figures for scheduled traffic for 2005 indicated passenger numbers on scheduled services of just over 2 billion. Accounting for a) non-scheduled services, b) the fact that most flights are return flights and c) the fact that many people fly more than once a year, a good estimate is that **far less than 5-10% of the world's 6.5 billion inhabitants use air transport at least once per year**. These disparities are also reflected in global aviation emissions figures: For instance, the US and the EU together account for less than 12% of the global population, while their CO_2 emissions from air transport amount to some 40% of global aviation emissions.

Therefore, in terms of distribution, while the impacts of climate change tend to create most difficulties for people in poorer regions of the world, increased ticket prices resulting from the EU ETS will be predominantly borne by the wealthier segments of the population both within the EU and globally. Despite the advent of low-cost services, air transport is still very much the preserve of the well off at both the regional and global level. The argument that higher ticket prices will strike poorer people hardest is therefore not credible – the facts indicate that the opposite would be the case.

However, the Commission will, in accordance with its general mandate to monitor competition in all markets, monitor airline ticket prices in order to ensure that price increases are not disproportionate to the costs to airlines from participating in the scheme.

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[36] Sally Cairns and Carey Newson: "Predict and Decide - Aviation, climate change and UK policy", report for Environmental Change Institute, Oxford University, September 2006 (ISBN: 1 874370 41 9).

[37] See report at: www.caa.co.uk/cap770, released on 15 November 2006.

5.3.4. *Economic impact on other modes of transport*

The impact on other modes of transport from the inclusion of aviation in the EU ETS has been modelled with TREMOVE, an economic and emissions assessment model for the transport sector developed for the European Commission[38].

TREMOVE has been used to model a scenario that corresponds to the main variant: it was assumed that all aviation emissions from flights departing from the EU would be subject to the EU ETS with an estimated allowance price of €30 in 2020. In TREMOVE, this has been implemented via an average increase in air transport fares of 4%. It has been assumed that the increase would affect air transport as a whole during 2010-20.

Table 6 gives the estimated impact of the price increase on passenger transport demand for each mode in 2020. **Air transport demand decreases on average by 1.5%, which reflects a rather low elasticity.** It is estimated that about 14% of the reduction in air transport would be picked up by other modes: passenger train demand would increase by 0.3% and long range buses (i.e. coaches) by 0.1%. **Overall transport demand is projected to decrease by 0.1% as a result of the inclusion of aviation in the EU ETS.**

Transport mode	Passenger transport demand (bn passenger km)		
	Base case in 2020	Impact of cost increase (€30/tCO_2) in 2020	% change
Aviation	609	600	-1,5%
Passenger train	435	437	0,3%
Long range buses (coach)	347	347	0,1%
Other passenger transport modes	6.950	6.949	-0,01%
Total for all modes	**8.341**	**8.333**	**-0,1%**

Table 6: Estimated impact of increased operation costs of aviation (€30 per tCO_2) on passenger transport demand by mode in the EU in 2020 (billion of passenger kilometres). Source: TREMOVE model

Table 7 shows the projected changes in greenhouse gas and air pollution emissions based on "well-to-wheel" emission factors. It is estimated that the inclusion of aviation in the EU ETS would have a positive impact. CO_2 emissions of the transport sector are projected to decrease overall by almost the full reduction made by air transport. A small part is however offset by additional emissions from trains (37 kt), coaches (79 kt) and private car transport (11 kt) as a result of the modal shift, but these additional emissions are almost neutralised by extra reductions of a similar magnitude from urban transport due to income effects.

The impacts on air pollutant emissions are also given in table 7. To some extent the reduction of air pollutant emissions in aviation is offset by the increase in emissions in rail and coaches. The overall balance is positive, though, as air pollution in transport sector is projected to decrease by about 0.1%. Further, the location of the emissions would differ and thus have a different impact on human health, ecosystems and global warming. For instance, due to different reactions in the atmosphere, a

38 See Annex 7.

release of NOx by aircraft at altitude has a greater effect than NOx emitted at ground level regarding its role as an ozone precursor.

Environmental impact	**Total change**	**Change in aviation**	**Change in Coach**	**Change in Passenger Trains**
Greenhouses gases (controlled under the Kyoto Protocol)				
Carbon Dioxide (CO2)	-0,14%	-1,54%	0,33%	0,21%
Nitrous Oxides (N2O) (exhaust)	-0,01%	-1,54%	0,38%	
Air pollutants				
Carbon Monoxide (CO)	-0,03%	-1,54%	0,24%	0,19%
Non Methane Volatile Organic Compounds (NMVOC)	-0,05%	-1,54%	0,36%	0,20%
Nitrogen Oxides (NOx)	-0,17%	-1,54%	0,17%	0,19%
Particulate Matter (PM)	-0,05%	-1,54%	0,24%	0,19%
Sulphur Dioxide (SO2)	-0,13%	-1,54%	0,33%	0,20%
Energy Consumption (change in PetaJoules)	-0,14%	-1,74%	0,33%	0,25%

Table 7: Estimated "well to wheel" impact of increased operation costs of aviation (€30 per tCO_2) on emissions from alternative modes in the EU in 2020

5.3.5. Economic impact on the EU ETS

As explained in section 4.7, for economic efficiency reasons the Commission has proposed an "open system" for aviation meaning that the aviation sector will be incorporated into the EU ETS rather than undertake emissions trading within a separate market. If the Commission had chosen to pursue a closed system for aviation, there would not be any impact from aviation on the sectors already covered by the EU ETS. However, choosing an open system does, in principle, mean there will be some impact from aviation's inclusion on those other sectors. Both of these options have been explored using the PRIMES energy model, using the "main variant" as described in section 5.1.1, in particular the coverage being all departing flights. This is modelled in PRIMES through simulating the purchases and sales of kerosene in the EU-25 – the closest proxy for all departing flights. However, this does mean that the output figures differ in some respects from those of the AERO model, which is based on flights and a geographical coverage of the EU-25, Bulgaria, Romania, Norway, Iceland and Liechtenstein (coverage of the EU ETS from 2008 onwards).

Two different sets of baseline growth assumptions have been used for the aviation sector in PRIMES. As for the AERO model, the first set of assumptions is based on traffic growth estimates produced by ICAO's Forecasting and Economic Analysis

Support Group (FESG). In addition, a sensitivity analysis was run using a lower emissions growth scenario generated by PRIMES on the basis, in turn, of a traffic scenario generated by the general transport model SCENES used for the review of the White Paper on a Common Transport Policy[39]. In this scenario, traffic in terms of passenger-kilometres grows by half between 2000 and 2010 (51%) and doubles by 2020 (+108%), and emissions in 2020 grow by 56 and 30% over 2000 and 2005, respectively.

As described in section 4.11, the emissions cap for the aviation sector has been set at 2005 emissions levels throughout the modelling. This is against a "Kyoto Protocol freeze scenario" background of the EU ETS emission reduction goal between 2013 and 2030 remaining at the level set for the 2008-2012 period. For the sectors not covered by the EU ETS, the policies and measures put in place to reduce greenhouse gas emissions in order to achieve the Kyoto Protocol target are also assumed to continue between 2013 and 2030.

On this basis, the following scenarios have been modelled:

(1) Closed system: aviation's emissions are capped at 2005 emissions levels between 2010 and 2030 within an aviation-only ETS.

(2) Reference scenario: aviation is not part of the EU ETS and so its emissions follow business as usual projections. Operators covered by EU ETS have *no access* to project credits from Joint Implementation or the Clean Development Mechanism.

(3) Open system: aviation's emissions are capped at 2005 emissions levels between 2010 and 2030 within the EU ETS. Operators covered by EU ETS have *no access* to project credits from Joint Implementation or the Clean Development Mechanism.

(4) Open system: aviation's emissions are capped at 2005 emissions levels between 2010 and 2030 within the EU ETS. Operators covered by the EU ETS have *limited access* to project credits from Joint Implementation and the Clean Development Mechanism.

(5) Open system: aviation's emissions are capped at 2005 emissions levels between 2010 and 2030 within the EU ETS. Operators covered by the EU ETS have *full access* to project credits from Joint Implementation and the Clean Development Mechanism.

The equilibrium allowance price under each of these scenarios is as follows:

Scenario	**PRIMES growth assumptions**				**FESG growth assumptions**			
	2015	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**

[39] See COM(2006)314 final: "Keep Europe moving - Sustainable mobility for our continent. Mid-term review of the European Commission’s 2001 Transport White Paper" and SEC(2006) 768 (Impact assessment).

(1)	98.7	114.1	137.1	150.3	211.7	325.8	559.5	943.4
(2)	40.0	31.3	26.9	26.3	40.6	31.8	27.4	26.9
(3)	43.3	34.6	30.2	29.6	48.8	40.6	43.9	42.8
(4)	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
(5)	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0

Table 8: Allowance prices (€, 2005 prices) under each PRIMES scenario from 2010 to 2030, assuming a "Kyoto Protocol freeze" background.

The results for all scenarios show that the EU ETS gradually becomes accustomed to its unchanging emissions cap: technological advances continue and more technologies are implemented. Therefore, allowance prices (in real terms: 2005 prices) gradually decrease over time.

Closed system:

The results for a closed system (scenario 1) clearly show, particularly when the higher FESG growth assumptions are used, that the marginal abatement costs for the aviation sector are higher than those for the sectors already covered by the EU ETS for the emission reductions required when assuming a "Kyoto Protocol freeze" background.

In considering these results, the following points can be made:

- Maintaining a single, open emissions trading scheme is economically more efficient, since a single price for carbon across the whole scheme means that all gains from trade can be exploited by all market participants, meaning in turn that the emission reduction goal can be met at minimum cost across all of the covered sectors. Therefore, a single scheme delivers benefits to both market participants and to society as a whole. This is why the EU ETS already covers multiple sectors and is anticipated to expand to more sectors and gases over time. Aviation is just the first candidate for expansion. Given that aviation would face an allowance price level of between €114.1 and €325.8 by 2020 in a closed system, it is clear that gains from trade are possible.

- Incorporating aviation into the EU ETS, as opposed to setting up a separate scheme for aviation, is more consistent with ICAO's endorsement of the concept of international open emissions trading.

- It is questionable whether an emissions trading scheme for the aviation sector in isolation would be large enough to ensure a viable market. A viable market needs a sufficient number of active players contributing to liquidity, meaning that problems of market dominance and volatility unlinked to changes in fundamental indicators for that market can be largely avoided. Taking 2005 emissions levels, the aviation sector (based on all departing flights) would only be 8% of the size of the existing EU ETS. Taking into account the fact that the EU ETS market is still developing in terms of active players and liquidity, it seems unlikely that the aviation sector on its own would be able to sustain a second well-functioning market.

Therefore, the Commission has a clear preference for an open system for the aviation sector and a closed system for aviation has not been pursued further in this impact assessment.

Open systems:

The impact of incorporating aviation into the EU ETS can be seen by comparing the results from scenarios (2) and (3). Using the PRIMES growth assumptions, this impact is very limited. Here, by 2020 aviation business-as-usual emissions levels would be at 209 Mt whilst the cap set at 2005 emissions levels is 161 Mt. This cap means a reduction of 48 Mt or 23%. In 2020 aviation reduces its emissions by 6.7% below business-as-usual levels and meets the remainder of its obligation through purchasing allowances, and in 2030 reduces its emissions by 5.7% below business-as-usual levels and meets the remainder of its obligation through purchasing allowances. Using the FESG growth assumptions, the impact is more substantial. Here, by 2020 aviation business-as-usual emissions levels would be at 286 Mt whilst the cap set at 2005 emissions levels is 161 Mt. This cap means a reduction of 125 Mt or 44%. In 2020 aviation reduces its emissions by 8.4% below business-as-usual levels and meets the remainder of its obligation through purchasing allowances, and in 2030 reduces its emissions by 9.2% below business-as-usual levels and meets the remainder of its obligation through purchasing allowances.

However, while it is useful to isolate the impact, neither of these scenarios is very realistic since they exclude access to Joint Implementation and Clean Development Mechanism credits. Therefore, scenarios (4) and (5) introduce a supply of project credits from outside the EU ETS. These figures are generated by the POLES model, a worldwide energy model, using assumptions consistent with the "Kyoto Protocol freeze scenario". Scenario (4) is used to illustrate the demand across the EU ETS for purchasing project credits if the EU ETS price does not go above €15. This is akin to implementing a limit on the quantity of project credits that can be used for compliance purposes by operators in the EU ETS. Scenario (5) is used to illustrate the demand across the EU ETS for purchasing credits if access to project credits is unlimited. The two tables below provide figures on the extent to which (a) emission reductions take place (b) operators across the EU ETS purchase credits (c) aircraft operators purchase credits.

Scenario	**Difference between business-as-usual levels and policy scenario outcome**	**2015**	**2020**	**2025**	**2030**
(4) €15 allowance price	Emission reductions, tCO_2 (total for whole EU ETS)	94	133	166	176
	Emission reductions, % (total for whole EU ETS)	3.7%	5.3%	6.5%	6.9%
	Credits purchased, tCO_2 (total for whole EU ETS)	267	222	214	207
	Emission reductions, tCO_2 (aviation only)	5	6	6	7
	Emission reductions, % (aviation only)	2.4%	2.8%	3.0%	3.1%
	Credits purchased, % (aviation only)	14%	19%	20%	21%

(5) €6 allowance price	Emission reductions, tCO_2 (total for whole EU ETS)	10	22	22	30
	Emission reductions, % (total for whole EU ETS)	0.5%	1.0%	1.0%	1.3%
	Credits purchased, tCO_2 (total for whole EU ETS)	351	333	358	353
	Emission reductions, tCO_2 (aviation only)	2	2	2	3
	Emission reductions, % (aviation only)	0.9%	1.1%	1.2%	1.2%
	Credits purchased, % (aviation only)	11%	14%	13%	14%

Table 9: JI/CDM impact with PRIMES growth assumptions

Scenario	Difference between business-as-usual levels and policy scenario outcome	2015	2020	2025	2030
(4) €15 allowance price	Emission reductions, tCO_2 (total for whole EU ETS)	95	133	170	184
	Emission reductions, % (total for whole EU ETS)	3.7%	5.1%	6.4%	6.8%
	Credits purchased, tCO_2 (total for whole EU ETS)	323	302	325	349
	Emission reductions, tCO_2 (aviation only)	6	8	10	11
	Emission reductions, % (aviation only)	2.4%	2.8%	3.0%	3.1%
	Credits purchased, % (aviation only)	26%	39%	45%	51%
(5) €6 allowance price	Emission reductions, tCO_2 (total for whole EU ETS)	10	25	24	31
	Emission reductions, % (total for whole EU ETS)	0.4%	1.0%	0.9%	1.1%
	Credits purchased, tCO_2 (total for whole EU ETS)	408	411	471	502
	Emission reductions, tCO_2 (aviation only)	2	3	4	4
	Emission reductions, % (aviation only)	0.9%	1.1%	1.2%	1.2%
	Credits purchased, % (aviation only)	21%	30%	33%	37%

Table 10: JI/CDM impact with FESG growth assumptions

With reference to the above tables, it is clear that introducing access to project credits changes the results under scenarios (4) and (5) quite significantly compared to the results under scenarios (2) and (3).

First of all, taking scenario (4) where access to project credits is restricted: Using the PRIMES growth assumptions, aviation now only reduces its emissions by 2.8% (down from 6.7%) by 2020 and by 3.1% (down from 5.7%) by 2030. In consequence, aviation purchases 14% and 21% of all project credits purchased by sectors covered by the EU ETS by 2020 and 2030 respectively. Using the FESG growth assumptions, the same emission reductions take place within the aviation sector reflecting what can be done at €15, but now aviation purchases greater quantities of project credits to cover its extra emissions: 39% and 51% of all project credits purchased by the sectors covered by the EU ETS by 2020 and 2030 respectively.

Now taking scenario (5) where access to project credits is unlimited: Using the PRIMES growth assumptions, aviation now reduces its emissions by only a very small degree: 1.1% (down from 6.7%) by 2020 and 1.2% (down from 5.7%) by 2030. In consequence, aviation purchases 14% of all project credits purchased by sectors covered by the EU ETS for both the years 2020 and 2030. The reason this figure does not increase through time is because it is now cheaper for the other sectors covered by the EU ETS to purchase greater quantities of project credits instead of making emission reductions internally. Using the FESG growth assumptions, again, the same emission reductions take place within the aviation sector reflecting what can be done at €6, but aviation again purchases an increased percentage of project credits: 30% and 37% by 2020 and 2030 respectively.

To summarise these results: whether or not allowance costs actually increase across an expanded EU ETS incorporating the aviation sector depends entirely upon the overall cap set (and therefore the overall emissions reduction effort required) and the extent to which access is available to Joint Implementation and Clean Development Mechanism project credits. Therefore:

- If access to project credits is unlimited, an increase in the overall emission reduction effort required simply results in increased levels of credits being purchased as opposed to pressure being put on allowance prices.

- If access to project credits is not given, or is restricted, any increase in allowance prices would have different impacts on the participants already covered by the EU ETS, depending on whether a participant is a buyer or seller in the market. Buyers would have to pay more for each allowance needed. Sellers would receive more for each allowance not needed. Since aviation is expected to be a buyer rather than a seller and so have an upwards influence on prices, as prices increase a greater proportion of sectors already covered would become sellers rather than buyers, and therefore be compensated (with a profit margin for all except the last emission reduction) for any emission reductions undertaken. Therefore, **seen as a whole, the economic impact on sectors already covered would be expected to be, at most, very limited.**

5.3.6. *Economic impact on tourism*

Europe, with its great diversity and density of tourist attractions, is the most visited tourist region in the world, and tourism is therefore a sector of major economic importance in the EU. Tourism in the EU is essentially driven by the demands of its own citizens which represent about 80% of all overnight stays.

According to EUROSTAT figures, about 25% of tourist trips involve air travel, and as a consequence the inclusion of aviation in the EU ETS might affect regions and Member States more dependent on tourism. The possible impacts of are analysed in detail in Annex 5. In summary the conclusion is that:

- Tourists may respond to higher prices in a number of ways of which some, but not all, entail a reduction in overall tourist receipts: i) tourists may choose other modes of transport where this is possible to reach the same destinations in the EU, e.g. rail, car or coach instead of air; ii) tourists may choose to spend less on accommodation or other expenditures to make up for increased expenditure on travel.

- Extra costs introduced by emissions trading would be expected to amount to a maximum of 2% of the average expenditure for a typical air travel holiday trip in Europe. This calculation assumes an allowance price of €30 and that both legs of the flight are covered under the EU ETS.

- Only for regions (or for the very few Member States such as Malta and Cyprus) whose tourism receipts depend almost completely on inbound air travel can impacts of a higher magnitude be expected on overall tourism receipts. For almost all Member States expected effects would be less than 2%, and in all cases comparable or inferior to natural yearly fluctuations due to fashion and other trends in tourist flows and in airline fuel costs.

- Historical experiences from past oil price shocks indicate that an increase corresponding to €30 per tonne of CO_2 are unlikely to have significant impact on international tourism demand, which depends much more on the general economic situation and purchasing power than on fuel costs.

- The most recent data suggest a similar conclusion: Despite a 49% average increase in fuel costs passed on at least partially to customers in the form of fuel surcharges, ICAO registered strong growth in international passenger traffic in 2005, and global traffic is expected to continue growing for 2006-2008 at about 5-6% per year.

5.3.7. Economic impact on remote and isolated regions

In its conclusions from December 2005, the Council urged the Commission to include in its impact assessment "analysis of the effects of the inclusion of the aviation sector on the diversity of situations in various regions of the Community including islands, the Outermost Regions and the Overseas Countries and Territories". Conceivably, the extra operational costs introduced by inclusion in the EU ETS could in some cases affect the economic viability of marginal air services to an airport serving a peripheral or development region, or a thin route to a regional airport considered vital for the economic development of the region in which the airport is located.

The analysis has been divided into two parts assessing respectively the possible impacts on 1) outermost regions (UPRs) and overseas countries and territories (OCTs), and 2) other disadvantaged regions. In addition, a specific analysis has been made for airports located on islands. The analysis focuses purely on cost increases, before going on to assess whether these cost increases can and will be passed on to consumers. Details are provided in Annex 10.

UPRs and OCTs:

Assuming UPRs and OCTs are treated as third countries, the additional direct costs attributable to inclusion in the EU ETS have been estimated. Results for UPRs are presented in table 11 for the different geographical scope options, for allowance prices of €6 and €30 and for different assumptions about the share of allowances auctioned.

Geographical scope	CO_2 emissions	Allowance price €6			Allowance price €30		
		Auctioning share			Auctioning share		
	Mt	10%	20%	40%	10%	20%	40%
Option 1: Intra-EU	0	0	0	0	0	0	0
Option 2: All departing	3,4	2	4	8	10	20	40
Option 3: All departing + all arriving	6,7	4	8	16	20	40	80

Table 11: Estimated extra costs for services to UPRs (€ million). Emissions estimated for 2005 with Eurocontrol's PAGODA on-line service

As regards flights to/from OCTs, total additional costs at current activity levels would at most (40% auctioning and option 3 for geographical scope) amount to €2.4 or €12 million for an allowance price of €6 or €30 respectively.

In the main, airlines flying both to UPRs and OCTs tend to operate commercial services. Therefore the analysis in section 3.5.1 applies, whereby the cost increases would be expected to be passed on, to a large extent or even in full, to customers with limited effects on demand growth.

Other disadvantaged regions (including specific UPR routes):

However, the situation is different for other disadvantaged regions, including also some specific UPR routes, where airlines tend not to operate commercial services, but are instead subsidised by Member States. Here, the additional costs implied by the EU ETS might lead to existing service levels being questioned. Therefore, estimates of potential extra costs for Member States associated with maintaining existing air services have been produced on the basis of i) routes that are known by the Commission to be subject to public service obligations (PSOs) ii) the assumption that all additional costs serving the airport-pairs concerned would need to be paid for by Member States. **The analysis shows apart from Italy, only countries that have UPRs would risk having to spend more than €1 million extra per year to neutralise the effects on services operating on routes subject to PSOs.**

Member State	CO_2 emissions (tonnes)	Auctioning price: €6 per allowance			Auctioning price: €30 per allowance		
		Share of allowances auctioned:			Share of allowances auctioned:		
		10%	20%	40%	10%	20%	40%
Spain	132.085	79*)	159*)	317*)	396*)	793*)	1585*)
France	550.472	330*)	661*)	1321*)	1651*)	3303*)	6606*)
Italy	373.595	224	448	897	1121	2242	4483
Portugal	261.260	157*)	314*)	627*)	784*)	1568*)	3135*)

Table 12: Estimated additional cost to maintain existing PSO services (€1000) for the most affected Member States

***) Important note**: The emissions and cost figures include specific routes to UPRs which would only be partly or fully covered, respectively, under options 2 and 3 for the geographical scopes. These costs would not be additional to the costs estimated for all UPRs above. In other words there is some overlap between the cost assessed on the basis of PSO routes and the costs for UPRs. Moreover, the figures include emission from aircraft of all sizes and therefore also costs that would not arise with a weight threshold applied.

Islands:

Finally, a specific analysis has been carried out to assess potential impacts on flights serving **airports located on islands**[40]. In three Member States aggregate additional costs for these services could potentially increase by just over €1 million per year under the cheapest scenario, and by more than €20 million per year under the most expensive scenario (see table 13). For all other Member States with islands, aggregate additional costs are negligible under both scenarios, with the exception of France where costs only reach €2.75 million per year under the most expensive scenario (see annex 10).

Airport Country	**Allowance price of €6**			**Allowance price of €30**		
	Auctioning share			**Auctioning share**		
	10%	**20%**	**40%**	**10%**	**20%**	**40%**
Greece	1,61	3,22	6,43	8,04	16,08	32,17
Italy	1,17	2,34	4,68	5,85	11,70	23,40
Spain	1,86	3,72	7,45	9,31	18,62	37,24

Table 13: Aggregate additional operating costs (€ million/year) for flights serving island airports for the 3 most affected Member States

5.3.8. *Macro-economic impacts*

The macroeconomic level (GDP growth and employment) could also be indirectly affected by the incorporation of aviation into the EU ETS. As context, the aviation sector's contribution to the EU economy in 2002 was as follows:

- 400,000 people were employed in the air transport sector in the EU, corresponding to 0.4 % of the total number employed in the non-financial business economy (NACE section C-K, excluding J);

- air transport accounted for 0.6% of the EU's value-added[41].

Macroeconomic impacts are complex as they result from both negative and positive direct and indirect effects. Other things being equal, a reduction in aviation activity and in air transport demand, meaning a slight decrease in the 138% business-as-usual growth scenario of 0.3%-1.9% per annum, would be more likely to lead to a small redistribution of future GDP growth rather than a decrease. This is because demand for goods and services (food, holidays, etc.) is unlikely to change much unless there is no alternative to air transport for sourcing a particular category of goods or

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40 Defined in accordance with the EUROSTAT definition as territories that must:
– have an area of at least 1 km2;
– have to be at least 1 kilometre from the continent;
– have a permanent resident population of at least 50 people;
– have no permanent link with the continent;
– not house an EU capital.

41 Source: Eurostat Structural Business Statistics (SBS): http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-NP-05-037/EN/KS-NP-05-037-EN.PDF

services, or the alternative is more expensive. For example, a consumer not wishing to pay more for a product transported by air would probably choose another similar product which had not been shipped by air. That consumer's disposable income, and hence overall demand in the economy, would only be reduced if the consumer had no choice but to pay the increased price because the product demanded is only ever transported by air or because options closer to home are even more expensive. Therefore, slightly lower growth in the income and employment levels of airports, aircraft manufacturers, and all activities which make use of air transport, is likely to be partially offset by positive effects in the form of increased employment and income levels generated from substitute activities (e.g. increased domestic agricultural production, increased use of other transport modes, etc.). Finally, it is important to bear in mind that consumers' disposable incomes are projected to continue to rise in real terms into the future, meaning that the cost impact of incorporating aviation into the EU ETS, in accordance with the parameters assessed in this impact assessment, will progressively decrease over time.

Where the introduction of an economic instrument would lead to government revenues, the macroeconomic effects depend on how that revenue is used. If a government chooses to increase public spending, there would only be short-term expansionary effects. If a government chooses to use the revenues to decrease levels of conventional taxes on e.g. private income or company profits, overall societal welfare levels would increase, since addressing an environmental issue has coincided with conventional tax reductions.

However, in any event, in terms of overall GDP growth and employment, the net impact would be very small for the scenarios envisaged in this impact assessment. In order to give an idea of the order of magnitude, it is helpful to refer to a simulation of the impact of an increase in VAT using the Commission’s QUEST model, where the revenue is used to reduce direct taxes. While VAT is different as regards the sectoral scope of the tax base, it can be considered that, in the medium term once the effects have spread through the economy, most of the results should more or less – in proportion to their revenue – hold true for other indirect taxes or equivalent economic instruments, such as an emissions trading scheme, in that all of them have an effect on the prices of goods and services. **The QUEST simulation showed that the impact on GDP of an increase in VAT generating revenue in the order of €3-4 billion, equivalent to revenue from auctioning 100% of allowances at a price of €30/tCO_2, would be approximately - 0.002% after 1 year, and +0.026% after 10 years.** Even though this simulation can only give a rough idea of the impact of the scenarios considered and does not include effects on income distribution among economic stakeholders, it shows that the overall order of magnitude for the economy as a whole is very small. It is furthermore important to note that while it might not be reflected in the conventional macro-economic indicators, the internalisation of at least a part of the external environmental costs of aviation’s climate impact would have a positive impact on overall welfare.

5.3.9. *Administrative costs*

In ensuring that emissions are covered by surrendered allowances, each operator already covered by the EU ETS will have costs associated with the general management of its participation in the scheme. These are termed "administrative costs" and derive from the following sources:

(1) The cost of applying for, and maintaining, a regulatory permit which (a) signifies the registration of the operator with the relevant Member State competent authority and (b) lists the operator's requirements regarding monitoring and reporting of emissions and the surrendering of allowances.

(2) The initial cost of setting up monitoring and reporting systems, and the annual cost of collecting and verifying the monitoring data.

(3) The cost of applying for, and maintaining, a registry account through which allowances can be held and transferred.

(4) The cost of setting up control systems for trading in the market, and the per transaction cost from trading in the market.

(5) The cost to Member States from administering aircraft operators under their responsibility.

In the sections below, each of these five categories is discussed with respect to the specificities of the aviation sector.

Permitting:

The Emissions Trading Directive requires Member States to ensure that operators of fixed installations hold a permit to operate that installation. This mechanism helped Member State regulators to identify the installations covered by the scheme and enabled monitoring requirements to be specifically tailored to the each installation. However this approach is not necessary for the aviation sector. Existing permits and authorisations required by the sector and air traffic management systems mean that it is already possible to identify flights within the scope of the scheme. Furthermore, as harmonised monitoring requirements will be applied to the aviation sector it is unnecessary for monitoring plans to be agreed individually. An obligation to surrender allowances can be placed directly in Member State legislation. **For these reasons it is considered that an additional permitting requirement would be unnecessary for the inclusion of aviation in the scheme. This approach will limit the administrative costs associated with the scheme.**

Monitoring, reporting and verification:

Under the legislative proposal, aviation has up to two reporting tasks: firstly, reporting verified tonne-kilometre data and secondly, reporting verified emissions data.

The first task is not mandatory, but is part of the process for applying for an allocation of allowances granted free of charge. As further described in section 5.4.5, parameters have been used which make use of data already collected by airlines. This means that systems do not need to be established anew to cater for aviation's inclusion in the EU ETS, but perhaps just adjusted so as to be able to manipulate the existing data in accordance with the allocation methodology. This will make the verification process easier, and therefore cheaper.

Regarding the second task: for the sectors already covered by the EU ETS, combustion processes are among the simplest regarding monitoring, reporting and verification. Here, it is installations such as mineral oil refineries and integrated steel plants which tend to be the most complex. Aircraft fall into the category of combustion processes, since the carbon dioxide emitted simply relates to the quantity and type of fuel burnt. Therefore, the annual monitoring, reporting and verification process for aircraft operators will be less complex, entailing lower costs, than the average for the EU ETS. In addition, and as explained in the permitting section above, the degree of mechanical homogeneity for aircraft also means that the annual process can be harmonised to an even greater extent than is the case for other combustion processes already covered by the EU ETS[42]. This further keeps costs down.

However, before operators start to monitor, report and verify their emissions on an annual basis, systems must be established. For aviation, monitoring and reporting fuel consumption is already a requirement for commercial aircraft operators under the terms of their AOC. Therefore, commercial aircraft operators will already have systems in place. For these, there is just a question of whether the systems need to be adjusted in the light of the exact requirements flowing from their participation in the EU ETS. For non-commercial aircraft operators (also termed "general" operators), this requirement does not exist and so, for these, the questions are (a) to what extent non-commercial operators should be covered by the scheme and (b) to what extent safety and fuel economy concerns mean that in all likelihood these operators have monitoring and reporting systems in place anyway.

The "main variant" threshold for inclusion in the EU ETS modelled throughout this section is aircraft with a certified maximum takeoff weight of 20,000 kg. The vast majority of aircraft operators using aircraft at or over this threshold are either undertaking standard commercial operations (for passengers or freight) or are providing more exclusive services for business clients on a large-scale. This latter category can choose between a business model operating with an AOC (therefore becoming a commercial aircraft operator) or a business model operating without an AOC (therefore remaining a non-commercial aircraft operator where business clients become fractional owners).

As a result, excluding non-commercial aircraft operators above 20,000 kg from participation in the EU ETS, in order to avoid the introduction of new mandatory requirements for monitoring and reporting systems, would introduce an incentive for aircraft operators solely providing business class services to switch from a business model which uses an AOC to one which does not. Given that these operators are in competition with those offering business class services through standard commercial operations, such an exclusion would be introducing a distortion of competition and therefore has not been proposed by the Commission.

Finally, any competitive aviation business is unlikely not to be monitoring patterns of fuel consumption within its fleet. Fuel bills comprise a significant proportion of the operating costs of an aircraft operator, and monitoring and reporting systems help to identify what actions can be taken to lower costs. In addition, for safety purposes, all aircraft operators keep a close eye on the payload and quantity of fuel carried, in

[42] For further information, see Commission Decision 2004/156/EC (the "Monitoring and Reporting Guidelines"), Annex II ("Guidelines for combustion emissions from activities as listed in Annex I to the Directive").

order to ensure that they do not breach their maximum takeoff weight. Therefore, in reality, a non-commercial aircraft operator using aircraft at or over the 20,000 kg threshold is likely to already have monitoring and reporting systems in place. **This means that aviation's inclusion in the EU ETS may introduce new, more specific requirements, but is unlikely to introduce many changes to industry operations.**

Registry accounts:

For aviation, costs from opening and maintaining a registry account have been minimised in two ways through the design of the legislative proposal.

Firstly, it is proposed that each aircraft operator should only have a single Administering Member State rather than needing to register within every EU country in which it operates. This means that an aircraft operator does not need to open and maintain a registry account in multiple Member State national registries.

Secondly, the decision to treat domestic aviation emissions in the same way as international aviation emissions (see section 4.9) also means that an aircraft operator does not need to open and maintain multiple registry accounts (covering each Member State in which it operates domestic flights alongside an additional account in respect of its international aviation emissions).

Therefore, each aircraft operator will only need to open and maintain a single registry account covering all of its aircraft operations. Each Member State decides what prices it will charge for opening and maintaining a registry account. Under Article 74 of Commission Regulation No 2216/2004: "*Any fees charged by the registry administrator to account holders shall be reasonable and shall be clearly displayed on the public area of that registry's web site*[43]*. Registry administrators shall not differentiate any such fees on the basis of the location of an account holder within the Community*." Member States are also required to submit reports covering the fees charged for opening and maintaining national registry accounts under Article 21 of Directive 2003/87/EC (which establishes the EU ETS). This information has been collated and published by the European Environment Agency[44].

Market transaction costs:

Whether to enter into the EU ETS market, and how frequently, is a decision made solely by each operator covered by the scheme. In addition, the costs of establishing control systems within a company in order to prepare for trading depend on its internal organisation.

With respect to paying transaction costs for each trade, this depends on the market. For the EU ETS, the market trades a standardised commodity: one tonne of carbon dioxide in the form of an allowance. This means that brokers and exchanges catering for other types of commodities can more easily extend their business to cover the EU ETS. This results in an increase in competition, which lowers transaction costs. In addition, EU ETS market participants trade allowances using a set of standardised contracts. Efforts are now being made to make the same progress with respect to

[43] EU national registry websites are listed at: http://ec.europa.eu/environment/ets/registrySearch.do

[44] Pages 28-29: http://reports.eea.europa.eu/technical_report_2006_2/en/technicalreport_2_2006.pdf

trading credits delivered under the Joint Implementation and the Clean Development Mechanisms. This means that, by the time aircraft operators are covered by the scheme, **they will benefit substantially from being able to enter into a large and competitive market which will have matured and developed over a number of years - the result being limited transaction costs.**

Costs for Member States:

The legislative proposal foresees Member States administering aircraft operators' participation in the EU ETS. This means Member States can just apply their existing range of responsibilities for sectors already covered under the EU ETS to aviation. These responsibilities cover: rolling out permits to operators; establishing a monitoring and reporting plan for each operator; proposing and finalising the quantity of allowances to be allocated to each operator and then issuing these allowances; setting up a registry containing an account for each operator; and enforcing all legislative obligations.

However, many of these procedures are simpler for aviation. The sections above have described how permits are not needed for the aviation sector, and how each aircraft operator will be using a harmonised monitoring and reporting plan meaning there is no need to establish individual plans. Regarding allocation: a harmonised system has been designed for the aviation sector which would be expected to significantly decrease the amount of resources Member States need to dedicate to aviation as compared to those currently dedicated to other sectors. Regarding the registry system: aviation will be using the existing national registries, which will in turn only need minor adjustments to cater for aviation since the simpler of the two options was chosen for ensuring consistency is kept between the EU ETS and the Kyoto Protocol (see section 4.8). Registry processes such as the opening of accounts and the issuance of allowances are automatic operations, and so increasing the number of these operations in line with the inclusion of aircraft operators would not be anticipated to create extra work.

Therefore, increased administration costs would be expected to be mainly confined to: checking, as necessary, submissions of verified tonne-kilometre data from aircraft operators; checking, as necessary, an increased number of verified emissions reports; answering queries from an increased number of operators covered by the scheme; and following up enforcement measures for that increased number of operators. From this list, it is clear that teams working in Member States on implementing the EU ETS will be applying existing skills to a larger number of companies rather than needing to learn new skills, and that care has been taken throughout the design of the legislative proposal to avoid unnecessary administrative steps wherever possible. Since the proposal also foresees some auctioning of allowances, Member States will also have the option of recouping administrative costs through auction revenues.

5.3.10. Economic impacts on developing countries

Just as any stationary installation falling within the existing scope of the EU ETS is subject to the rules of the scheme even if owned or operated by third country companies or persons, all aircraft operators on routes within the scope of the scheme would also be covered. Therefore, aircraft operators from developing countries will be affected to the extent they operate on routes covered by the scheme.

Data from Eurocontrol on the nationality of operators has been used to make an estimate of the aggregated costs for third country airlines from regions that include developing countries. The results are shown in table 14, based on current activity levels in the "all departing" scope option. The table shows the distribution of emissions for world regions with developing countries. **Far from all emissions (and thus costs) represent carriers from countries that can be considered as developing countries – for example the "Far East" region includes Japan.**

As operators from third countries generally represent a limited share of emissions covered, the impact is also modest. For example, the total additional operating costs for <u>all</u> operators based in Africa would, at current activity levels, vary from €2 to €35 million per year depending on allowance prices and the share of allowances auctioned.

Operator nationality and share of CO_2 emissions		**Allowance price of €6**			**Allowance price of €30**		
		Auctioning share			**Auctioning share**		
		10%	**20%**	**40%**	**10%**	**20%**	**40%**
Africa	2,2%	2	4	7	9	18	35
Central America	0,3%	0	0	1	1	2	5
South America	1,2%	1	2	4	5	9	19
Middle East	2,7%	2	4	9	11	22	44
Far East	9,3%	8	15	30	38	76	151
Oceania	0,0%	0	0	0	0	0	0

Table 14: Additional costs (€ million) for all operators registered in regions with developing countries. Base year emissions for 2005 for all departing flights (135 million tonnes CO_2) applied to 2004 data on distributional shares.

The estimates above are aggregate average figures. For carriers with relatively old and inefficient fleets the impact may be higher as the effective proportion of allowances acquired for free through benchmarking is lower. However, as third country airlines would generally only have a fraction of their fleet operating to Europe, they may in some cases be able to reduce the effects to some extent by shifting their most efficient aircraft to operate on routes covered by the scheme.

To the extent that aviation's inclusion in the EU ETS creates additional demand for credits from JI and CDM projects, there may also be positive effects as such projects imply additional investments in clean technologies in developing countries.

It is important to note that the measure would be fully in line with the principle of "common but differentiated responsibilities" under the UNFCCC. Incorporation of aviation emissions from routes to/from EU airports into the EU ETS would first of all be a measure taken by the Community as an Annex I Party to the UNFCCC. In terms of the economic impacts, **a larger proportion of compliance costs would naturally be borne by Annex I carriers as they generally have a higher market share on the routes covered**. However, carriers from developing countries that are able to operate in competition with Annex I carriers on such routes would of course need to be covered in order to avoid a) distortions of competition and b) discrimination as to nationality in line with the Chicago Convention.

5.4. Impacts of specific design options

5.4.1. Changing the geographical scope

The analysis in section 5.3 has assumed a geographic coverage of all departing flights. This section considers how the effects of incorporating aviation into the EU ETS might change if two variants are considered: intra-EU flights only and all departing and arriving flights. The issues addressed are as follows:

(1) Competition between airlines operating both within the EU and outside the EU.

(2) Competition between airports situated both inside the EU and outside the EU.

(3) The effect on tourism.

(4) The contribution of the aviation sector towards addressing climate change within the EU ETS.

Changing the geographical scope: competition between airlines:

In exploring the extent to which competition between airlines is affected, it is necessary to look at the extent to which flights that are covered by the EU ETS could be subsidised by flights which are not covered. This concept is known as cross-subsidisation, and is a widespread practice in the aviation industry. Airlines may choose to support economy class services using profits from business class passengers. Similarly, airlines running hub and spoke services may subsidise feeder flights using the profits from intercontinental flights. The key question for this section is the extent to which additional cross-subsidisation would take place upon aviation's incorporation into the EU ETS. This means that two considerations are potentially relevant:

(1) The relative proportion of an airline's operations that are subject to the EU ETS.

(2) The competitive situation that the airline faces in all its separate areas of operation.

Analysis indicates that airlines have little to gain by cross-subsidising flights included in the EU ETS by raising costs for flights not included in the EU ETS. Yes, subsidising flights included in the EU ETS would allow an airline to gain additional market share within the EU. However, gaining market share implies increasing its services, for which additional allowances are required. If the costs of these allowances are not covered by the revenues for the additional flights (since the cost of allowances has not been passed on to consumers), there appears to be little financial benefit from increasing market share. Moreover, that airline would have had to raise prices for its services on flights not covered by the EU ETS. There, the airline would have lost market share, and consequently revenues. The only exception here might be airlines which operate flights not covered by the EU ETS in non-competitive markets. However, no significant domestic or intercontinental market operates without competition, and the degree of competition in any market is increasing over time (not forgetting that the timeframe of this impact assessment stretches out to 2020 for most of the analysis, and 2030 in some cases).

Hence, whether the scope of the scheme is intra-EU, all departing flights, or all departing and arriving flights, additional cross subsidisation is unlikely to occur. This means that competition between airlines is unlikely to be affected by the geographic scope chosen.

Changing the geographical scope: competition between airports:

Section 5.3.3 explored the impact on airports from aviation being incorporated into the EU ETS. The conclusions for the first two categories of passengers and freight would be little changed by the geographic scope of the EU ETS. For the first category (passengers or freight being transported from or to the EU, or within the EU, where the airport of departure or destination (or both) could be changed to a non-EU airport) outgoing passengers would be less affected by a scheme based on all departing and arriving flights whereas incoming passengers would be less affected by an intra-EU scheme. However, the outcome of the cost equation remains the same as in the initial analysis, and so whatever the coverage of the scheme, there would not be likely to be much impact from this category of customers. For the second category (passengers or freight being transported from one non-EU country to another non-EU country and are currently transferred at an EU hub), passengers would be less affected by an intra-EU scheme, but in any case the number of passengers in this category is extremely small.

The more significant case is the final category. This considered passengers or freight being transported from or to the EU which are currently transferring at an EU hub. Here, the analysis concluded that it was highly unlikely that EU or non-EU airlines would choose to re-locate their hub from being inside the EU to outside the EU. This was because airlines primarily choose the location of their hub based on the concentration of economic activity in the surrounding area. In addition, changing a hub is costly.

Analysis points to this conclusion remaining unchanged when the geographic scope of the scheme is changed. Take, for example, a flight from Glasgow in Scotland to Philadelphia in the US. One option via an EU hub might be Glasgow-London-Philadelphia. An option via a non-EU hub might be Glasgow-New York-Philadelphia. For each option, there are four flight legs (two for the departing journey and two for the returning journey). For the EU hub option, the number of legs covered by the EU ETS moves from being two, to three, to then four out of four as the scope of the scheme progressively increases from being intra-EU to all departing flights, and then to being all departing and arriving flights. For the non-EU hub option, the number of legs covered by the EU ETS moves from being zero, to one, to then two out of four as the scope of the scheme progressively increases.

Hence it can be seen that, irrespective of the scope of the scheme, there is a constant differential in flight legs covered by the scheme of two when comparing the hub options. It could be argued that even with a constant differential in flight legs covered, that changes in the cost differential are not neutral. Here, comparisons of fuel consumption between the two options as compared to EU ETS compliance costs are relevant. However, the EU is well situated regarding some of the busiest flight routes, as explained in the example given in section 5.3.2 where a high allowance price of €30 does not lead to compliance costs outweighing Europe's fuel consumption savings. This analysis points in the direction of changes in the cost differential being on occasion positive. However, changes in the cost differential may sometimes also be negative. Therefore, the conclusion is that, in general, the geographic scope of the scheme is neutral with respect to impacts on airports.

Changing the geographical scope: effect on tourism:

Section 5.3.6 pointed out that tourism in the EU is essentially driven by EU citizens. It also concluded that the extra costs introduced by aviation's incorporation into the EU ETS under a scenario of all departing flights were very limited. This means that the cost differential between choosing a tourist destination within the EU and one outside the EU would not be expected to be very large. However, it was acknowledged that there is a greater risk for regions whose tourism receipts depend almost completely on inbound air travel.

For these regions, any risk of EU citizens significantly increasing the extent to which they choose to holiday in, for example, Turkey instead of the Greek islands, would likely be eliminated if the scope of the scheme was changed from all departing flights to being all departing and arriving flights. This is because there would no longer be any cost difference between arriving in an EU country and arriving in a non-EU country. Consequently, any risk would clearly be increased if the scope of the scheme was changed from all departing flights to intra-EU flights only. At this point, there would be the largest possible cost difference between arriving in an EU country and arriving in a non-EU country.

Changing the geographical scope: addressing climate change within the EU ETS:

The environmental effect of incorporating aviation into the EU ETS was explained in section 5.2.1. It is clear from table 3 that the environmental benefits of an EU ETS with a geographic coverage of intra-EU flights only would be very limited. In contrast, the environmental benefits of a geographic coverage of all departing and arriving flights would be maximised. The AERO model, based on FESG traffic growth assumptions, predicts that by 2020 a scheme based on all departing and arriving flights would be four times as large as a scheme based on intra-EU flights only. To make the other comparisons, a scheme based on all departing and arriving flights would be 1.6 times as large as a scheme based on all departing flights, and a scheme based on all departing flights would be 2.5 times as large as a scheme based on intra-EU flights only.

These comparisons show in turn that there would be differences regarding the size of the aviation sector within the EU ETS. However, **as long as the aviation sector has access to Kyoto Protocol project credits within the EU ETS, there would not be expected to be a difference in impact on the allowance price under the different scenarios.** Instead, the difference between the scenarios would be the quantity of project credits purchased by the aviation sector.

As explained in section 5.3.1, the cost of purchasing project credits would be expected to be passed on to consumers which would reduce future forecasted demand relative to business as usual levels. AERO forecasts that for an allowance price of €30 and a geographic coverage of all departing and arriving flights, by 2020 this reduction in revenue tonne kilometres for domestic flights and flights between Member States is unchanged from the all departing flights scenario, and for flights to and from third countries this reduction increases from 1.5% to 2.9%. This last figure breaks down into a reduction of 3.1% for passenger demand and 2.7% for cargo demand.

To place this figure on reduced future forecasted demand into context, the business as usual increase in revenue tonne kilometres between 2005 and 2020 is estimated by the AERO model to be 142%. Therefore, a percentage reduction of 1.7%-2.9% for an allowance price of €30 (the percentage varying with the type of flight) is modest. In essence it means that, **taking the maximum reduction figure of 2.9% across <u>all</u> flights (i.e. an over-estimate), the increase in revenue tonne kilometres would still be a minimum of 135%.**

5.4.2. Considering different treatment of remote and isolated regions

The analysis in section 5.3 has assumed that special provisions are made for outermost regions as defined in Article 299(2) of the Treaty regions (the Azores, the Canary Islands, Madeira, and the French Overseas departments). The special provisions are that outermost regions are treated as third countries. This section further analyses the other two options shortlisted in section 4 in respect of the treatment of remote and isolated regions: not making any special provisions for any types of regions, and defining further types of regions for which special provisions could be made.

No special provisions for any type of regions:

Changing the treatment of remote and isolated regions from classifying outermost regions as third countries to not making any special provisions would mean that additional flights involving UPRs would be covered by the scheme. This is illustrated in table 15.

Geographical scope	**<u>Additional</u> routes covered**
Option 1: Intra-EU	Flights between UPRs, and between UPRs and mainland Europe.
Option 2: All departing	Flights between UPRs, and from UPRs to mainland Europe and third countries.
Option 3: All departing + all arriving	Flights between UPRs, and from UPRs to third countries.

Table 15: Additional routes covered if no special treatment is accorded to outermost regions (UPRs) as a function of the geographical scope

Under none except the most narrow geographical scope is this geographical scope likely to represent a disproportionate burden.

- In an intra-EU scheme, the core flights covered would be those between two airports in mainland Europe. However, if UPRs were not treated as third countries, flights between the EU and UPRs, plus flights between UPRs, would also be covered, representing more than 10% of all emissions covered in an intra-EU scheme (a large proportion due to this specific category of intercontinental flights being included). This is despite the fact that no other intercontinental flight would be covered, plus no other flights from airports in regions neighbouring UPRs.

- In a scheme covering all departing flights, the differences in treatment would be reduced since flights from mainland Europe to both UPRs and airports in regions neighbouring UPRs would now be covered. However, the return leg of the journey from a UPR back to mainland Europe would also be covered and now flights from a UPR to a third country would be covered. Flights between UPRs would still be covered.

- In a scheme covering all departing and arriving flights, flights between mainland Europe and UPRs or between mainland Europe and airports in regions neighbouring UPRs would be treated in the same way for both legs of the journey. However, now both legs of the flight between UPRs and third countries are covered plus of course flights between UPRs.

It might be argued that an advantage of this option (no special provision for UPRs) is that the special treatment of the Azores, the Canary Islands and Madeira, compared to other popular European tourist destinations would be eliminated. While aid of a social character to the benefit of its inhabitants may be justified, it does seem questionable whether air services in general – and therefore the many tourists choosing e.g. the Canary Islands over e.g. Malta, Sicily or Greece – should benefit from special provisions.

Define further types of regions for which special provisions could be made:

Changing the treatment of remote and isolated regions to defining further types of regions for which special provisions could be made would mean that, instead of using the existing instruments (the public service obligation and aid of a social character regimes) to protect vulnerable air services of special public or regional interests from the additional operating costs arising from the scheme, specific exemptions or provisions in the allocation methodology would be applied for the regions or services in question.

The core problem with this policy option is how to identify upfront these additional regions or services: experience with the existing PSO and AOSC schemes shows that it is already challenging to define with sufficient accuracy criteria that cannot be abused. Under these existing schemes Member States decide which regions or services qualify on a case-by-case basis after having ensured consistency with the Community rules and informed the Commission. This is clearly not practical regarding undertaking allowance allocation within a strict time limit in advance of each trading period.

The second more general point is that if any region or service should benefit from financial relief, they should already qualify for the existing PSO and AOSC schemes. Therefore, making special provisions through the allocation methodology would not achieve any relief that could not be achieved through the PSO or AOSC schemes and would simply add another set of complicated rules to the existing ones.

5.4.3. *Differing aircraft size thresholds*

The analysis in section 5.3 has assumed an aircraft size threshold of 20,000kg maximum take-off mass (MTOM). This assumption follows on from the explanation in section 4 that it may be appropriate to use such a threshold as inclusion criteria. This section further analyses different possible thresholds in order to confirm the right balance between the amount of emissions covered by the scheme and the administrative costs associated with managing it both for operators and regulatory authorities.

Therefore, data from Eurocontrol have been used to estimate the trade-offs between the amount of emissions excluded and the number of operators included in the scheme (as an indicator for administrative costs) assuming different aircraft size thresholds.

On the basis of two certified values – maximum certified passenger capacity (pax) and maximum take-off mass (MTOM) – it is possible to consider 4 potential ways of combining these:

An aircraft is included if:

(1) MTOM > X kg

(2) MTOM > X kg AND pax > Y passengers

(3) MTOM > X kg OR pax > Y passengers

(4) Pax > Y passengers

The analysis has assessed the implications of all four kinds of thresholds with different values of X (weight). One possible threshold for passenger capacity, 19, has been tested. Aircraft having a seating capacity of less than 20 seats are generally used for general aviation whereas aircraft with 20 seats or more are used in commercial aviation[45].

The results for the "all departing" flights scenario are shown in figure 2. The trade-off between number of operators included and the emissions excluded is clear.

Similar graphs are made for the other scenarios and found in Annex 1.

Overall the optimal combination seems to be inclusion only of aircraft with an MTOM higher than 20,000 kg AND with a maximum certified passenger capacity of 20 or more.

[45] Data from Eurocontrol indicate that 94% of all flights for which the type of flight in the flight plan has been indicated to be "general aviation" are performed with aircraft with less than 20 seats.

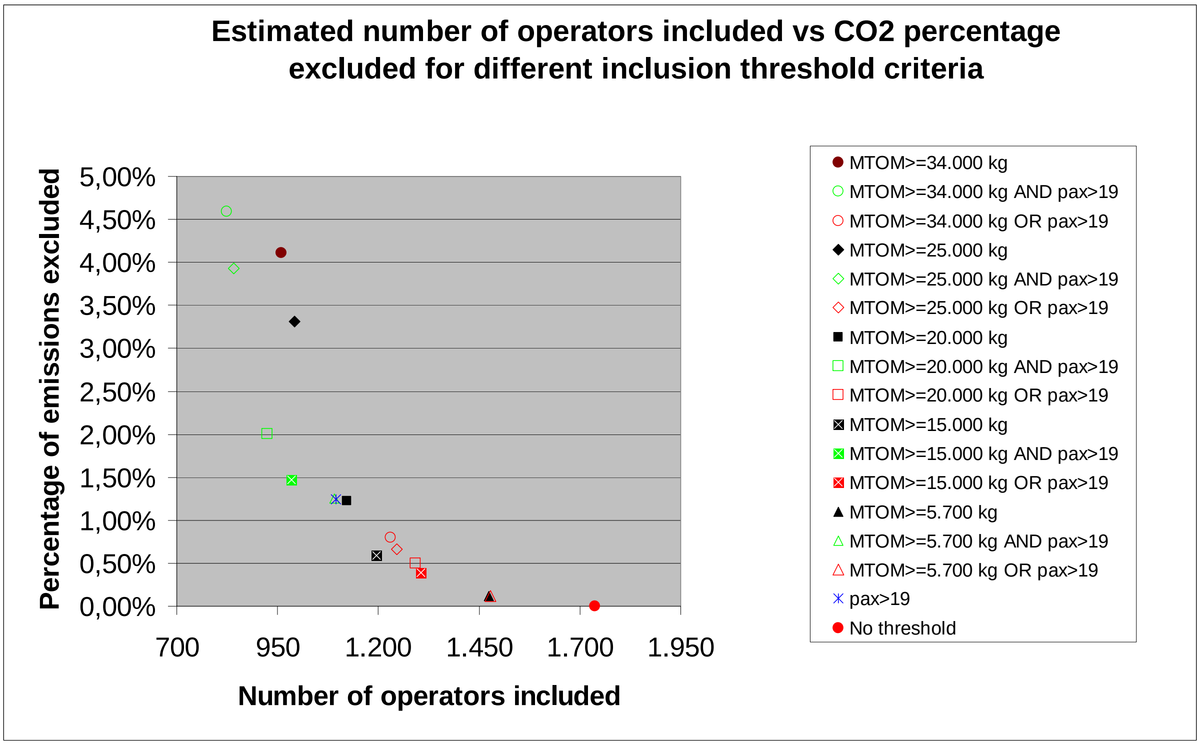

Figure 2: Estimated number of operators included and share of emissions excluded for different thresholds. Data for "all departing" scenario.

5.4.4. *Different ways of addressing non-CO_2 emissions*

The analysis in section 5.3 has assumed that non-CO_2 impacts are addressed outside of the scheme (for instance through modulation of airport charges according to certified NOx emissions and, once the scientific basis allows it, by incorporating environmental criteria into air traffic flow management optimisation procedures to reduce flights e.g. in supersaturated areas of air space where possible and beneficial from an overall assessment taking into account potential trade-offs with fuel burn etc.). This section further analyses an alternative option for addressing aviation's non-CO_2 impacts: addressing them within the scheme using a pragmatic approach based on a multiplier reflecting the higher external costs of climate change associated with aviation activity than with other activities.

This **alternative** option implies that aviation operators would have to surrender a number of allowances corresponding to a multiple of their CO_2 emissions to approximate the fact that the aviation activity associated with the emission of a tonne of CO_2 effectively has a higher climate impact because of the other non-CO_2 impacts also associated with that activity.

The current scientific state-of-the-art does not allow calculating an estimate of the appropriate multiple in a metric which can be compared to the Global Warming Potential of a tonne of CO_2 emissions (1 tonne of CO_2 equivalent)[46]. Given that the EU ETS is based on GWPs, a pragmatic approach based on the precautionary

[46] For a detailed discussion of this see CE 2005: http://ec.europa.eu/environment/climat/pdf/aviation_et_study.pdf.

principle would therefore have to be applied. Given that the overall radiative forcing produced by aircraft has been estimated to be 2-4 times the forcing from the additional atmospheric CO_2 concentrations due to historic aircraft emissions, a value of 2.0 has been used in the sensitivity modelling performed for this variant.

The effect of a multiplier is in essence to i) ensure that aviation more fully accounts for the external costs it imposes and ii) increase the incentive for aircraft operators to reduce their own emissions rather than buying allowances from other sectors. Having to buy 2 allowances for each extra tonne of emissions will increase marginal abatement costs for aviation participants who need to buy additional allowances to have enough to cover their emissions. This will mean that more of the abatement effort takes place in the sector, and that the compliance costs will increase for aviation participants.

The modelling runs in AERO suggest that the costs for aviation will roughly double with a multiplier of 2.0, as will the amount of reductions made in the sector. In tandem, the demand for allowances bought from other EU ETS participants, or for JI and CDM project credits deriving from emission reductions made outside the EU ETS, whichever is cheapest, would also increase by almost double.

5.4.5. *Different options for allocating allowances*

The analysis in section 5.3 is not affected by the methodology for <u>distributing</u> aviation allowances amongst aircraft operators. Instead, the primary consideration was the <u>total quantity</u> of aviation allowances that would be distributed. Therefore, this section further analyses how to distribute aviation allowances, following on from section 4.7 where the focus was narrowed down to two methodologies: benchmarking and auctioning, and following on also from section 4.13, where auctioning a proportion of the total quantity of allowances was considered to be the best way of catering for new entrants. Hence the relevant questions are: what proportion of allowances should be auctioned, and how should the remainder be distributed through benchmarking.

Proportion of allowances auctioned:

Economic theory predicts that, irrespective of whether allowances are distributed against payment or for free, the value of an allowance will be incorporated by a company into the cost of producing a good or service to the extent allowed by its competitive environment. This is because an allowance is an asset with a market value which is given up when used to cover the greenhouse gases emitted when producing that company's good or service. In other words, in deciding to produce a good or service, the company has forgone the opportunity to sell the allowances it owns. As a result, a production process which is carbon intensive and therefore requires the use of many allowances to cover the resultant greenhouse gas emissions will see the price of the good or service produced increase relatively more than the price of a good or service which has a less carbon intensive production process. This pricing rationale is not particular to the sectors covered by the EU ETS and allowances: the same practice should occur in every market with respect to each input cost and is known as "marginal cost pricing".

Experience to date within the EU ETS has shown that companies are indeed passing on the value of allowances through prices charged to consumers to the extent allowed by their competitive environment. Hence, companies operating within a market where all competitors are covered by the EU ETS e.g. European power markets, have had the ability to pass on the value of an allowance to consumers, whereas companies operating within a market where only a proportion are covered by the EU ETS have had less freedom regarding this decision. Therefore the predictions made by economic theory are being seen in reality: whether companies receive allowances free of charge or against payment does not make any difference to this cost pass-through decision; what really matters is whether companies are all equally exposed to the policy in question. When allowance costs are passed-through to consumers and yet some or all of those allowances have been received for free, the issue of "windfall profits" arises.

Since the EU ETS will be covering *all* aircraft operators operating on covered routes, aircraft operators would be expected to be able to pass on the value of an allowance to consumers. The analysis in section 5.3.1 estimated that, with full cost pass-through of all the costs associated with participating in the scheme, the consequent reductions in future forecasted demand growth from business as usual levels would be modest. Therefore, the legislative decision regarding the proportion of allowances auctioned versus the proportion allocated for free is not driven by the impact of incorporating aviation into the EU ETS on airlines or consumers. Instead, the decision is more driven by providing for new entrants and auctioning being the most accurate way in which to reward operators which have taken, or are taking, action to reduce their greenhouse gas emissions.

Therefore, the legislative proposal aims for a consistent approach between the aviation sector and other sectors covered by the EU ETS through the proportion of allowances auctioned (accompanied by the recycling of revenues) for the period 2011-2012 corresponding to the average percentage proposed by the Member States including auctioning in their national allocation plans. The legislative proposal sets an exact number for aviation, as opposed to a ceiling or floor, due to it treating all aircraft operators across the EU-25 in a consistent manner. Thereafter this provision will be reviewed in the light of the results of the general review of the EU ETS.

Distributing the remainder of allowances through benchmarking:

The calculation methodology for distributing the remainder of allowances through a benchmarking system is as follows:

Total Quantity of Allowances Distributed for Free = Benchmark x Activity Data

This equation means that aircraft operators will receive a fixed number of allowances per unit of activity. Therefore, two aircraft operators with exactly the same activity levels will receive exactly the same allocation of allowances. As a result, an aircraft operator which is less carbon intensive than average will receive proportionately more allowances as compared to its needs than an aircraft operator which is less efficient than average.

However, the type of activity data used is important in terms of staying true to the incentives that should be delivered through a benchmarking system. Here, the following principles have been used:

(1) Environmental credibility: A benchmarking system should incentivise companies to deliver a good or service in a less carbon intensive manner.

(2) Simplicity: An overly complex way of determining activity data will prevent a benchmarking system from being transparent and easily understood which will obscure the right incentives being given.

(3) Practicability: Benchmarking is the most data-intensive allocation methodology, and so care must be taken that the activity data used can actually be collected, so that the system can actually be implemented.

(4) Equity: The opportunity for gaming should be minimised in order to establish a level playing field. This can be done through the use of recognised methods for measuring activity data.

Following these principles, the Commission has concluded that using actual payload carried by an aircraft multiplied by the actual number of kilometres between two airports is most appropriate methodology for measuring activity. In the aviation sector, this activity data is often called "revenue tonne kilometres" or, more simply, "tonne kilometres".

Actual payload: The role of an aircraft operator is to carry passengers or freight between two locations. This means that not taking account of the actual payload carried (whether through using a maximum capacity payload or omitting the concept of payload altogether and simply using kilometres) would be rewarding aircraft operators with allowances for flying even whilst empty. This clearly would not be credible environmentally. It would be akin to a benchmark for the power sector that allocated allowances per unit of fuel burned, whatever the carbon content of the fuel used or the combustion efficiency of the power plant, rather than per unit of electricity produced, which would take account of these two factors. In other words, a methodology should be focused on the output of a sector, not inputs. Regarding the other criteria, much work has been done both internationally within ICAO and on a European level by the Joint Aviation Authorities (JAA) and the European Aviation Safety Agency (EASA) on how to calculate actual payload carried. This means that the simplicity, practicability and equity of using actual payload carried has already been considered in depth by stakeholders.

Actual number of kilometres between two airports: This measure is otherwise known as the "great circle distance" between two locations. The other main alternative would be to calculate the actual number of kilometres flown between two airports. However, using this as an indicator would mean that aircraft operators would be rewarded with allowances when flying indirect routes. Again, this is clearly not environmentally credible. **The allocation methodology should support more direct routes being flown and therefore incentivise efficiency measures being taken such as air-traffic control management reforms, rather than give incentives in the opposite direction.** In terms of simplicity, practicability and equity, great circle distance is a long established metric used on a daily basis by cartographers and the aviation industry alike.

Using a benchmark of tonne kilometres, based on actual payload carried by an aircraft multiplied by the actual number of kilometres between two airports, means that there will be counterbalancing advantages for different types of carriers. For example, a short haul carrier taking passengers to a tourist destination on a low-cost basis will likely have fewer business class customers and therefore a higher payload than a long haul carrier taking passengers to a major city. However, the proportion of fuel purchased for the journey burnt on takeoff and landing will likely be higher for the short haul carrier, meaning that the journey length is less fuel efficient on a per kilometre basis as compared to the long haul carrier, until the latter reaches a journey length where the weight of fuel carried begins to reduce efficiency rates. For either short haul or long haul carriers, more fuel-efficient aircraft or more fuel efficient operational practices will bring benefits. **Therefore, the tonne-kilometre benchmark favours fuel efficiency across the board and does not favour particular types of air services.**

6. COMPARING THE OPTIONS

6.1. Introduction

In the analysis of the many options documented in section 5 the effects of varying individual parameters were examined and compared. Based on this comparison a best possible combination of the different design parameters should be chosen which is also coherent and balanced. **In this section, a summary is given for each of the parameters and a workable and effective combination is set out.**

6.2. Overall architecture of the system

In terms of the **accountable entity**, further analysis of the possible options has confirmed the preliminary conclusion from the Communication that aircraft operators are the preferred choice. No other entities have as much control over the investments and operational decisions affecting emissions as **aircraft operators**, and no other type of entity would be able to provide the data necessary for monitoring emissions. This decision is also consistent with the treatment of those sectors already covered by the EU ETS.

In terms of the type of integration with the EU ETS, the analysis confirms the conclusion from the Communication that **an open system, meaning integration with the EU ETS, would be preferable to a closed system**. A stand-alone aviation system would not be able to achieve the same environmental improvements without very high costs to the aviation industry.

Given that no assigned amount units can be issued in respect of international aviation emissions, it is necessary to ensure coherency between the accounting systems of the EU ETS and the Kyoto Protocol. For this reason, **aviation allowances will be fully tradable but will not be able to be used by operators from other sectors to fulfil their compliance obligations**. Aviation will be able to use allowances from the EU ETS to fulfil their obligations.

Aviation will also be able to use credits from the **Joint Implementation and Clean Development Mechanisms** to fulfil their compliance obligations to an extent comparable with existing EU ETS sectors.

With respect to the treatment of domestic aviation, **by far the simplest solution is to treat domestic and international aviation in the same way** to facilitate the management of the scheme from the operator's point of view. Doing so will provide Member States with an instrument that will assist them in controlling domestic air transport emissions for which they are accountable under the Kyoto Protocol, without affecting national preferences over how much this effort should contribute to meeting the national targets under the burden-sharing agreement.

6.3. Scope

The analysis confirms that the broadest possible **geographical scope of all departing and arriving flights** would give the biggest environmental benefits, would be neutral from a competition point of view considering the alternative scope options, and would be the best option for tourism. On the first point: it would most adequately reflect the higher external costs associated with long haul trips. On the second point: competition between airlines and airports is unlikely to be affected by the geographic scope chosen. **However, regarding tourism, even though impacts are estimated to be limited, they would likely be decreased with the largest scope.** Therefore, the proposal covers all departing and arriving flights from 2012 onwards. However, the proposal begins by covering intra-EU flights during the year 2011 only, in order that aircraft operators can gather practical experience from participating in the scheme before the coverage widens.

With regard to the **treatment of remote and isolated regions**: the only regions defined as falling within a specific category are the outermost regions (Article 299(2) of the Treaty: the Azores, the Canary Islands, Madeira, and the French Overseas departments). However, **some of these outermost regions are actually relatively close to the European mainland, and so special provisions for these regions alone may introduce distortions of competition vis-à-vis the mainland**. All other regions potentially eligible for subsidies are not listed, but identified and considered on a case-by-case basis. Therefore, for the purpose of defining the coverage of the scheme, special provisions have not been made. Instead, **any special treatment should be addressed within the existing framework regulating subsidies to air transport**, namely the rules on public service obligations and aid of a social character, rather than as part of the EU ETS allocation process or compliance obligations. The extent to which use of these instruments will be necessary will as now have to be based on a case-by-case assessment and in the first instance be a matter for the Member States to decide, subject to the Treaty provisions and the secondary EU legislation in force.

The analysis indicates that a number of **other delimitations of the scope** would be necessary or desirable to reduce the complexity and the administrative costs of the scheme in line with the Commission's general drive for better regulation and simplification. Therefore, the conclusion was drawn that **a number of categories of aircraft and aircraft operations should be excluded** from the scheme because of their minor contribution to overall aircraft emissions, special legislative regimes and/or the disproportionate administrative burden that their inclusion would imply.

They are: 1) military and other types of State aircraft; 2) flights performed exclusively under visual flight rules; 3) circular flights; 4) flights testing navigation equipment or for training purposes; and 5) flights for rescue purposes.

The analysis suggested that the exclusion of the smallest aircraft might seem desirable in terms of using current data to balance the number of operators included in the scheme against their share of the emissions. However, this approach would not take into account the fact that travelling using small business jets as an alternative to larger aircraft is a rapidly expanding sector with a rapidly growing environmental impact. In addition, there is no policy in place which addresses this environmental impact. **Therefore, the legislative proposal excludes only the smallest aircraft with a certified Maximum Take-off Weight of less than 5,700 kg.**

With respect to coverage of the **non-CO_2 effects** of aviation on the climate, initially only CO_2 emissions will be included in the scheme. By the end of 2008, the Commission will put forward a proposal to address the NOx emissions from aviation, after a thorough impact assessment, in order to provide an adequate economic incentive for manufacturers and operators to invest in low NO_x technologies in the context of fleet renewals.

6.4. Allocation

The consultation with stakeholders confirmed a very strong desire for the allocation methodology to be harmonised at EU level as proposed in the Communication from 2005. A harmonised allocation methodology is also consistent with maintaining the equal treatment of aircraft operators regardless of nationality, as required under the Chicago Convention. This has numerous practical implications for how the allocation process can and cannot work. An example is the way in which a mix of allocation free of charge and auctioning as currently applied would have to be specified in terms of a fixed percentage rather than as a ceiling. The impact analysis has shown that **a share of auctioning corresponding to the average percentage proposed by the Member States including auctioning in their national allocation plans for the period 2011-2012 would not imply unreasonable compliance costs for the industry since the cost of allowances, whether received for free or against payment, would be expected to be passed onto consumers to a large extent or even in full.** Such a share of auctioning would also make the overall initial allocation more efficient than all allowances being granted free of charge and would provide an additional source of allowances for new entrants, which is important in the light of the analysis demonstrating that special provisions for **new entrants and closures** would be extremely difficult and costly to define appropriately and operate. Being categorised as a new entrant would only be temporary: new entrants would be able to apply for an allocation of allowances as incumbents when allowances for the subsequent period are allocated free of charge. From 2013 onwards, the share of allowances auctioned will be reviewed in the light of the results of the general review of the EU ETS.

With respect to **allowances allocated free of charge**, the clearly preferable option is **benchmarking**. Benchmarking would in contrast to grandfathering reward those operators having taken early action, and would, more generally speaking, allow the allocation process to reward efficiencies in various places in the air transport operations. To obtain a simple, workable and transparent scheme that rewards cleaner aircraft *as well as* the more efficient use of existing aircraft, a **single, sector wide benchmark based on emissions per tonne-kilometre seems the best way forward.** The amount of tonne-kilometres would be based on the amount of passenger and cargo actually transported and the great circle distance between the airports in question.

Regarding the **amount of allowances issued to aviation participants,** this would be the main determinant of the environmental outcome of the scheme. The lower the cap, the more effect it has. The analysis has shown that aviation participants would be likely to make much use of the flexibility the trading scheme offers to reduce compliance costs, so while reductions would occur in the sector itself, the majority of emissions reductions would take part in other EU ETS sectors, or outside of the scheme altogether, whilst funded by the aviation participants. This flexibility will reduce overall compliance costs and increase cost-effectiveness. The analysis shows that, provided that aircraft operators have some access to the Joint Implementation and Clean Development Mechanisms, **a target to stabilise emissions at 2005 levels over the period 2013-2022 would be a realistic outcome which would not put significant upward pressure on allowance prices in the EU ETS. In setting this cap, the Commission has explicitly recognised that, given the extent to which aviation has grown since 1990, the sector cannot be expected to take on the same level of ambition as other sectors already covered by the EU ETS.**

6.5. Timing

Finally, in terms of **timing**, the co-decision procedure should allow the directive to enter into force around 2008, with monitoring and reporting obligations starting in 2010 and compliance obligations starting in 2011.

6.6. Overall economic impact

Regarding the aviation sector's contribution to the EU economy, in 2002, air transport accounted for 0.6% of the EU’s value-added. However, aviation accounts for approximately 3% of the EU's carbon dioxide emissions. Incorporating aviation into the EU ETS would have only a marginal effect on the profitability of the aviation sector for the following reasons:

- Since every airline on each covered route would be treated equally, airlines would be expected to be able to pass on, to a large extent or even in full, the cost of participating in the scheme to their customers. Whether airlines receive allowances free of charge would not be expected to make any difference to this cost pass-through decision. In this respect, airlines have similar characteristics to, for example, European power generators.

- Fully passing on costs to customers would mean that *by 2020* airline tickets for a return journey could increase by €4.6 to €39.6, depending on the journey length. This assumes coverage of all departing and arriving flights and a high allowance price of €30.**This would have only a small effect on forecasted demand growth** from business-as-usual levels of 142% to a minimum of 135%.

- **This small impact on growth reflects demand for aviation being, in general, not very price sensitive.** This is partly because, according to data on the socio-economic distribution of air transport users, increased ticket prices would be borne predominantly by the wealthier segments of the population. An additional explanatory factor is that both GDP and disposable income are projected to continue to increase in real terms into the future.

- Since all airlines would be treated equally, **competition between airlines would not be expected to be significantly affected**. The main difference between airlines is the length of journey undertaken, the age of the aircraft used and the payload carried. Therefore carriers travelling shorter distances, using older aircraft or carrying fewer passengers or less freight would be affected to a greater extent than more fuel-efficient carriers. **The choice of geographical scope is not likely to change this conclusion.**

- Competition between airports and tourism would not be significantly affected since forecasted demand growth remains high; there will always be an economic rationale for providing air services through EU airports; and the majority of tourism in the EU is generated by EU citizens. **The choice of geographical scope is not likely to change this conclusion for airports. However, any risk to tourism would likely be decreased if the scope covers all departing and arriving flights**.

Regarding the impact of incorporating aviation into the EU ETS on other sectors already covered by the scheme: as long as all operators have access to project credits generated under the Kyoto Protocol, the impact on allowance prices would be expected to be marginal.

Therefore, the final conclusion of this impact assessment is that the benefits from the aviation sector accounting for its fast rising CO_2 emissions, through incorporation into the EU ETS with a reasonable environmental goal of stabilising at 2005 emission levels, seem to significantly outweigh the costs.

7. MONITORING AND EVALUATION

7.1. Indicators of progress towards meeting the objective

The concept of emissions trading inherently incorporates stringent monitoring mechanisms. The **core indicators for progress** towards meeting the objectives will thus be indicators reflecting the **timely implementation** and **effective enforcement** of the obligations established by the scheme.

The Commission will follow developments in scientific understanding and the extent of climate impacts from aviation. Particular attention will be given to the effects that are not covered by the emissions trading scheme or any other measures.

7.2. Outline for monitoring and evaluation arrangements

The Commission will in cooperation with Member States and Eurocontrol follow developments in the implementation of the Directive and respect of its requirements. The main sources of data will be the annual reporting of emissions data from operators combined with data on any non-compliant operators and air traffic data provided by Eurocontrol.

As regards non-CO_2 emissions, the Commission will monitor developments in estimated NO_x emissions as well as advances in scientific understanding of the impacts generated by contrails and cirrus clouds and of potential mitigation measures, including possible criteria to be integrated in air traffic management in the context of the SESAR programme.

Finally, the functioning of the EU ETS in general is already subject to continuous review by the Commission and this will continue to be the case also after aviation's inclusion.

Annex 1: Glossary and definitions

ACARE	The Advisory Council on Aeronautics Research in Europe. Comprises about 30 members, including representatives from the Member States, the Commission and stakeholders, including manufacturing industry, airlines, airports, service providers, regulators, the research establishments and academia. See: www.acare4europe.org.
ATM	Air Traffic Management
CAEP	Committee on Aviation Environment Protection of the International Civil Aviation Organization (www.icao.int)
CDM	Clean Development Mechanism. Both Joint Implementation and the Clean Development Mechanism are project mechanisms under the Kyoto Protocol which enable developed countries that have binding emission reduction or limitation targets to undertake emission-saving investments in third countries and credit these savings towards their own emission target. The CDM covers projects in countries without an emission target under the protocol, i.e. developing nations. JI applies to projects in countries that have agreed to an emission target – other industrialised countries and countries with economies in transition. The EU scheme is the first in the world that recognises most of these credits as equivalent to emission allowances (1 allowance = 1 CDM project credit = 1 JI project credit) and allows them to be traded under the scheme. Credits from nuclear facilities and land use, land-use change and forestry activities are not accepted.
CO_2	Carbon dioxide, see Annex 2.
EU ETS	The EU Greenhouse Gas Emissions Trading Scheme established by Directive 2003/87/EC.
ETTF	Emissions Trading Task Force – a task force set up in response to the ICAO Assembly to the ICAO Council to prepare guidance to help ICAO Contracting States wishing to include international aviation in an open emissions trading scheme.
ICAO	The International Civil Aviation Organization (www.icao.int)
IPCC	The Intergovernmental Panel on Climate Change (www.ipcc.ch)
JI	Joint Implementation – see Clean Development Mechanism.
LTO	Landing-and-take-off. The international standards regulating emissions from aircraft engines are based on performance under standardised test conditions simulating a landing-and-take-off-cycle - the ICAO LTO-cycle. The emission values represent standardised indicators for the amounts of pollutants emitted at four typical thrust settings and timings to represent the total emissions of NO_x, smoke, unburned hydrocarbons and CO below 3000 feet.
NO_x	See annex 2.

QUEST	QUEST is a model used by the European Commission. It was designed to analyse the economies in the member states of the European Union and their interactions with the rest of the world, especially with the United States and Japan. The focus of the model is on the transmission of the effects of economic policy both on the domestic and the international economy. For a detailed description, see Roeger and in't Veld (1997): http://europa.eu.int/comm/economy_finance/publications/economic_papers/economicpapers123_en.htm
RPK	Revenue-Passenger-Kilometres.
RTK	Revenue-Tonne-Kilometres.
SES	Single European Sky - an ambitious initiative to reform the architecture of European air traffic control to meet future capacity and safety needs launched in 1999 and introducing new EU legislation adopted in 2004. See http://europa.eu.int/comm/transport/air/single_sky/index_en.htm
SESAR	The SESAR programme is the European air traffic control infrastructure modernisation programme. It will combine technological, economic and regulatory aspects and will use the Single Sky legislation by synchronising the implementation of new equipment, from a geographical standpoint in all European Union member states, as well as an operational standpoint by ensuring that aircraft equipage is consistent with ground technological evolutions. See http://europa.eu.int/comm/transport/air/single_sky/sesame/index_en.htm
TAR	Third Assessment Report of the IPPC – see www.ipcc.ch
UNFCCC	United Nations Framework Convention on Climate Change – http://unfccc.int
Emissions from national transport	Under the UNFCCC rules, Parties report emissions from national transport (including domestic air transport) as part of their national inventories. Emissions from international air transport are not included but reported separately as a memo item (see also below).
International aviation emissions	According to the IPCC Guidelines, emissions from the use of fuels for international air transport are excluded from national emissions totals. This provision has been reflected in the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, part I: UNFCCC reporting guidelines on annual inventories" (UNFCCC reporting guidelines) that have been adopted under the Convention process. The UNFCCC reporting guidelines stipulate that "Parties should also report emissions from international aviation and marine bunker fuels as two separate entries in their inventories". This information should be reported using the common reporting format (CRF) which is specifically designed for this purpose (table 1.C). In addition, Parties are required to provide an explanation on "how they distinguish between domestic marine and aviation emissions… and international bunker emissions" in their national inventory reports (NIRs),

	and an explanation on "how the consumption of international marine and aviation bunker fuels was estimated and separated from the domestic consumption" in the CRF table 1.C. For an overview of the definitions of domestic and international flights consult document FCCC/SBSTA/2003/INF.3 available from the UNFCCC's website (http://unfccc.int).

Annex 2: European Council and Parliament statements on Communication

European Union 2697th Environment Council meeting, Council conclusions on reducing the climate change impact of aviation

The Council of the European Union,

1. RECALLS the need, in developing the EU's medium and long-term strategy to combat climate change and initiating a process among all Parties to the United Nations Framework Convention on Climate Change (UNFCCC), to explore how further to implement this Convention to achieve its ultimate objective by developing a post-2012 arrangement, to ensure the widest possible co-operation by all countries, include all important greenhouse gases, sectors and mitigation options, drive technological innovation, employing an optimal mix of "push" and "pull" policies, promote the transfer of technologies to appropriate markets, and provide for the continued use of market-based and flexible instruments.

2. RECALLS the 6th Community Environment Action Programme (EAP) calls for the identification and undertaking of specific actions to reduce greenhouse gas emissions from aviation if no such action is agreed within the International Civil Aviation Organisation (ICAO) by 2002; REAFFIRMS the numerous past Council Conclusions which recognise global emissions from aviation as a serious and growing problem and have called for action as set out in the 6th EAP; and RECOGNISES that the European Union, as a major player in global aviation accounting for about half of the CO2 emissions from international aviation reported by Annex I Parties to the UNFCCC, has a responsibility to pursue courses of action to address the climate impact of aviation.

3. RECOGNISES that Member States have obligations under international law, notably arising from the Convention on International Civil Aviation (the Chicago Convention) and the UNFCCC and NOTES the European Union's position that, until the aviation sector has reached the point of fully addressing its climate impact, all policy instruments with the capability of reducing this climate impact should be maintained as potential options.

4. WELCOMES the Commission Communication "Reducing the climate impact of aviation" on tackling the urgent problem of aviation emissions as an important step in analysing the options for further action and RECOGNISES this Communication as being a specific response to calls by the Council for action to be taken.

5. RECOGNISES that, in view of the urgency of the issue, follow-up work on the Communication must receive prompt attention from Member States; AFFIRMS the assessment of the Commission in its Communication that a comprehensive and consistent approach to tackling the climate impact of aviation is needed, and STRESSES that existing policies and actions should continue and be strengthened, and complemented with additional cost-effective approaches.

6. RECOGNISES that, from an economic and environmental point of view, the inclusion of the aviation sector in the EU Emissions Trading Scheme (EU ETS) seems to be the best way forward, in view of emissions trading already having been implemented within the EU and it holding greater potential for application

internationally than other policy alternatives; therefore, URGES the Commission to bring forward a legislative proposal by the end of 2006 which is both environmentally meaningful and economically efficient, accompanied by an impact assessment which provides detailed analysis of the environmental, economic including competitiveness and social impacts, including inter alia analysis of the effects of the inclusion of the aviation sector on:

– the trading scheme, including the price of allowances, and in conjunction with the general review of the Emissions Trading Scheme, potential impacts on the price of electricity and the competitiveness of the energy sector including energy-intensive industry;

– the competitive market between air carriers;

– the competitive market between different modes of transport;

– the diversity of situations in the various regions of the Community, including islands, the Outermost Regions and Overseas Countries and Territories.

7. WELCOMES the decision of the Commission to set up an Aviation Working Group under the second phase of the European Climate Change Programme with the task of considering ways of incorporating the climate impact of aviation into the EU ETS; EMPHASISES the need to apply the system under uniform conditions to both EU and third country carriers; NOTES that the design of the system should take into account the diversity of the various regions of the Community, including islands, the outermost regions and overseas countries and territories, and RECOGNISES that the following issues are at the centre of the further debate: the type of entity made responsible for aviation's climate impact, the extent to which the full impact is addressed, the types of flights covered, the approach taken for calculating and apportioning the sector's overall emissions limitation; and the interplay with the Kyoto Protocol. Without prejudice to the outcomes of further technical analysis by the Aviation Working Group, TAKES NOTE that the following preliminary guiding principles should be taken into account:

– The entity made responsible should be the air carriers and aircraft operators, as they have the most direct control over the type of aircraft in operation and the way in which they are flown;

– In order to minimise potential negative trade-offs between the different impacts and safeguard the environmental integrity of the overall scheme, both the CO2 and non-CO2 impacts of aviation should be addressed to the extent possible. In doing so, the uncertainties surrounding certain impacts should be balanced against the risks they pose to the climate. Pending scientific progress in developing more suitable metrics for comparing the different impacts, a pragmatic approach is needed. The Aviation Working Group should assess this issue further;

– The objective should be to provide a workable model for aviation within emissions trading in Europe that can be extended or replicated worldwide. In environmental terms, the preferred option is to cover all flights departing EU airports as limiting the scope to intra-EU flights would address less than 40% of the emissions from all flights departing from the EU. Work within the

Aviation Working Group should further consider this issue and should, in particular, address competition issues such as the impact on relative market shares of EU and non-EU carriers and minimising distortions in the market;

– Given the level of integration in the Community's air transport market, the methodology for distributing the total number of allowances allocated to the aviation sector within that sector should be harmonised at EU level. However, the Aviation Working Group should further consider this issue;

– The inclusion of aviation should not adversely affect the accounting system established in Commission Regulation (EC) No 2216/2004 to ensure consistency between trading under the EU ETS and trading under the Kyoto Protocol.

Brussels European Council, 15/16 December 2005, extract:

The European Council also welcomes the Commission Communication "Reducing the climate impact of aviation", recognises that the inclusion of the aviation sector in the EU Emissions Trading Scheme seems to be the best way forward, and welcomes the intention of the Commission to bring forward a legislative proposal by the end of 2006 accompanied by an impact assessment which includes the specific analysis requested in the conclusions of the 2 December 2005 Council.

European Parliament resolution on reducing the climate change impact of aviation

The European Parliament,

– having regard to the Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: Reducing the Climate Change Impact of Aviation (COM(2005)0459),

(a) having regard to its resolution of 16 November 2005 on Winning the Battle against Climate Change(1) ,

(b) having regard to Rule 45 of its Rules of Procedure,

(c) having regard to the report of the Committee on the Environment, Public Health and Food Safety and the opinion of the Committee on Transport and Tourism (A6-0201/2006),

(d) whereas the EU is committed to the objective of tackling climate change and has put forward a global goal of limiting global temperature increase to +2°C compared to pre-industrialised levels,

(e) whereas in its abovementioned resolution of 16 November 2005 the European Parliament stated that strong emission reductions - 30% by 2020 and 60-80% by 2050 - are to be undertaken by developed countries,

(f) whereas the contribution of aviation to climate change is substantial and growing rapidly,

(g) whereas international aviation is subject to no commitment arising from the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol or from any other international commitment in the area of climate change,

(h) whereas the EU should show leadership in the fight against climate change and, by taking regional and early action, lay down an example of how to tackle aviation's impact on the climate,

1. Welcomes the Commission Communication and its recognition that a comprehensive package of measures including regulatory, economic, technological and operational instruments is needed to address all impacts of aviation on the climate, applying the "polluter pays" principle and ensuring full cost internalisation;

2. Stresses that the overall objective of the policy instruments chosen must be to reduce, in a cost-effective way, the climate change impact of aviation; these policy instruments must be chosen in such a way as to ensure that the reduction of greenhouse gas emissions is as high as possible while the distortion of competition between Europe based air carriers and carriers from outside the EU is minimised and the unfair competition between the air transport sector and other transport sectors within the EU is reduced;

3. Stresses that in this respect every kind of unnecessary bureaucratic burden should be excluded, especially in light of the small air carriers that exist on the market;

4. Fully endorses the Commission's intention to pursue the introduction of kerosene taxes, and urges it to begin immediately by requiring a tax on all domestic and intra-EU flights (with the possibility to exempt all carriers on routes on which non-EU carriers operate); calls on the Commission to propose arrangements for their worldwide introduction;

5. Stresses the urgency of achieving results in the ongoing re-negotiations of air service agreements – in particular the agreement with the US - to unconditionally allow for the taxing of fuel supplied to EU and non-EU carriers on an equal basis;

6. Underlines that the tax exemptions on air transport and other imbalances lead to very unfair competition between aviation and other transport sectors;

7. Stresses that this is particularly a burden for the railway sector, because the railway sector is not only covered by taxes but also by the EU Emissions Trading Scheme (ETS), which significantly raises the cost for this environmentally friendly transport system

8. Underlines that this distortion of competition between transport sectors also leads to distortion of competition between tourist regions, to the disadvantage of those regions which are reached mainly by car, bus or railway;

9. Underlines that it is necessary to consider a fair solution for the environmental problems caused by aviation;

10. Encourages the introduction of charges as a step towards full cost internalisation, with the extent of their role, and their magnitude, reflecting the extent to which any emissions trading system falls short of the requirements outlined below;

11. Asks that special attention be paid to the situation of the most isolated territories which are particularly dependent on air transport services, and especially to insular or outermost regions, where alternative solutions are limited, or do not exist;

12. Welcomes the speech of the then President-in-Office of the European Council and Austrian Chancellor Wolfgang Schüssel in the European Parliament in January 2006 in which he addressed the issue, and asks the Presidency-in-Office to work on concrete proposals in this area;

13. Stresses that better air traffic management is urgently needed to reduce CO2 emissions, contrails and cirrus clouds and that this would be a cost-efficient measure;

14. Calls for further research efforts in order to enhance our understanding of the full effects of aviation on climate change; considers that it is particularly important to clarify the effects of aircraft contrails (water vapour) as well as to what extent flying at lower altitudes would reduce overall emissions and hence climatic impact, and to assess the heating effect of aerosols emitted in the stratosphere;

15. Urges the Commission to promote the introduction of bio-fuels for aviation as a contribution to reducing the impact on climate change;

16. Stresses that, in the Seventh Framework Programme for research, technological development and demonstration activities (RTD) too, research and development relating to clean engine technologies and alternative fuels must be assigned priority; considers that an integrated approach should be pursued, combining both emissions trading and the development of clean engines and fuels, in order also to reduce emissions of substances other than CO2 in the aviation sector;

17. Believes it necessary, moreover, to pursue scientific and technical targets for improving the energy efficiency of aircraft and helicopters;

18. Points out that measures under the Seventh RTD Framework Programme to foster technological innovations in the aerospace sector and the improved air traffic management resulting from the Single Sky legislation are of decisive importance where emission reduction is concerned;

19. Calls on the Commission to take initiatives without delay for improving air traffic control and air traffic management within the SESAR (Single European Sky ATM Research) project and the Single Sky legislation, with a view to improving the energy efficiency of flights and reducing or avoiding vapour contrails;

20. Calls on the Commission to ensure that appropriations under the Seventh RTD Framework Programme are set aside, in the context of collaborative research, with a view to improving the environmental and energy efficiency of aircraft and helicopter engines;

On inclusion of aviation into the EU ETS:

21. Recognises that emissions trading has the potential to play a role as part of a comprehensive package of measures to address the climate impact of aviation, provided it is appropriately designed;

22. Stresses that the environmental effectiveness of any emissions trading scheme will depend on it having sufficiently broad geographical scope; a rigorous cap; full auctioning of initial allocation; the technological level and early actions taken into account in the allocation; and addressing full climate impact;

23. Asks the Commission to present immediately an impact assessment on the specific parameters of its design proposals, e.g. level of cap for aviation, compliance, choice of participating entity (aircraft operators, airlines or airports), and to present proposals to ensure that the EU ETS will be applicable to airlines from outside the European Union;

24. Proposes the introduction of a separate dedicated scheme for aviation emissions, recognising that, due to the lack of binding commitments for international aviation emissions under the UNFCCC and the Kyoto Protocol, the aviation sector would be unable to actually sell into the ETS;

25. Notes that accounting would be substantially simplified by a separate, closed system; considers that, if there were to be a gateway to allow airlines to buy from the EU ETS, this should be on a carefully limited basis;

26. Stresses that, if aviation is to be eventually incorporated into the wider ETS, there should at least be a pilot phase of a separate scheme covering the period 2008-2012;

27. Notes that potential entry of outside credits to a separate scheme (e.g. Clean Development Mechanism and Joint Implementation (CDM/JI), or credits from regional cap-and-trade schemes in countries which are not parties to the Kyoto Protocol) must be minimised by capping them at a level which guarantees that the sector contributes to achieving the overall objective of halting climate change, as well as minimising bureaucracy and increasing transparency;

28. Proposes that, should aviation be eventually incorporated into a wider ETS, special conditions be applied to ensure it does not distort the market to the detriment of less protected sectors: a cap on the number of emission rights it is permitted to buy from the market, and a requirement to make a proportion of the necessary emissions reductions without trading, before being allowed to buy permits;

29. Calls on the Commission to put forward other policy instruments to address the non-CO2 impacts of aviation in parallel to the ETS; where uncertainties exist over any of these impacts, policy should be based on the precautionary principle; in addition to climate impacts, special attention should be paid to air and noise pollution during the ascent and descent of aircraft; calls on the Commission to encourage research programmes to improve scientific knowledge on the non-CO2 impacts of aviation and to support ICAO action in developing standards on NOx;

30. Does not rule out accompanying local measures having to be taken in the future;

On the scope of the aviation scheme:

31. Believes that a scheme for aviation should as a first step cover all flights to and from any EU airport (if possible also intercontinental flights transiting through EU air space), irrespective of the country of origin of the airline concerned, so as to ensure a level playing field to operators with different route profiles, to avoid distortion of the market in favour of flights to destinations outside the EU, to ensure environmental effectiveness, to prevent cross-subsidisation and to influence aircraft design; stresses that a worldwide emission trading scheme needs to be introduced as soon as possible;

32. Acknowledges that the Commission, after careful assessment, is of the opinion that such a broad scope is compatible with international agreements, e.g. WTO rules; asks the Commission and the Council to defend this position against possible attacks of third countries in international organisations;

On initial allocation:

33. Stresses that the total initial allocation should be defined in line with the Kyoto commitment target and must therefore not allow for growth in emissions above the base year;

34. Believes that the initial allocation amount must be set at EU level, as setting it at Member State level would risk overly generous initial allocations which would distort the market and undermine the environmental effectiveness of the scheme;

35. Stresses that the allocation method should not directly or indirectly punish those companies having already introduced efficient airplanes, so that early action has to be recognised under any circumstances and the main pressure to change put on carriers whose fuel efficiency is poor;

On the allocation method:

36. Believes that auctioning is the best option for distribution of allowances, since it reflects the dynamic nature of the sector, with no prejudice against new entrants or against those regions which have yet to develop in this sector;

37. Notes that auctioning also meets the requirements of the "polluter pays" principle, with further environmental benefits if the revenues are appropriately hypothecated; and that it automatically rewards good performance by operators in the past and future;

38. Stresses that an eventual partial free allocation of permits, whether through grandfathering or benchmarking, should not discriminate against operators who enter the scheme after the initial allocation period; therefore, special provision would have to be made to accommodate new entrants;

39. Notes the likelihood that free allocation of permits, whether through grandfathering or benchmarking, would lead to windfall profits to the sector at the consumer's expense, due to marginal cost pricing based on market price of allowances despite free allocation; emphasises that this is not the objective of the policy;

40. Considers that free allocation of grandfathered emissions is the worst option as it punishes early action by airlines, and that free allocation by benchmarking, whilst incentivising more appropriately in theory, risks being overly complicated and

bureaucratic, with all calculation methods having difficulties in determining true best performance;

41. Instructs its President to forward this resolution to the Council and Commission, and the governments and parliaments of the Member States.

Annex 3: Institutions' views on the coverage of non-CO_2 climate impacts

The Council echoed the position expressed by the Commission, albeit without referring to the two specific alternative approaches. Instead it asked for the Aviation Working Group to assess this issue further.

The Resolution of the European Parliament "*[c]all on the Commission to put forward other policy instruments to address the non-CO_2 impacts of aviation in parallel to the ETS; where uncertainties exist over any of these impacts, policy should be based on the precautionary principle; in addition to climate impacts, special attention should be paid to air and noise pollution during the ascent and descent of aircraft; calls on the Commission to encourage research programmes to improve scientific knowledge on the non-CO2 impacts of aviation and to support ICAO action in developing standards on NOx; …Does not rule out accompanying local measures having to be taken in the future;*"

In its Opinion the European Economic and Social Committee concluded that "*[f]or other impacts, use should be made of more appropriate local instruments, such as an NOx levy or operational measures.*" It added that "*[i]nvestment in research into the climate change effects of aviation's non-CO_2 emissions and technological developments to secure cleaner air transport should be a key priority for the Community and industry, with particular emphasis on preventing adverse trade-offs between local noise, local emissions and global emissions of aircraft.*"

<u>Annex 4: Options for treatment of domestic aviation</u>

The options considered for the treatment of domestic aviation were:

(1) Treat domestic and international aviation in the same way.

(2) Treat domestic aviation in the same way as existing sectors in the EU ETS through the national allocation plan process either determined by the Member State at its discretion or based on a harmonised EU methodology.

(3) Exclude domestic aviation emissions from the scheme.

Under option 1, the treatment of domestic and international aviation would be fully consistent. Special aviation allowances without AAUs would be allocated based on rules decided at EU level both in respect of international and domestic aviation emissions. A consequence of this approach is that any constraints applied to the use of allowances issued in respect of aviation to ensure the integrity of the accounting system (see section 4.8) would also apply to allowances issued in respect of domestic aviation. This option would ensure the harmonised treatment of all carriers and incorporation into the EU ETS would in any case help Member States to control domestic aviation emissions.

Under option 2, domestic aviation would be included in the scheme but would be treated in the same way as sectors in the existing EU ETS. Member States would therefore allocate allowances to the domestic aviation sector through National Allocation Plans. The risks of differing treatment could be mitigated by prescribing a harmonised allocation methodology for the allocation to the domestic sector. However, to the extent that special aviation allowances would be issued to the international aviation sector which are not backed by AAU, this approach would result in a difference in the trading currency allocated in respect of domestic and international aviation emissions. This would imply different treatment of international and domestic emissions as any restrictions on the use of aviation allowances would not apply to domestic aviation. It would also increase the administrative burden for aircraft operators as they would be required to account for domestic emissions in each Member State and international emissions separately, hold a registry account for each country in which domestic flights are operated plus an account for international emissions, and deal with two different but connected markets.

Option 3 would exclude domestic flights in the EU emissions trading scheme. A significant drawback of this approach is that it <u>would provide *no* assistance from the EU level to Member States</u> in terms of controlling the aviation emissions to be accounted for under the Kyoto targets. It would leave it up to Member States to address their own domestic aviation emissions, and Member States would have no guarantee of having sufficient AAUs to cover their domestic aviation emissions unless they take specific national measures to ensure that. In addition, carriers based in different Member States might be treated differently in their home markets as Member States would have full discretion over whether to apply any measures and the expected contribution of such measures to reductions. This option <u>offers the least degree of harmonisation</u> with respect to domestic flights.

In conclusion, option 1 is considered the better approach as it treats domestic and international aviation alike. At the same time it is simpler for aircraft operators and regulators. Under this option Member State will have to individually manage availability of AAUs to cover their domestic aviation emissions for the purpose of Kyoto compliance, but this is unlikely to be a significant problem given that:

(1) domestic emissions are a relatively small share of all EU aviation emissions;

(2) the growth of domestic aviation emissions is generally slower than international aviation emissions;

(3) Member States still have the ability to implement other, national measures which might in any case have been needed without EU action; and

(4) the inclusion of domestic aviation in the EU ETS would help Member States to reduce their domestic aviation emissions (thus contributing to efforts to meet their Kyoto targets).

Annex 5: Summary analysis of impact on tourism

The role of tourism in Europe

Europe, with its great diversity and density of tourist attractions, is the most visited tourist region in the world. Tourism has therefore become a sector of major economic importance in the EU. In 2004, expenditure on tourism in the 25 EU countries was €223.4bn, whilst the income received from tourism was €222.5bn[47].

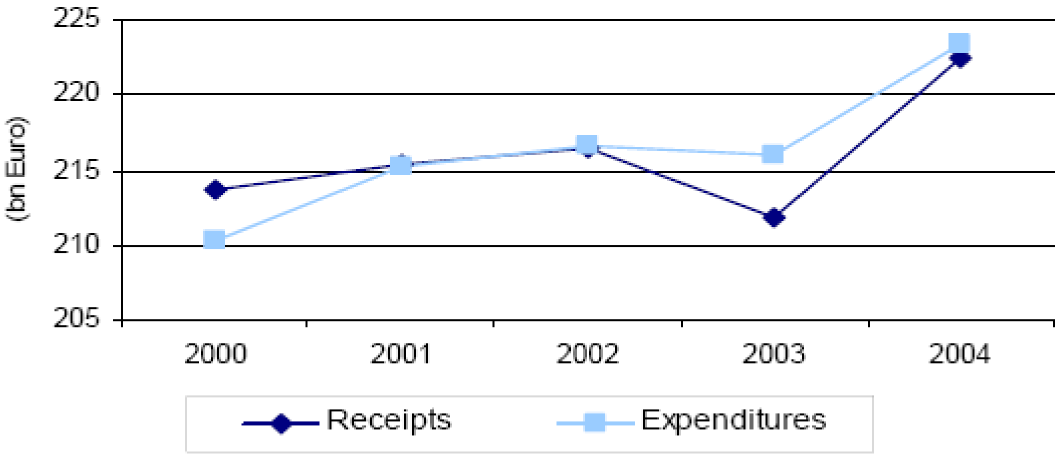

Figure 3: Tourism receipts and expenditure in the EU-25 between 2000 and 2004 (bn EUR). Source: EUROSTAT

The importance of intra-European tourism

Tourism in the EU is essentially driven by the demands of its own citizens. The main information indicator for inbound tourism is the number of nights spent in a country by non-residents. According to EUROSTAT figures, **intra-EU-25 tourist flows accounted for 80 %** of all nights spent in hotels and similar establishments in 2003. Concerning tourists coming from outside the EU, those from the US represent the biggest market share (6.4 %)[48].

Dependence on air transport

By definition transport is a very important aspect in holiday organisation. **On average**, most European holidaymakers prefer to use their own or hired cars (58 %), while **air travel is the second mode of transport (24.9 %)**. Coach/bus and rail travel tie for third place (15.7 %)[49]. However, these average figures cover over differences as the choice of mode obviously depends on the profile of the tourists and destinations concerned.

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47 "Inbound and outbound tourism in the European Union" - Statistics in focus 5/2006. EUROSTAT, 2006.

48 EU integration seen through statistics - Key facts of 18 policy areas, EUROSTAT 2006 (ISSN 1725-2784)
Breakdown of trips by mode of transport used (last available year).

49 EU integration seen through statistics - Key facts of 18 policy areas, EUROSTAT 2006 (ISSN 1725-2784)
Breakdown of trips by mode of transport used (last available year).

As illustrated in table 16 below, the share of air travel in tourist arrivals vary greatly between individual Member States. In particular tourism arrivals at Malta and Cyprus are almost fully dependent on air travel. The same is true for certain regions within Member States, the Canary Islands in Spain being the prime example.

Member State/ country	**Total number of arrivals (all modes, 2000, thousands)**	**Estimated share of air travel in total tourism arrivals (2000)**	**Predicted share of air travel in total tourism arrivals (2020)**
Malta	1,035	100%	100%
Cyprus	2,655	91%	94%
Latvia	257	37%	49%
Greece	30,542	32%	38%
Spain	97,269	32%	37%
Portugal	19,857	31%	38%
Ireland	10,316	20%	23%
Estonia	1,328	14%	22%
United Kingdom	61,781	13%	16%
Sweden	35,845	13%	16%
Netherlands	27,924	12%	16%
Austria	21,528	12%	16%
Switzerland	9,554	11%	14%
Denmark	6,855	10%	13%
Luxemburg	740	10%	13%
Finland	10,574	10%	13%
France	231,952	10%	13%
Italy	112,474	10%	14%
Hungary	5,768	10%	14%
Norway	22,350	10%	12%
Slovenia	1,307	8%	12%
Belgium	15,249	7%	8%
Lithuania	1,384	6%	8%
Czech Republic	9,218	6%	10%
Germany	72,622	5%	7%
Bulgaria	10,080	5%	11%
Poland	12,707	3%	4%
Romania	16,292	1%	3%
Slovakia	4,259	1%	2%

Table 16: Share of air travel in total tourism arrivals. Source: Peeters et al., 2004[50]

Equally, tourists arriving from outside the EU obviously depend to a greater extent on air transport. However, **intercontinental inbound tourism represents only about 4% of the total number of trips** and 12% of all international inbound tourism[51].

This is reflected in the general transport statistics for number of passengers carried by destination. As is the case generally (for all modes), air transport within the EU is also predominant.

50 Database prepared for MuSTT project, kindly provided by Paul Peeters (NHTV Centre for Sustainable Tourism and Transport).

51 Final report - Feasibility and preparatory study regarding a Multi-stakeholder European Targeted Action for Sustainable Tourism & Transport, DG Enterprise European Commission, October 2004.

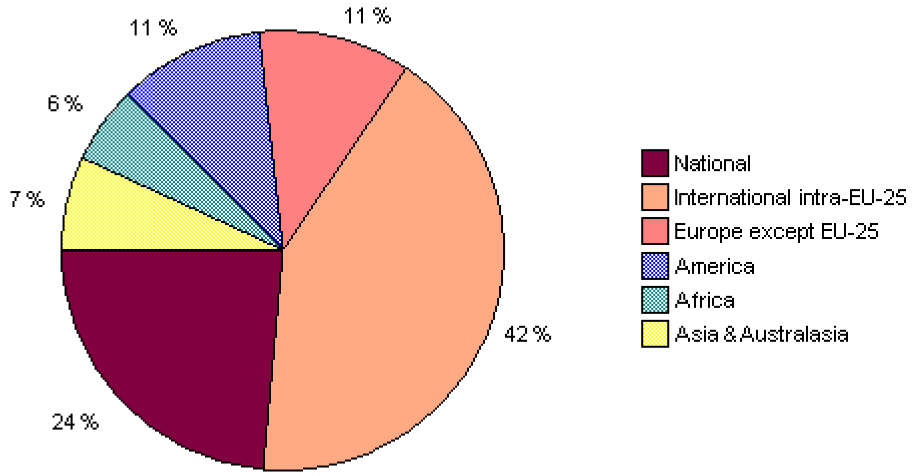

Figure 4: Total number of air passengers carried in 2004: share by world region of destination (source: EUROSTAT)

Impacts of inclusion of aviation in the EU ETS

This section first assesses the possible impact that the inclusion of aviation in ETS can have on air travel tourism from two different perspectives.

<u>The micro-perspective – the impact on a typical air travel holiday trip</u>

On a typical holiday trip with a 1,500 km flight within Europe (Germany to Spain, for example), the CO_2 emissions per passenger on a typical medium haul aircraft are in the range of 150-200 kg CO_2 per flight leg. Assuming an allowance price of 6 €/tCO_2, a full pass-on of allowance costs would add around €1 per one-way flight, or around €2 per round trip. At an allowance price of 30€/tonne, the effect would be around €5 per one way flight and €10 per return flight (see Table 5 in section 5.3.3 for more information on ticket price increases).

There are no official EUROSTAT data on average air fares. However, a rough estimate of the price for a typical 1500 km return trip can be constructed from airline data for passenger yields (revenue per passenger kilometre). Latest figures from 28 member airlines of the Association of European Airlines[52] indicate an average yield of 15.92 US cents/RPK for flights in geographical Europe. The International Air Carrier Association (IACA), which represents airlines significantly or predominantly serving leisure travellers, does not report average yields. The low-cost operator easyJet, which mainly operates in geographical Europe, reported an average yield of 4.89 pence/RPK for the financial year 31 September 2005. Using the average, and allowing for fare elements such as airport taxes, security charges etc., a typical airfare of €315 is used. Data from the World Tourism Organisation (UNWTO) indicates that receipts from international tourists - *including* receipts for international passenger transport - in Europe averaged €630 per arrival.

With the above assumptions and allowance prices of €6 and €30, fare increases would be 0.6% or 3.2% respectively, and the increase in the cost of a holiday would be 0.3% or 1.6% respectively. These increases are significantly lower than the fuel cost fluctuations arising

52 AEA Summary of Traffic and Airlines Results (S.T.A.R.) 2005.

from changes in the world oil market price. Assuming a price elasticity of demand of -1.5% for leisure travel, **the maximum impact for regions whose tourism income depends fully on inbound air travel would be a decrease in tourist *arrivals* of 1 to 5% compared to a business as usual scenario, i.e. a slightly slower growth in tourism but no absolute reduction (for allowance prices of €6 and €30 respectively)**. The percentage impact on overall tourist *receipts* would be expected to be lower because tourists who react to a €10 increase in ticket price spend less than the average tourist.

In regions which are not wholly dependent on inbound aviation based travel, the impact would be smaller. As indicated above, **in all but 3 Member States less than 33% of all arrivals depend on aviation, so accordingly the impact here would be at most around 1.7%**. Changes of this order of magnitude would most likely be difficult to detect given natural fluctuations in tourist receipts according to "fashion" and other trends and factors, including the general growth trend. Table 17 below indicates annual changes in tourism receipts in Europe in recent years. **In most countries and, on average in the EU as a whole, the natural yearly fluctuations in tourism receipts are well beyond what could be expected as a direct consequence of extra costs dues to emissions trading**.

Member State/ country	Average yearly growth of tourism receipts			
	1995-2004	2000-2004	2002-2003	2003-2004
Austria	2%	3%	4%	0%
Belgium	9%	1%	-1%	2%
Bulgaria	19%	11%	22%	23%
Cyprus	2%	-5%	-12%	-3%
Czech Republic	5%	1%	1%	7%
Denmark	6%	3%	-8%	-2%
Estonia	11%	7%	1%	20%
Finland	3%	2%	0%	1%
France	5%	0%	-5%	1%
Germany	5%	2%	0%	9%
Greece	14%	1%	-8%	9%
Hungary	4%	-5%	-9%	-9%
Iceland	9%	5%	8%	6%
Ireland	8%	5%	5%	1%
Italy	3%	-1%	-2%	4%
Latvia	34%	11%	15%	10%
Lithuania	30%	10%	4%	11%
Luxembourg	9%	11%	4%	11%
Malta	2%	-1%	2%	2%
Netherlands	6%	2%	-1%	3%
Norway	4%	3%	2%	6%
Poland	-1%	-7%	-21%	30%
Portugal	6%	3%	-4%	8%
Romania	-1%	1%	13%	3%
Slovakia	5%	11%	-2%	-5%
Slovenia	5%	6%	4%	11%
Spain	7%	3%	4%	4%
Sweden	7%	3%	-5%	6%
United Kingdom	4%	-1%	-7%	13%
EU27+EEA average	5%	1%	-2%	5%

Table 17: Variations in tourist receipts (source: UNWTO[53])

It must be underlined that tourists may respond to higher prices in a number of ways of which some but not all entail a reduction in overall tourist receipts:

- Tourist may choose other modes of transport where this is possible to reach the same destinations, e.g. rail, car or coach instead of air.

- Tourists may choose to spend less on accommodation or other expenditures to make up for increased expenditure on travel.

- Tourist may reduce spending in other parts of their household budget to maintain holiday expenditures.

<u>The macro-perspective – experience from historical changes in fuel cost increases</u>

At macro-level, statistical information about oil prices (and thus aircraft fuel prices) and tourism receipts may be used to assess the extent to which costs from aviation's inclusion in the ETS would be expected to affect air travel tourism at an aggregate level. **An extra cost of 30€ per tonne of CO_2 emitted would correspond to about 1/3 of the increase in fuel costs experienced since 2003**[54].

In a recent analysis of the impact of rising oil prices on international tourism[55], the World Tourism Organisation looked at experiences from the oil shocks of 1974, 1979 and 1990, and analysed the possible impacts of the increase in 2005. **Comparing the three earlier oil shocks, the UNWTO analysis concludes that the increase in oil prices did not have a major *direct* impact on international tourism**. There were significant adverse *indirect* impacts but these were due to the general effect of the oil prices on the world economy and the resulting stagnation or diminution of purchasing power. As regards the latest price increases in 2005, the analysis points out that it differs from the previous ones as it comes in a more favourable microeconomic context, which has tended to limit its adverse impacts. The inflationary tensions and impacts on interest rates and economic growth have thus far been much more limited, and indeed, **there are no indications that the rise in fuel prices over the last few years has significantly affected the steady long-term increase in air travel demand**. According to the International Civil Aviation Organization (ICAO), **scheduled traffic measured in tonne-kilometres in 2005 showed a relatively strong growth in total (domestic and international combined) traffic of 6%, and 7% on international services, in a year when average fuel prices increased by some 49%**[56]. Over the same period, total and international world passenger traffic (measured in number of passengers) increased by about 7%. Moreover, despite the sustained higher level of oil prices, world airline scheduled passenger traffic is expected to grow by 6.1, 5.8 and 5.6% in 2006, 2007 and 2008 respectively, according to the latest medium-term forecasts prepared by ICAO[57].

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53 UNWTO 2006, Tourism Market Trends, 2005 Edition.

54 Based on data on Airline Fuel Cost and Consumption (1977 - 2006) from the US Bureau of Transport Statistics (international services, 2003 to 2006 (year-to-date) as of October 2006).

55 Special Report number 26: The Impact of Rising Oil Prices on International Tourism, UNWTO 2006.

56 ICAO News release PIO 07/06: "World Airlines Improve Operating Profits In 2005 Despite Fuel Cost Increases", Montreal, 30 May 2006.

57 ICAO News release PIO 08/06: "Strong Air Traffic Growth Projected Through To 2008", Montreal, 29 June 2006.

While the analogy between an oil price increase and the inclusion of aviation in the EU ETS should be valid as regards the direct impacts on tour operators' operating costs, the EU ETS would not entail the same kind of indirect impacts on the general economy and purchasing power which drives tourism expenditure. In addition, the fact that the EU ETS would only affect routes within, to and from Europe would obviously be different from the effect of world oil market price increases. The implications of this need to be considered in the light of the types of routes covered (geographical scope), which is addressed in section 5.4.1.

Annex 6: FESG traffic growth scenario used in AERO baseline

Definition of flows		Growth input				2002 RPK		2020 RPK	
Code	Flow	2003-2005	2006-2010	2011-2015	2016-2020	RPK	percent	RPK	percent
XDA	Domestic Africa	3,5	4,0	4,0	4,0	1,3941E+10	0,45%	2,7821E+10	0,40%
XDE	Domestic Europe	2,5	5,0	5,0	4,5	8,6182E+10	2,79%	1,8845E+11	2,72%
XDF	Domestic Asia-Pacific	5,0	7,0	6,0	6,0	2,2281E+11	7,20%	6,4707E+11	9,32%
XDL	Domestic Latin America	1,0	4,0	4,0	4,0	6,2127E+10	2,01%	1,1528E+11	1,66%
XDM	Domestic Middle East	3,0	4,2	4,0	4,0	1,2658E+10	0,41%	2,5144E+10	0,36%
XDN	Domestic North America	0,6	3,0	3,0	3,0	8,0240E+11	25,94%	1,2719E+12	18,33%
	Total Domestic					1,2001E+12	38,79%	2,2757E+12	32,79%
XEM	Europe - Middle-East	4,0	4,0	4,0	4,0	5,6596E+10	1,83%	1,1466E+11	1,65%
XEP	Europe - Far East	2,6	8,0	7,0	6,0	2,2842E+11	7,38%	6,8042E+11	9,80%
XLA	Africa	3,5	4,0	5,0	5,0	1,4138E+10	0,46%	3,0969E+10	0,45%
XLF	Asia-Pacific	5,0	6,0	6,0	6,0	2,8769E+11	9,30%	7,9757E+11	11,49%
XLM	Middle East	3,0	4,0	5,0	5,0	1,1310E+10	0,37%	2,4424E+10	0,35%
XLN	North America	2,0	4,0	3,0	3,0	2,8750E+10	0,93%	4,9857E+10	0,72%
XLS	Latin America	3,0	5,0	5,5	5,0	2,3196E+10	0,75%	5,3951E+10	0,78%
XSA	South Atlantic	3,0	5,5	5,0	4,5	5,0746E+10	1,64%	1,1526E+11	1,66%
XNA	North Atlantic	1,0	6,0	4,5	3,5	3,8826E+11	12,55%	7,9288E+11	11,42%
XNC	North America - Central America	1,5	5,8	5,0	5,0	7,3949E+10	2,39%	1,6691E+11	2,40%
XNO	Europe - Africa	4,0	5,0	4,5	4,5	9,0399E+10	2,92%	2,0133E+11	2,90%
XNS	N. America – S. America	2,0	6,0	5,0	5,0	3,7106E+10	1,20%	8,5902E+10	1,24%
XOI	Other International Flows	3,0	5,0	5,0	5,0	8,8692E+10	2,87%	2,0118E+11	2,90%
XMA	Mid Atlantic	3,0	7,0	6,0	5,5	5,3789E+10	1,74%	1,4422E+11	2,08%
XTP	Trans-Pacific	1,9	7,5	6,5	6,0	2,2421E+11	7,25%	6,2439E+11	9,00%
XWE	Europe	2,0	6,5	5,8	5,0	2,3632E+11	7,64%	5,8086E+11	8,37%
	Total International					1,8936E+12	61,21%	4,6648E+12	67,21%
	World	2,2	5,5	5,0	4,7	3,0937E+12		6,9405E+12	

Annex 7: Description of models used in the analysis

PRIMES

PRIMES is a modelling system that simulates a market equilibrium solution for energy supply and demand in the European Union (EU) member states. The model determines the equilibrium by finding the prices of each energy form such that the quantity producers find best to supply match the quantity consumers wish to use. The equilibrium is static (within each time period) but repeated in a time-forward path, under dynamic relationships. The model is behavioural but also represent in an explicit and detailed way the available energy demand and supply technologies and pollution abatement technologies. The system reflects considerations about market economics, industry structure, energy/environmental policies and regulation. These are conceived so as to influence market behaviour of energy system agents. The modular structure of PRIMES reflects a distribution of decision making among agents that decide individually about their supply, demand, combined supply and demand, and prices. Then the market integrating part of PRIMES simulates market clearing. PRIMES is a general purpose model. It is conceived for forecasting, scenario construction and policy impact analysis. It covers a medium to long-term horizon. It is modular and allows either for a unified model use or for partial use of modules to support specific energy studies

Further documentation available at: http://www.e3mlab.ntua.gr/

TREMOVE

TREMOVE is a transport and emissions simulation model developed for the European Commission. It is designed to study the effects of different transport and environment policies on the emissions of the transport sector. The model estimates the transport demand, the modal split, the vehicle fleets, the emissions of air pollutants and the welfare level under different policy scenarios. All relevant transport modes are modelled, including air and maritime transport. The model covers the 1995-2020 period, with yearly intervals.

Further documentation available at: http://www.tremove.org/index.htm

AERO

The AERO Modelling System (AERO-MS) was devised to evaluate economic, regulatory, operational, and technical measures to reduce air traffic impacts on the atmosphere and was developed over the period 1994 to 2000 funded by the Dutch government. It has been used for analysis in ICAO. The key objective of AERO-MS is to quantify the economic and environmental impacts of possible measures related to the air transport system, where differing future scenarios are considered. AERO-MS is a comprehensive tool that encompasses all of these objectives and their potential impacts, allowing a consistent evaluation of the cost-effectiveness of environmental measures.

A more detailed description of the AERO modelling system, provided by the AERO modelling team, is found in section A below.

A. Key principles of the AERO Modelling System

A1: Introduction

In 1994 the Dutch Government commissioned Project AERO (Aviation Emissions and Evaluation of Reduction Options) with the remit to find the "best" strategy to reduce the impacts of air traffic on the atmosphere, by weighing the environmental benefits against the economic consequences.

The main feature of Project AERO has been the development and application of a policy-testing information and forecasting system of future world-wide aviation activity, with its associated atmospheric emissions and economic impacts. The AERO Modelling System has been set up in a robust and user-friendly computing environment, so that policy analysis can be carried out efficiently and confidently. The model has undergone several phases of development and functional enhancements. Through these enhancements, additional detail has been added, and improvements were made to the model capabilities for policy analysis.

AERO is exceptional among air traffic modelling systems in that forecasts of **demand** for air services, sensitive to economic growth and air transport prices, are the key driving force behind estimates of future air traffic in both the presence and absence of emissions-related policy measures. The chief outputs of AERO are:

- the volume and three-dimensional spatial distributions of aircraft emissions in the atmosphere, and their environmental impacts;

- the costs and revenues of airlines at a world-region level.

The AERO Modelling System has been used to analyse the impact of aviation charges and other Market Based Options for ICAO's Committee on Environmental Protection (CAEP) and the European Commission. For a detailed description of the model reference is made to the main report of the AERO project [Pulles et al., 2002].

The next section (A2) of this annex provides an overview of the AERO model system and describes the analytical approach that is followed to investigate the economic and environmental impacts of emission reduction policy measures. Then the individual models included in AERO for forecasting the impacts of economic incentives are explained in more detail (Section A3).

A2: Analytical approach and overview of system

A2.1: Basic approach

In analysing the effects of policy measures, the approach of AERO is to make a very clear distinction between a scenario - a user-defined specification of the future, excluding policy measures - and a policy forecast - the estimated outcome of imposing measures in the scenario. The overall structure of AERO was created around this distinction.

The structure comprises three fundamental steps (see Figure A2.1). The first involves a description (in the Unified Database) of Base-year aviation activity, in terms of civil aircraft movements, passenger and cargo demand by flight stage and the characteristics (costs, fuel use, emissions) in the Base year which is 1992.

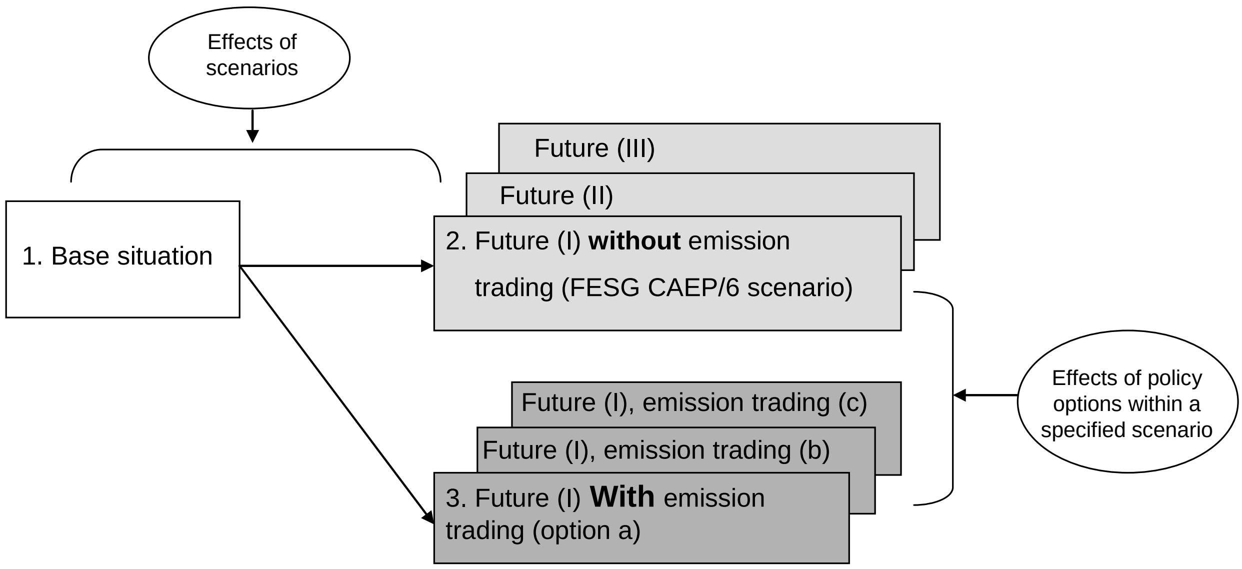
The second step sets up the scenario. The user's input assumptions - such as economic growth rates, real changes in fare levels, and technological development - are translated by AERO into changes in aviation activity between the Base-year and a future year for which forecasts are required. In particular, the underlying changes in aircraft technology through time can be specified by the user as part of the scenario.

The model system allows the computation of a number of consistent intermediate scenario situations within the overall Forecast period. In particular, an intermediate calibration is possible for the most recent year (currently 1998) for which a complete set of inputs and validation data are made available. The result of this process to ‘update’ the AERO base year is that the model forecasts will take into account as many of more recent developments in aviation as possible, and correspondingly increase the reliability of future forecasts.

In the third step, the user introduces the policy measures to be tested, within the context of the scenario. AERO estimates the differences in aviation activity that would result from the measures compared to the scenario position.

To establish the merit of alternative policy measures requires the third step to be compared with the second. Clearly, the impact of measures may change if the scenario situation is changed. It is therefore important that the User can test the effects of measures within alternative scenarios: that is, within alternative views of the future (without measures).

Figure 5: Overview of AERO analysis approach



A2.2: Effects of policy measures and treatment of technology change

Based on the comparison of alternative futures (with policy measures compared to the scenario situation without measures), typically the process for computing the effects of an emission trading option (but also other policy measures) is:

- emission trading increases the costs for airlines;
- airlines (seek to) pass on the additional costs in terms of higher passenger fares and freight rates;

- higher fares and rates depress (growth in) demand;
- capacity offered is correspondingly lower (ie grows less rapidly);
- emissions are thereby lower (than they would otherwise have been).

There will also be an effect on emissions through supply side effects. AERO forecasts an increase in operating costs (which for emission trading is different for different aircraft technologies) will provide an incentive to airlines to shift more strongly to newer technology aircraft than they otherwise would have. This reduces the impact of the charge on total operating costs, and the consequent effects on fares and rates, and demand and capacity would be smaller than without the technology shift.

A2.3: Overview of models in the AERO Modelling System

AERO covers a sequence of steps from the description and generation of aviation demand to the assessment of the environmental impacts of aviation emissions. These steps are formulated through a Unified Database of base year demand and capacity and the following nine linked models:

(1) ATEC: Aircraft technology model

(2) ACOS: Aviation operating cost model

(3) ADEM: Air transport demand and traffic model

(4) DECI: Direct economic impacts model

(5) MECI: Macro-economic impact model

(6) FLEM: Flights and emission model

(7) OATI: Other atmospheric emissions model

(8) APDI: Atmospheric processes and dispersion model

(9) ENVI: Environmental impact model

A further description of the Unified Database and the models is given in Section A3. The section only focuses on the models ATEC, ACOS, ADEM and DECI as these models were the main models used for the analysis carried out.

All the components of AERO - models, input data, system assumptions, user inputs and modelled outputs - are embedded in a software shell. The main functions of the shell are to facilitate communication and interaction between the various models, and between the user and the complete AERO system.

A3: Model descriptions

A3.1: The Unified Database

The Unified Database quantifies global aircraft movements and air passenger and cargo demand for the Base-year of AERO. Though global in coverage, the data are spatially disaggregated. Flight stages connecting about 350 major world cities are recorded individually; other flight stages are grouped by world region, hub airport and stage length.

Within the Unified Database, aircraft movements are categorised by aircraft capacity, range, function (passenger/combi or dedicated freighter) and technology level. Movements are also classified by scheduled, charter and non-commercial; 24 million civil aircraft flights are represented in the database.

The scheduled flight data were taken from the ICAO "Traffic by Flight Stage" (TFS) data for international movements, the US Department of Transport "T-100" data for US domestic flights, and the ABC (now OAG) timetable for scheduled movements not included in the first two sources, following elimination of double-counting (based on matching origin, destination, carrier and aircraft function). A similar elimination of double-counting between the ANCAT database and the compendium of scheduled sources was also necessary, to extract non-scheduled (mainly charter) movements from the ANCAT database.

Given the dependency of AERO on aviation **demand** forecasting, a major advantage of the TFS and T-100 data sources is that they include passenger and cargo demand data, as well as aircraft movements, for the flight stages which they cover. Other scheduled flight stages drawn from the ABC timetable do not (of course) have empirical demand data; instead, these were synthesised from the load factors (by region-pair, length of haul, etc) implied by the TFS and T-100 sources. IATA data were the basis of the passenger class split for different categories of flight stage (again by region-pair, length of haul, etc).

A significant refinement for the current version of AERO has been to expand the aircraft type definition to include a more detailed representation of aircraft with capacity in the range 80 to 179 seats (and freighter equivalents). The generic aircraft type definitions classify aircraft by both capacity and range capability, as shown in the table below.

Aircraft Type	Range (Km)	Seat Band
0	< 4000	< 20
1	< 4000	20 to 79
2	< 4000	80 to 124
3	< 4000	125 to 179
4	4000 to 8000	80 to 124
5	4000 to 8000	125 to 179
6	4000 to 8000	180 to 299
7	> 8000	180 to 299
8	> 8000	300 to 499
9 (New Large Aircraft)	> 8000	> 500

Within each of these types (except NLAs), a distinction is made between 'old' and 'current' technology aircraft. This gives a total of 19 generic classes by which the civil aircraft fleet is broken down in the AERO modelling system. Relevant aircraft characteristics for the generic aircraft types are derived from existing aircraft types representative of each generic class. Enlargement of the aircraft classification was accompanied by improvements and refinements to the performance data of the representative aircraft types, and to the mapping procedure to obtain aircraft characteristics for generic aircraft types.

A3.2: Aircraft TEChnology (ATEC) Model

Model ATEC allows the AERO user to work with chosen assumptions concerning the rate of technology development. ATEC calculates aircraft technology indices for future years, based on the progress of technology over aircraft lifetimes up to the AERO Base-year and on user inputs relating to technology development into the future. The indices refer to the development through time of fuel-use and emission characteristics for each generic aircraft type. A similar process applies to the prediction of new aircraft prices, and real price changes over time are correlated with the user's input scenario of the rate of technological development.

In the latest version of AERO, a regional component has been added to ATEC, which ensures that aircraft characteristics represent the average age and technology of aircraft operating in different parts of the world.

ATEC's estimates of fuel flow rates and new aircraft prices are employed by the operating cost model (ACOS), while ATEC's emission rates are used by the flight and emissions model (FLEM). These models are described below.

A3.3: Aviation DEMand and Air Traffic (ADEM) Model

The fundamental objective of model ADEM is to forecast aircraft movements in a situation with and without measures. ADEM outputs its forecasts of aircraft movements to a database (of identical structure to the Unified Database) so that model FLEM can estimate the emissions that would arise from those movements. ADEM contributes to the accuracy with which the effects of policy measures on emissions can be estimated by forecasting aircraft movements:

- at a high level of spatial disaggregation (individual city-pairs for the majority of seat-km);

- by aircraft type, distinguishing range, capacity and technology level.

ADEM forecasts scheduled, charter and non-commercial air traffic. The treatment of scheduled demand (passenger and cargo) and capacity is as follows.

In practice, the capacity offered on any route is an interplay of the forces of supply and demand, including the costs of operation, the fares (and freight rates) charged, the sensitivity of passenger (and cargo) demand to these, and competition between carriers. If costs are increased (through a higher route charge, for example), fares may be increased. Demand will then be lower than it otherwise would have been, as will the capacity offered. ADEM, in association with model ACOS, seeks to emulate the final position that would be reached as a result of these complex real-world interactions.

It is assumed that, at any prevailing level of fares (and freight rates), capacity will be forthcoming to satisfy passenger (and cargo) demand. Forecast aircraft movements are therefore very largely determined by forecast demand, and much of ADEM's functionality is associated with forecasting demand. This is described in more detail below.

ADEM is an incremental forecasting model. Its fundamental input is the Unified Database of passenger and cargo demand, and of aircraft movements, by city-pair in the AERO Base-year. It then estimates changes in demand and movements arising from the scenario specified by the AERO-User. The outputs of this scenario case then become the input database for a policy case in which the further differences in demand and movements due to policy measures are estimated.

Economic and demographic growth rates are assumed to be the main drivers of growth in aviation traffic. Aviation demand is forecast by means of elasticities to these growth rates, calibrated from historical data. Separate growth forecasts are made for business and non-business passenger demand, and for cargo demand, because of the availability of elasticities with respect to economic growth of these categories of demand. Another vital feature of AERO is that aviation demand is sensitive to changes in real fare levels and freight rates.

On overland flight stages of up to 700 km length, ADEM assumes that air services are faced with competition from surface modes. The effect of these is modelled in two respects. Firstly, air passenger and cargo demand elasticities are higher (more sensitive) to reflect that, if fares and freight rates are increased, there will be loss of airline traffic to the surface modes in addition to the outright suppression of traffic. Secondly the AERO user is permitted (as part of the scenario) to assume that different extents of high-speed rail network are implemented in Europe (and elsewhere), which increases the surface competition faced by parallel flight stages concerned.

As noted above, it is assumed that capacity is provided to match (in some sense) a given demand. Empirical data show that, for a given length of route, both the service frequency and the distribution of flights by size of aircraft vary systematically (on average) with the level of demand. In forecasting growth in demand on a route, ADEM also adjusts service frequency and the aircraft size distribution on the route in accordance with the empirical relationships. In this way, capacity is made to satisfy demand with realistic load factors.

The mix of aircraft (in terms of size and technology level) on a route is also modified by ADEM in response to unit cost changes resulting from policy measures, as estimated for each aircraft type by model ACOS. An increasing proportion of capacity is forecast to be provided by those aircraft types for which cost per unit of capacity falls most or increases least as a result of a measure.

The responses and mechanisms of ADEM are mostly the result of relationships calibrated between dependent and relevant independent factors drawn from empirical data. This applies, for instance, to the sensitivity (elasticity) of air demand growth to economic growth and to real fare levels. Another example is that AERO’s forecast adaptation of fleet mix to traffic growth and changes in operating costs is based on statistically estimated relationships between the existing fleet mix and both demand and operating costs.

In case of measures affecting fleet composition, the implicit assumption is that the available time between the introduction of the measure and the forecast year would be sufficient for these fleet responses to have been achieved.

Most policy measures will increase airline operating costs. The effect of the measures will depend crucially on how airlines respond to the increase in costs, and this in turn will tend to depend on the scope that carriers have - within the constraints of industry cycles and competition - to pass on higher costs in increased fares and freight rates.

As part of setting the scenario, the AERO user can decide the extent to which carriers would be able to pass on higher costs. At one extreme, the model reflects that carriers might have to absorb the additional costs, so that fares would be unchanged (from the scenario level) and demand would consequently be unaffected. Apart from any mitigating effects of a shift in the aircraft fleet mix, the policy measure would be predicted to have no major impact on emissions, though the profitability of airlines would deteriorate. At the opposite extreme, the AERO user can stipulate that carriers would be able to pass on cost increases in higher fares and freight rates to achieve the profitability per unit of capacity that is estimated in the scenario run. In this case, the policy measure curtails growth in demand and capacity, and thus has an appreciable impact on emissions.

A3.4: Aviation COSt (ACOS) Model

The cost of providing a given level of capacity (seats, cargo space) may vary over time, and also as a result of the imposition of policy measures. The relative cost of operating different aircraft types may also change. The main function of model ACOS is to estimate these changes in cost, which are fundamental to the forecasts of passenger and cargo demand, and aircraft movements, made by model ADEM.

On the basis of the cost changes estimated by ACOS, ADEM adjusts fares and freight rates. These influence ADEM's forecasts of passenger and cargo demand, which in turn lead to estimates of the capacity to be offered. ADEM uses the relative cost changes between aircraft types to modify the mix of aircraft (by size and technology level) through which the forecast capacity will be met. ADEM is then able to forecast aircraft movements, for which model FLEM calculates the volume and spatial distribution of emissions.

The cost changes from ACOS also contribute to the synthesis by the direct economic effects model (DECI) of the effects of policy measures on the financial position of airlines.

ACOS estimates changes in operating costs for each of several aircraft types which are distinguished by size (capacity), range, function (passenger/combi or freighter), and technology level. The operating costs are estimated for each flight stage (city-pair, or aggregations thereof) in the AERO database of aircraft movements.

Since AERO employs an incremental modelling approach, forecasts of (for example) the mix of aircraft types are obtained as adjustments to a prior position, in response to changes from that position in the relative costs of different aircraft types. ACOS therefore only has to be concerned with those categories of cost which will vary over time differentially by aircraft type and/or which will be directly modified by the imposition of policy measures, namely: i) flight crew; ii) cabin staff; iii) maintenance; iv) fuel; v) airport and navigation fees; and vi) capital charges.

Costs which do not vary with either aircraft type or policy measure, such as general and administrative or ticket and sales costs, are excluded from ACOS, though these are subsequently treated as "volume-related costs" by DECI.

ACOS does not deal specifically with variable costs in the sense that they can be altered in the short-run; rather, ACOS estimates the differences in costs in the forecast year with policy measures in operation compared to the same year without measures (the scenario). Carriers are assumed to have had the opportunity to adapt to the impact of policy measures, by - in particular - modifying the mix of aircraft types operated compared to the scenario fleet. (As noted above, the degree of adaptation depends upon the length of time between announcement of measures and the Forecast year.)

The cost structure for a particular type of aircraft is built up from "physical" measures and unit costs. The physical measures are based on cycle (such as landing fees), block time (such as crew costs) and flight stage distance (such as route charges). Fuel consumption has both cycle and distance components. Unit costs are averaged at a region-pair level of spatial disaggregation. They relate to cycle, block time or distance, depending upon the category of cost. Multiplying the physical measures by unit costs allows a cost per cycle of operating each aircraft type on a flight stage to be estimated. Dividing by aircraft size scales the cost per cycle to a cost per unit of capacity for each aircraft type.

The difference in unit costs between scenario and policy cases (due to measures) for each aircraft type is entered into a fleet mix adjustment sub-model in ACOS. This forecasts - for each flight stage - an increase in the proportion of capacity supplied by the aircraft type(s) with the least unfavourable change in costs. The average change in costs for each flight stage will therefore be less than if the aircraft mix had remained the same. This average cost change is passed to ADEM to calculate changes in fares, with consequential effects on ADEM's forecasts of demand and capacity for each stage.

The cost changes by aircraft type are subsequently transmitted to ADEM for use in its own (identical) fleet mix adjustment sub-model. This is applied after the final capacity forecast for each stage has been estimated, and converts the capacity into movements by the revised mix of aircraft types.

A3.5: Direct EConomic Impacts (DECI) Model

Model DECI has three main functions:

(1) Post-processing traffic volume, operating cost and revenue results from models ACOS and ADEM.

(2) Computing direct socio-economic impacts, such as airline operating results, employment, contribution to gross value-added.

(3) Computing direct policy impacts on aviation consumers and governments.

DECI produces a large number of output variables at global, world region and region-pair levels of spatial aggregation. This allows the AERO-User to investigate the varying impact of policy measures on aviation activity, airline profitability, consumers and governments by region. This is clearly important for the assessment of measures that are applied at a regional level, but global measures also can have differential impacts for different regions.

The regional breakdown of results is an important feature of DECI. Since the effects of both scenarios and measures are modelled mainly by flight stage, many of these effects are inevitably inter-regional. Using information on the proportion of airline service on each flight stage that is provided by carriers from different regions, DECI can allocate (changes in) aviation activity, costs, revenues, subsidies, consumer benefits, etc to the airlines, their clients and governments based in individual regions.

Through the AERO User-Interface, DECI's results are output in several standard tables. (Other information can also be readily obtained by interrogation.) These tables provide overviews of:

- cost, economic and employment information by world region and region-pair, including:
- variable operating costs by component (see above under ACOS);
- other (volume-related) operating costs;
- revenue ton-km operated;
- operating revenues and operating results;
- gross value added and airline employment by category of operating staff;
- fuel consumed;
- civil aircraft fleet, classified by:
- capacity and range capability (nine types);
- technology level ("old" or "current");
- function (passenger/combi or dedicated freighter);
- global fleet, and EU carriers separately;
- impacts of policy measures (changes from scenario position) on:
- airlines: changes in operating costs, revenues and results;
- consumers: changes in expenditure and consumer surplus;
- governments: income from taxes and charges and outgoings due to subsidies.

The outputs facilitate comparative analysis across all cases: Base-year, scenario and policy. The Base-year outputs can also be validated against other global and regional data sources.

Reference:

Pulles J.W. et al., 2002. Aviation emissions and Evaluation of Reduction Options/AERO, Ministry of Transport, Public Works and Water Management, Directorate-General of Civil Aviation, The Hague, The Netherlands.

Annex 8: Analysis underlying impacts on consumers

To provide an indication of the impact on ticket prices and freight rates from aviation's incorporation into the EU ETS, the potential cost increases were estimated, both per flight and per passenger ticket, for three exemplary flights. The exemplary flights are the following:

– Short-haul flight: Amsterdam – Paris Charles de Gaulle, 480 km (259 nm).

– Medium-haul flight: Munich – Palma de Mallorca, 1,402 km (757 nm).

– Long-haul flight: London Gatwick – Newark, 6,404 km (3,458 nm).

This assessment is based on the following assumptions and specifications:

(1) The analysis has been carried out for the year 2020, assuming that the amount initially allocated to the sector is equal to 2005 emission levels[58].

(2) Results vary according to the different geographical scopes assumed due to differences in the aircraft deployed and thus number of passengers carried, and due to the fact that the long haul flight is assumed to be intercontinental.

(3) In one variant a multiplier of 2 is applied to account for non-CO_2 climate impacts. This implies that for each tonne of CO_2 emitted by the aviation industry, two allowances must be bought from other sectors. Vice versa, for each tonne of CO_2 reduced by the aviation sector, the sector can sell two allowances to other sectors.

(4) In the business as usual scenario, the CO_2 emissions under the various geographical scenarios are based on an implementation of the FESG 2002 scenario for payload carried multiplied by kilometres travelled (revenue tonne kilometres) using the AERO model.

(5) It is assumed that the aviation sector does not make emission reductions but is a net buyer of allowances, since aviation has relatively high marginal abatement costs for CO_2 emission reduction.

(6) The effects have been calculated assuming two alternative market prices for allowances. These are exogenous factors in the calculations and were set at €6 and €30 per tonne of CO_2.

(7) The policy-induced cost increases to airlines are passed on to consumers by increasing fares on those routes subject to the EU ETS. No cross-subsidising over and above the current level of cross-subsidisation is assumed regarding routes not subject to the scheme.

(8) Aircraft operators pass on the opportunity cost of allowances in their entirety, irrespective of whether these allowances are received for free or against payment.

Due to these assumptions being made, the costs passed on per tonne of CO_2 are simply the allowance prices on the market. In case a multiplier (of 2) is applied, the costs passed on are twice the allowance price on the market.

[58] Note that the amount of allowances initially allocated to the sector does not influence the impact on ticket prices under the assumption that the full (opportunity) costs are passed on.

Note that the allocation method (grandfathering, auctioning, benchmarking or a combination) does not affect the results under an assumption of a full pass on of (opportunity) costs. For example, a fuel inefficient service would require the purchase of additional allowances under a benchmarking system, compared to a more fuel efficient service. However, the price associated with the emissions remains the same, whether allowances need to be purchased or not.

Aside from the assumptions discussed so far, in calculating the impact on aircraft operating costs and ticket prices, the data presented in table 18 have been used. Data on fuel use have been taken from the EMEP/CORINAIR database[59].

Flight length	**Aircraft type**	**Seats/ Occupancy rate**	**Trip fuel (kg)**	**CO_2 emissions trip (kg)**
Short haul	Airbus A320	150 / 70%	2,539	8,024
Medium haul	Boeing 737-400	150 / 70%	4,998	15,793
Long haul	Boeing 777	340 / 70%	49,694	157,033

Table 18: Data assumptions for impact calculations

Under the aforementioned assumptions, the average impact at flight level and on ticket prices can be estimated for the three exemplary flights, as shown in section 5.3.1.

Illustration of cost impact calculations

The calculations for a short-haul flight under an intra EU scheme are illustrated below, with an allowance price of €6 and no multiplier. Total CO_2 emissions are estimated at 8,024 tonnes (see table 18). Allowances for these emissions will have to be surrendered at the end of the commitment period. If allowances are auctioned or purchased, the price equals €6 per tonne. If they are grandfathered or benchmarked, the opportunity costs equal €6 per tonne. The cost increase per return flight thus equals 2 (return flight) times 8,024 times €6 = € 96,3.

The cost increase per ticket can be calculated by dividing the cost increase at flight level by the average number of occupied seats, which in this case is assumed to be 105 (70% of 150).

The impacts at flight level for the short and medium haul flight do not differ across the geographical scope. This is due to the fact that both types of flights are assumed to be intra EU flights, and thus included fully in all three scenarios. Emissions from the long haul intercontinental flight are not included in the intra EU scheme, one leg of the flight is included in the all departing scheme, and emissions are included fully for the round trip in the arriving and departing scenario.

59 EMEP/CORINAIR Emission inventory guidebook – 3rd edition, September 2004 update.

Annex 9: International travel transferring at EU hubs

Given that reliable statistical information on the origins and destinations of passengers travelling through EU airports is not publicly available, MVA Consultancy has used data from the ICAO-CAEP Forecasting and Economic Sub Group (FESG) and Eurostat, in combination with a gravity model based on generalised costs, in order to develop credible estimates (MVA Consultancy 2006). Table 19 shows that in 2005, an estimated 9.6 million passengers were travelling from a point of origin outside the EU to a destination outside the EU, with a plausible route being via an EU hub. Of these, 4.7 million were estimated to actually transfer at an EU hub. These constitute approximately 1.0% of all passengers departing from EU airports[60].

Origin		Destination	Routing	Estimated number of passengers, 2005 (million)	Estimated impact of inclusion of all departing flights in ETS (allowance price €30)
EU	to	EU	Direct	218.3	-1.6%
			Via EU hub	36.8	-2.0%
			Via non-EU hub	0.5	0.0%
			Total	255.6	-1.7%
EU Non-EU	to to	non-EU EU	Direct	26.4	-0.8%
			Via EU hub	54	-2.4%
			Via non-EU hub	48.2	-0.2%
			Total	128.6	-1.3%
Non-EU	to	non-EU	Direct	2.7	0.0%
			Via EU hub	4.7	-2.6%
			Via non-EU hub	2.2	+1.3%
			Total	9.6	-0.9%

Table 19: 1.0% of passengers at EU airports are on journeys from outside the EU to a destination outside the EU. Source: MVA Consultancy (2006)

Assuming coverage of all departing flights and an allowance price of €30, MVA Consultancy estimates that 2.6% of the passengers on routes from outside the EU to outside the EU, and currently transferring at an EU hub, would either change their route or choose not to travel.

At an allowance price of €100, MVA Consultancy estimates the percentage of these passengers bypassing EU hubs to be 7.9%. This equals 0.08% of all passengers departing from EU airports.

Of course, only major hubs will be affected by passengers rerouting their journeys. So for some airports the impacts will be larger than for others. Under the assumption that all hubs will be affected in the same way (i.e. all hubs have an equal share of non-EU to non-EU transfers), the hubs with the highest share of transfer passengers are affected most. MVA identifies these airports as Amsterdam, Frankfurt, Vienna and Prague. At an allowance price

[60] Both intra-EU passengers and passengers to and from the EU flying direct or transferring at a non-EU hub depart once from an EU airport; when these passengers transfer at an EU hub, they depart twice from an EU airport; passengers flying direct from a non-EU point of origin to a non-EU destination do not depart from an EU airport, as nor do passengers that transfer at a non-EU hub on these journeys.

of €30, these airports would see the number of departing passengers decease by 0.07% at most (table 20).

Hub	Estimated number of passengers	Estimated number of transfer passengers	Estimated totals number of passengers	Change due to lost non-EU transfers
Amsterdam	12.4	9.2	21.6	-0.06%
Brussels	7	1.2	8.2	-0.02%
Paris	25.4	10.6	36	-0.04%
London	48.3	11.3	59.6	-0.03%
Dublin	7.9	0.9	8.8	-0.01%
Frankfurt	13.2	13.8	27	-0.07%
Munich	10.9	4.5	15.4	-0.04%
Copenhagen	6.8	2.5	9.3	-0.04%
Vienna	6.9	6.2	13.1	-0.06%
Madrid	12.5	11.4	23.9	-0.06%
Lisbon	3.8	1.5	5.3	-0.04%
Rome	8.7	3.9	12.6	-0.04%
Milan	7.2	4.5	11.7	-0.05%
Athens	4.8	2.3	7.1	-0.04%
Rest Greece, Cyprus	4.4	0.3	4.7	-0.01%
Helsinki	2.5	1.7	4.2	-0.05%
Warsaw	3.1	1.3	4.4	-0.04%
Budapest	2.9	0.4	3.3	-0.02%
Prague	3.9	3.9	7.8	-0.07%
Rest EU	1.7	0.6	2.3	-0.03%

Table 20: Even major transfer hubs would only see an extremely small reduction in non-EU traffic. Source: MVA 2006, calculations by CE Delft 2006.

Annex 10: Impact on remote and isolated regions

Assessing the impacts on remote and isolated regions necessitates defining which areas are concerned. Two groups of such regions are well defined in the Treaty, namely overseas countries and territories (OCTs) and outermost regions (also know as "ultra-peripheral regions" or UPRs). As regards other disadvantaged regions which have some of the same characteristics but are not as clearly defined, the situation is more complex.

Outermost regions (UPRs) and overseas countries and territories (OCTS)

Given their particular location being situated far away from mainland Europe, but in most cases close to third country territories, the main assumption in the analysis has been that UPRs and OCTs are treated as third countries. This means that flights to and from a UPR or OCT are only covered to the extent they departs from (and, for geographical scope option 3, arrives at) an airport in mainland Europe[61], and that the flight is covered by the scope of the scheme. Table 21 shows an overview of how different types of flights to/from UPRs and OCTs under this assumption are treated under the different geographical scope options.

Geographical scope	**Routes covered by the ETS**	**Routes not covered**
Option 1: Intra-EU	None	Any flight to or from an UPRs/OCT.
Option 2: All departing	Flights from mainland Europe to an UPR/OCT	Flights arriving from third countries to, or any flights from, an UPRs/OCT.
Option 3: All departing + all arriving	Flights between mainland Europe and an UPR/OCT	Flights between UPRs/OCTs and third countries exempted

Table 21: Main assumption about coverage of flights to/from outermost regions and overseas countries and territories

Under the above assumption the actual extra annual cost for flights to/from UPRs at current activity levels can be calculated as shown in table 22 depending on the geographical scope, the degree of auctioning used and allowance prices.

Geographical scope	**CO_2 emissions**	**Allowance price €6**			**Allowance price €30**		
		Auctioning share			**Auctioning share**		
	Mt	**10%**	**20%**	**40%**	**10%**	**20%**	**40%**
Option 1: Intra-EU	0	0	0	0	0	0	0
Option 2: All departing	3,4	2	4	8	10	20	40
Option 3: All departing + all arriving	6,7	4	8	16	20	40	80

Table 22 Estimated extra costs for services to UPRs (€ million). Emissions estimated for 2005 with Eurocontrol's PAGODA on-line service

As regards flights to/from OCTs, the amount of emissions from flights between the EU and OCTs is estimated to be less 1 million tonnes of CO_2. Accordingly total impacts at current activity level would at most (40% auctioning and option 3 for geographical scope) amount to €2.4 or €12 million for an allowance price of €6 or €30 respectively.

61 Here defined as EU27+EEA excluding UPRs.

Other disadvantaged regions

As regards other disadvantaged regions, such as other peripheral, isolated or insular regions, the situation is more complex as these regions are not as clearly defined in the EC Treaty. However in the context of the application of Articles 86 and 87 of the Treaty the Commission has established a practice for assessing whether state aid or other measures potentially having a similar effect are compatible with the Treaty. As any special provisions for certain air services to mitigate the economic effect of the EU ETS could effectively be comparable to operating aid and risk distorting the internal market, the set of criteria established for assessing compatibility of aid with the Treaty is clearly relevant in terms of defining regions where such provisions could potentially be acceptable.

Apart from the general guidelines on regional aid[62], the following sector specific rules apply to air transport and allow for certain air services to be supported economically in various ways:

- Council Regulation (EEC) No 2408/92 of 23 July 1992 on access for Community air carriers to intra-Community air routes.
- Commission guidelines on the "Application of Articles 92 and 93 [now 87 and 88] of the EC treaty and article 61 of the EEA agreement to State aids in the aviation sector" (1994/C/350).
- Community guidelines on financing of airports and start-up aid to airlines departing from regional airports (2005/C/312).

In essence, apart from time-limited “start-up” aid for opening new services, subsidies to defray operational costs for airlines are only acceptable for services that are subject to a **public service obligation (PSO)** imposed according to the rules laid down in Regulation 2408/92/EC, or if granted as **aid of a social character (AOSC)**.

As regards **PSOs**, Regulation 2408/92/EC provides that a Member State may impose a public service obligation "*in respect of scheduled air services to an airport serving a peripheral or development region in its territory or on a thin route to any regional airport in its territory, any such route being considered vital for the economic development of the region in which the airport is located, to the extent necessary to ensure on that route the adequate provision of scheduled air services satisfying fixed standards of continuity, regularity, capacity and pricing, which standards air carriers would not assume if they were solely considering their commercial interest.*". The Member State "*…may reimburse [the air carrier] for satisfying standards required by a public service obligation*". The Regulation also clarifies that the adequacy of scheduled air services shall be assessed by the Member States having regard to, among other things, “*the possibility, in particular for island regions, of having recourse to other forms of transport and the ability of such forms to meet the transport needs under consideration*”[63].

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62 Old ones (C/1998/074): http://europa.eu.int/eur-lex/pri/en/oj/dat/1998/c_074/c_07419980310en00090031.pdf
New ones (C/2006/54): http://ec.europa.eu/comm/competition/state_aid/regional/rag_en.pdf

63 On 18 July 2006, the European Commission adopted a proposal for a revision of the “third package” which would amend the PSO provisions currently enshrined in Regulation 2408/92/EC. However, for the purpose of this analysis this would make no difference.

Alternatively, Member States can guarantee affordable access to remote regions by giving **aid of a social nature**. The Commission has on several occasions examined and approved national measures in respect of their compatibility with the state aid rules and Article 87(1) of the Treaty[64]. For instance, Member States may for social reasons be allowed to support certain categories of passengers without establishing PSOs, as France has done for students and people under education flying to its overseas departments[65].

It must be underlined that subsidies in the form of PSOs or AOSCs are always assessed on a case-by-case basis. The criteria and conditions are not specific enough to draw up a complete list of regions to which air services for certain would satisfy one or both of the sets of conditions and qualify as a PSO service or a service where AOSC can be given.

In assessing potential additional costs for this category of regions, the analysis therefore takes as a point of departure regions where the existing regimes for acceptable subsidies are already applied in practice in the Member States.

In the case of **AOSC**, it is predominantly used in connection with air services to UPRs, for which the impacts have already been assessed above.

For **PSOs** the analysis has been based on information about PSO routes notified to the Commission. Eurocontrol traffic data has been used to assess the frequencies and emissions of flights serving airport-pairs between which PSOs have been imposed.

The impact has been estimated as the extra costs for Member States assuming that they would have to pay all additional costs arising from the EU ETS to maintain existing service levels at routes currently subject to PSOs. Table 23 gives an overview of the impact under different assumptions about allowance prices and degree of auctioning used. Since these routes can be assumed to be uncompetitive, there is no reason to assume that opportunity costs will be passed on for these routes. So the costs of the allowances would equal the costs of the auctioned allowances only.

Member State	**CO_2 emissions**	**Allowance price €6**	**Allowance price €30**
		Auctioning share	**Auctioning share**

64 Decision N386/1998 of 29 July 1998 concerning links between the Balearics and the rest of Spain, Decision N387/1998 of 29 July 1998 concerning links between the Canaries and the rest of Spain, Decision N414/1998 of 27 August 1998 concerning links between Madeira and the rest of Portugal, Decision N399/1998 of 3 September 1999 concerning support for air links in favour of the residents of the minor islands of Sicily, Linosa, Lampedusa and Pantelleria, Decision N26/2003 of 5 March 2003 concerning links between Paris and Corsica, Decision N24/2000 of 3 March 2000 concerning links between Marseille, Nice and Corsica, Decisions N638/2000 and N639/2000 of 5 October 2000 concerning links between Lyon, Montpellier and Corsica, Decision N385/2004 of 20 October 2004 concerning aid of a social character for certain categories of passenger on air services between Guadeloupe and metropolitan France, Decision N516/2004 of 20 April 2005 concerning aid of a social character for certain categories of passenger on air services between Martinique and metropolitan France, Decision N169/2006 concerning aid of a Social Character Air Services in the Highlands and Islands of Scotland.

65 Commission Decision of 15/4/2005 concerning schemes of a social character benefiting passengers of certain categories travelling from France to the French overseas departments (NN 25/2005).

See also: http://europa.eu.int/rapid/pressReleasesAction.do?reference=IP/05/980&format=HTML&aged=0&language=en&guiLanguage=en

	(tonnes)	10%	20%	40%	10%	20%	40%
Germany	5.881	4	7	14	18	35	71
Spain	132.085	79*)	159*)	317*)	396*)	793*)	1585*)
Finland	1.393	1	2	3	4	8	17
France	550.472	330*)	661*)	1321*)	1651*)	3303*)	6606*)
UK	1.302	1	2	3	4	8	16
Greece	15.088	9	18	36	45	91	181
Ireland	10.836	7	13	26	33	65	130
Italy	373.595	224	448	897	1121	2242	4483
Portugal	261.260	157*)	314*)	627*)	784*)	1568*)	3135*)
Sweden	25.693	15	31	62	77	154	308

Table 23: Estimated extra cost to maintain existing PSO services (1000 €)

<u>*) Important note</u>: The emissions and cost figures include routes to UPRs which would only be partly or fully covered, respectively, under options 2 and 3 for the geographical scopes. These costs would not be additional to the costs estimated for UPRs above. In other words there is some overlap between the cost assessed on the basis of PSO routes and the costs for UPRs. Moreover, the figures include emission from aircraft of all sizes and therefore also costs that would not arise with a weight threshold applied.

Islands

The Council conclusions specifically referred to the need for assessing impacts on islands. As a consequence, an analysis has been performed to assess the potential additional costs from the EU ETS for flights to and from airports situated on an island.

While the meaning of the term “island” may seem obvious at first, a complete quantitative analysis has to be based on a Geographical Information System and therefore requires a precise definition. For the purpose of this analysis, the EUROSTAT definition of what an island is has been used. Apart from being surrounded by water an island must according to this definition:

– have an area of at least 1 km^2;

– have to be at least 1 kilometre from the continent;

– have a permanent resident population of at least 50 people;

– have no permanent link with the continent;

– not house an EU capital.

With assistance from the European Environment Agency and Eurocontrol, a list of airports known to Eurocontrol and situated on territory satisfying the criteria above was produced. The traffic and emissions data from flights to and from these airports was estimated and are presented in table 24 below. The table also presents estimates for direct, additional costs implied by an EU ETS at current activity levels, given varying assumptions about allowance prices and share of allowances auctioned. It is important to note that the analysis does not cover flights performed under visual flight rules. Such flights are not included in Eurocontrol data, and would in any case not be covered by the EU ETS as explained in section 4. As can be seen from the results, many flights would also not be included if an aircraft size threshold was applied.

Airport Country	Data	Aircraft weight		Allowance price of 6€			Allowance price of 30€		
				Auctioning share			Auctioning share		
		< 20,000 kg	>= 20,000 kg	10%	20%	40%	10%	20%	40%
ÅLAND ISLANDS	CO2 (tonnes)	1061	1373	0,00	0,00	0,00	0,00	0,01	0,02
	Flights (number)	3841	1070						
CROATIA	CO2 (tonnes)	978	638	0,00	0,00	0,00	0,00	0,00	0,01
	Flights (number)	1187	165						
DENMARK	CO2 (tonnes)	587	6313	0,00	0,01	0,02	0,02	0,04	0,08
	Flights (number)	1131	4899						
ESTONIA	CO2 (tonnes)	66	189	0,00	0,00	0,00	0,00	0,00	0,00
	Flights (number)	213	114						
FRANCE	CO2 (tonnes)	8734	229273	0,14	0,28	0,55	0,69	1,38	2,75
	Flights (number)	8312	31978						
GERMANY	CO2 (tonnes)	2636	560	0,00	0,00	0,00	0,00	0,00	0,01
	Flights (number)	4510	93						
GREECE	CO2 (tonnes)	48480	2680663	1,61	3,22	6,43	8,04	16,08	32,17
	Flights (number)	36904	135825						
ITALY	CO2 (tonnes)	39039	1938743	1,17	2,34	4,68	5,85	11,70	23,40
	Flights (number)	39176	1950386						
NETHERLANDS	CO2 (tonnes)	13	0	0,00	0,00	0,00	0,00	0,00	0,00
	Flights (number)	79	0						
SPAIN	CO2 (tonnes)	39640	3103625	1,86	3,72	7,45	9,31	18,62	37,24
	Flights (number)	34108	203138						
SWEDEN	CO2 (tonnes)	6839	8655	0,01	0,01	0,02	0,03	0,05	0,10
	Flights (number)	10590	4416						
UNITED KINGDOM	CO2 (tonnes)	16905	23535	0,01	0,03	0,06	0,07	0,14	0,28
	Flights (number)	25590	6011						

Table 24: Assessment of extra cost (€ million/year) for flights to/from islands at current service level. Emissions and numbers of flights estimated for 2005.

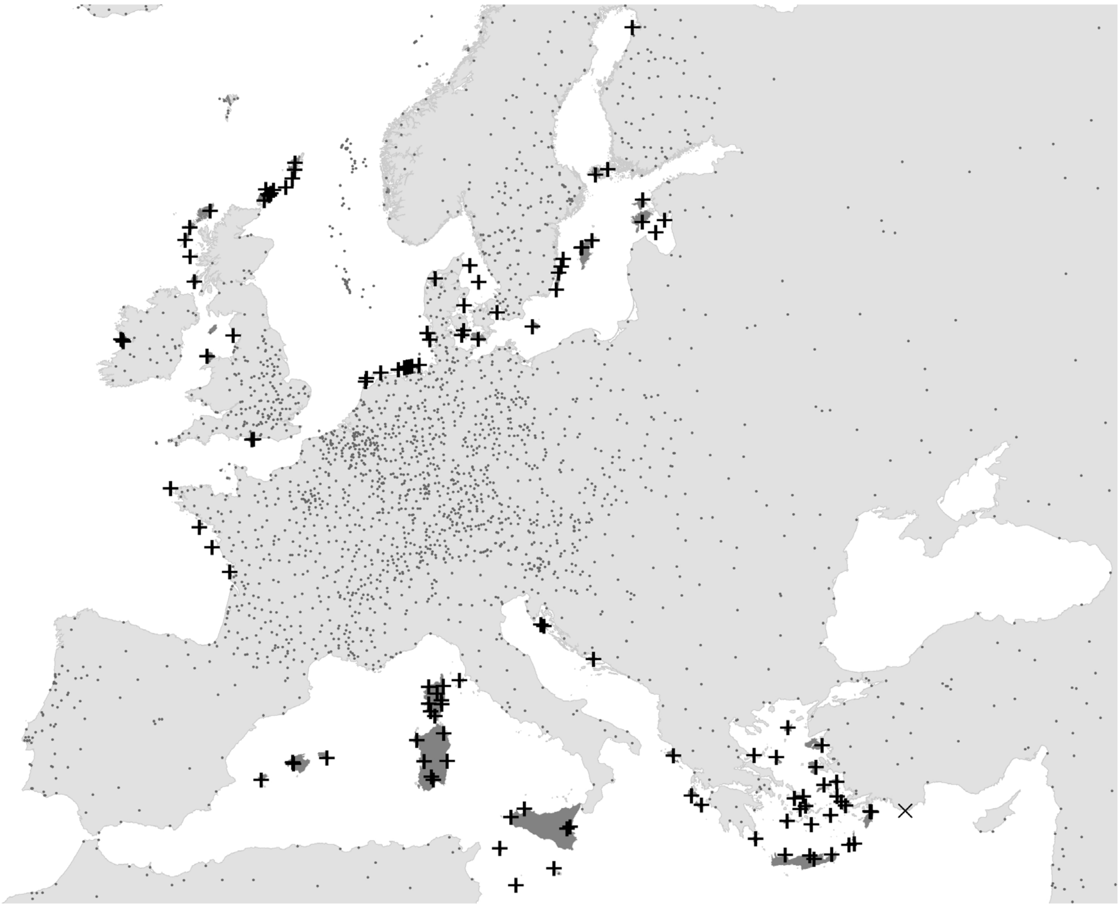

Figure 6: Map of Europe identifying airports known by Eurocontrol (dots) on locations satisfying the EUROSTAT definition of an island (crosses). Source: Analysis by the European Environment Agency based on airport data from Eurocontrol.

Annex 11: Improvements in air traffic management efficiency

Conclusion

Based on the information below, an assumption regarding the additional, future efficiency gains from improved air traffic management has been made. For the purpose of the analysis in AERO, it has been assumed that ATM improvements flowing in part from the implementation of the SESAR programme will result in an additional 1% improvement in fuel efficiency for each of the years 2013-2020[66].

SESAR

The EU SESAR programme aims to develop the next generation European ATM system. In the SESAR proposal from 2005 - COM(2005)602 - the Commission stated that "*It is estimated that the savings in terms of the reduction of greenhouse gas emissions could be between 4 and 6% per flight*". In the accompanying impact assessment report this is explained and presented as a conservative estimate (p.24). However, the 4-6% was related only to the flight trajectories and does not include reduction potential related to taxiing, queuing and holding patterns. The implementation step of SESAR (2014-2020) will see the large scale entry into service of the new systems, and the application of their enhanced functional capacities.

IPPC 1999 report

The IPPC report in the executive summary stated the following about the potential:

"*Several studies associated with the implementation of CNS/ ATM systems have been carried out. Although some of these studies provide results in terms of cost/benefit and associated fuel savings and do not specifically address environmental benefits, there is an obvious correlation with reductions in gaseous emissions. These studies suggest that improvements in air traffic management could help to improve overall fuel efficiency by 6-12%.*

Other strategies that exist for mitigating the environmental impact of emissions from aviation could achieve environmental benefits through reduced fuel burn. These strategies include: optimizing aircraft speed, reducing additional weight, increasing the load factor, reducing nonessential fuel on board, limiting the use of auxiliary power units, and reducing taxiing. Airlines are already under strong pressure to optimize these parameters, largely because of economic considerations and requirement within the industry to minimize operational costs. The potential reduction in fuel burn by further optimization of these operational measures is in the range of 2-6%." (http://www.grida.no/climate/ipcc/aviation/119.htm)

Eurocontrol flight efficiency indicators

Data from the 2005 report from the Eurocontrol Performance Review Commission (PRC)[67] gives indications about the horizontal flight inefficiencies arising from flights being longer than theoretically necessary.

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66 See Annex 10 for details.

67 http://www.eurocontrol.int/prc/gallery/content/public/Docs/prr2005.pdf

Flight efficiency has horizontal and vertical components, which can be split into en-route and terminal flight segments. Insufficient information is presently available to address flight efficiency in the vertical dimension and in Terminal Manoeuvring Areas (TMA) (the area surrounding the airports), so the available indicators focus on the horizontal dimension of flight efficiency in the en-route flight segment.

Two performance indicators are measured for en-route horizontal flight efficiency, as illustrated in figure 7:

(1) En-route inefficiency (E_R[68]), the relative difference between the actual en-route flight length (A) and the great circle distance between origin and destination terminal areas (G);

(2) Direct route inefficiency (E_D[69]), the relative difference between the actual en-route flight length (A) and the great circle distance between TMA entry and exit points (D).

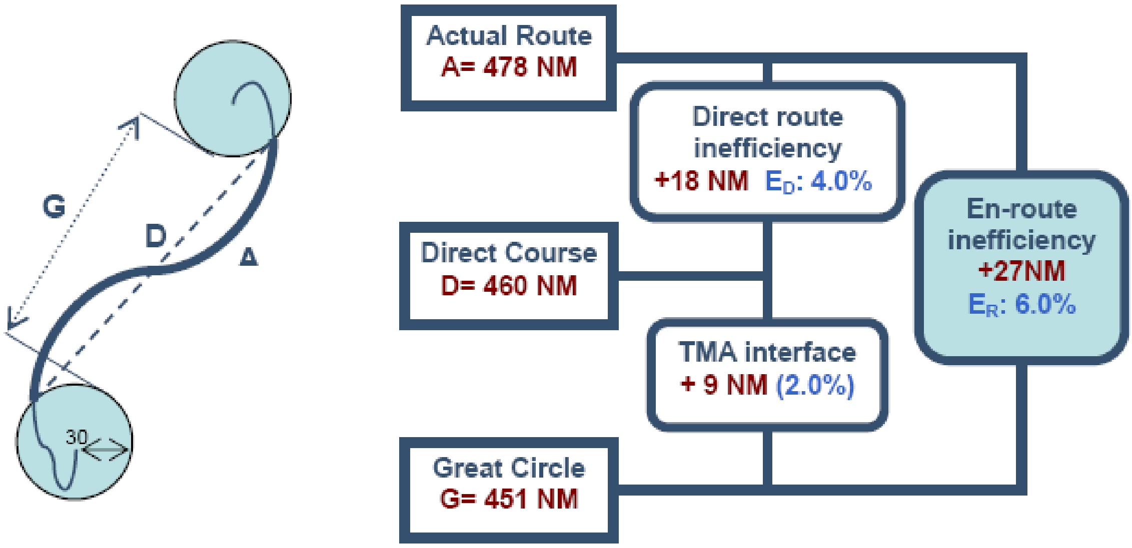

Figure 7: Illustration of flight efficiency indicators. Source: Eurocontrol Performance Review Commission[70].

In order to assess the different sources of potential inefficiencies, the PRC applies a further breakdown of the inefficiencies according to the framework presented in figure 8.

68 E_R=(A–G)/G

69 E_D=(A-D)/D

70 Distances shown are average for all city pair in Europe in 2005. Where the flight originates or ends outside Europe only the portion of flight inside the IFPS zone has been taken into account.

The figure shows that en-route horizontal flight inefficiencies are principally driven by airspace design and its strategic utilisation. The tactical use of airspace partly compensates the selection of longer routes. The PRC concluded that the potential for tactical improvements in the use of existing airspace is limited, and that fundamental changes in the airspace structure itself (dynamic optimisation) will be needed so as to make best possible use of all airspace.

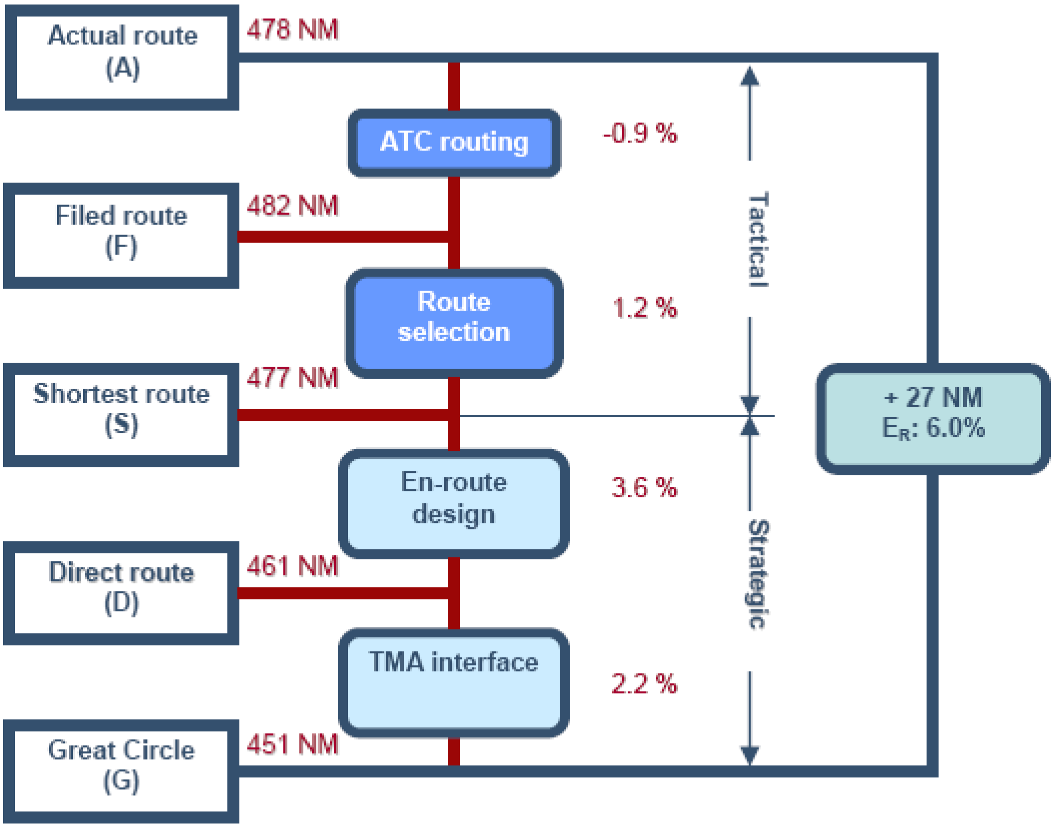

Figure 8: Detailed framework for analysing sources of inefficiencies. Source: Eurocontrol Performance Review Commission.

Annex 12: The impact of aircraft on the global climate

The impact of aviation on climate was analysed in detail in a Special Report by IPCC (1999) and more briefly in the IPCC's (2001) Third Assessment Report. These results have been updated by Sausen et al. (2005) based on a recent EC research project, TRADEOFF (contract EVK2-CT-1999-00030). A summary is given below.

Present commercial subsonic aircraft operate at cruise altitudes between 8-13 km (in the upper troposphere-lower stratosphere), where they release gases and particulates (aerosol), thereby altering the atmospheric composition and changing the energy balance of the atmosphere-earth system. Primary emissions from aircraft include carbon dioxide (CO_2) and water vapour (H_2O), nitrogen oxides (NO_x= $NO+NO_2$), sulphur oxides (SO_x), soot and unburned hydrocarbons.

According to the IPCC (1999), the total amount of burned fuel and emissions of carbon dioxide, NO_x and water vapour from aviation are well known. In 1992 aircraft emitted 0.14 Gigatonnes Carbon (GtC)/year (about 2% of total anthropogenic carbon dioxide emissions for 1992, accounting for 13% of the emissions from the transport sector). The transport sector is rapidly growing in an expanding world economy, aviation being the fastest growing transport mode. As a consequence, aviation fuel use will also increase rapidly and enhance aircraft emissions. Model calculation based on different scenarios projected into the future show emissions in the range between 0.23-1.45 GtC/year by 2050.

Although direct emissions of CO_2 from aircraft are relatively well known, the emissions of other gases and particles are subject to greater uncertainties and the climate impact is much more difficult to quantify due to a number of direct and indirect effects. This is primarily because of their different residence times in the atmosphere and different radiative properties, how the emissions modify the atmospheric composition by chemical reactions, and the way they trigger the formation of contrails and other clouds. In order to compare the climate impact of the different gases and particles, and their direct and indirect effects, the concept of radiative forcing (RF) has been used. It expresses a change in the energy balance of the earth-atmospheric system (here measured in milliWatts per square metre (mWm^{-2}). Positive radiative forcing values imply warming, negative values imply cooling. Currently, RF is the best consensus descriptor for comparing the climate consequences of diverse effects, such as changes in greenhouse gas concentrations and clouds, and has been used for quantifying aviation effects by the IPCC (1999) and more recently by Sausen et al. (2005).

Current knowledge of the principal components from aircraft emissions as regards radiative forcing is summarised below.

Carbon dioxide is the most important greenhouse gas (GHG) because of the large quantities released and the long residence time of this gas in the atmosphere. Increasing concentrations of GHGs have a direct positive RF effect and tend to warm the earth surface. RF from CO_2 is well known.

Water vapour released into the troposphere and lowermost stratosphere has a short residence time because it is quickly removed by precipitation; so the direct RF is small. However, water vapour emitted into the upper (cold) regions of the troposphere often triggers the formation of line shaped contrails, which tend to warm the earth's surface. Persistent contrails may also disperse to form (optically thin) cirrus clouds (called contrail cirrus), which could have an additional warming effect. The direct RF of water vapour and the RF of linear contrails is fairly well known, however, RF associated with contrail cirrus is highly uncertain.

Sulphate and soot aerosols have a much smaller direct forcing effect compared with other aircraft emissions, but their RF is opposite in sign. Soot absorbs heat and has a warming effect; sulphate reflects radiation and has a slight cooling effect. In addition, accumulation of sulphate and soot aerosol might influence the formation and the radiative properties of clouds. Direct RFs are fairly well known, but indirect RF through changing cloud properties is highly uncertain.

Nitrogen oxides have an indirect effect on the quantity of ozone in the upper troposphere and lower stratosphere. Nitrogen oxides are chemically reactive gases which produce **ozone (O_3)** under the influence of sunlight**.** As a consequence of complex tropospheric chemistry, NO_x, will also reduce the ambient atmospheric concentration of **methane (CH_4)**. Both O_3 and CH_4 are strong greenhouse gases. The RF of ozone and methane are opposite in sign and fairly well known. Overall the positive ozone RF dominates the negative methane effect.

Short-lived elements such as water vapour, NO_X, and aerosols remain concentrated near flight routes and therefore have a more regional effect on climate. The total climate impact of aircraft emissions is a superposition of the RF from the principal components, their direct and indirect effects. Table 1 (Sausen et al. 2005) summarises our current knowledge:

Year	**Study**	**RF [mW/m^2]**							
		CO_2	**O_3**	**CH_4**	**H_2O**	**Direct Sulphate**	**Direct Soot**	**Contrails**	**Total (w/o Cirrus)**
1992	IPCC (1999)	18.0	23.0	- 14.0	1.5	- 3.0	3.0	20.0	48.5
2000	IPCC (1999) scaled to 2000	25.0	28.9	-18.5	2.0	- 4.0	4.0	33.9	71.3
2000	TRADEOFF	25.3	21.9	-10.4	2.0	- 3.5	2.5	10.0	47.8

Table 25: Radiative forcings (RFs) from aviation [mW/m^2]. The best estimates for 1992 by IPCC (1999) and two estimates for 2000 are given: one is derived from IPCC (1999) by linear interpolation, the second is based on the mean values resulting from the TRADEOFF project (Sausen et al. 2005). As in IPCC (1999), the TRADEOFF RFs for CO_2, O_3 and CH_4 were scaled by a factor of 1.15 to account for systematic biases resulting from assumptions in the emission inventories. The RFs from O_3 and CH_4 are both a result of aircraft NO_x emissions.

Table 25 summarises the best estimates of radiative forcing (RF) from aircraft emissions reported by IPCC (1999), the TRADEOFF project, and other related research. Reliable RF figures for contrail-induced cirrus clouds are not available and have been omitted. Studies conclude that aviation emissions have a significant impact on climate and that both the direct and indirect effects must be taken into account. Total RF is about 2-4 times higher compared with CO_2 only (IPCC 2001); latest results from TRADEOFF are somewhat smaller (around two times higher).

Although there is a noticeable difference between IPCC (1999) and TRADEOFF regarding the RF of O_3 and CH_4, the actual RF figures (RF_{O3} + RF_{CH4}) correspond closely (about 11 mW/m^{-2}). The most striking difference concerns the estimates of RF from contrails, TRADEOFF reporting a much smaller RF (factor 3-4) compared to IPCC (1999). The figures reported by the TRADEOFF project are based on more observation of contrails, better understanding of formation process, and improved modelling techniques. The RF from aviation-induced cirrus clouds might be as large as the present estimate of total RF (without cirrus). However, our present knowledge about these aircraft-induced cirrus clouds is too poor to provide a reliable estimate of the associated RF (Sausen et al. 2005). Research should be intensified to increase our knowledge of RF from contrail-induced cirrus clouds.

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IPCC, 2001: Climate Change 2001 - The Scientific Basis. Contributions of working group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, UK and New York, NY, USA, 881 pp.

Sausen, R., Isaksen I., Grewe V., Hauglustaine D., Lee D.S., Myhre G., Köhler M., Pitari, G., Schumann U., Stordal F. and Zerefos C., 2005: Aviation radiative Forcing in 2000: An Update on IPCC (1999); Meteorol. Z. (accepted).

Annex 13: Threshold analysis for geographical scope 1 and 3

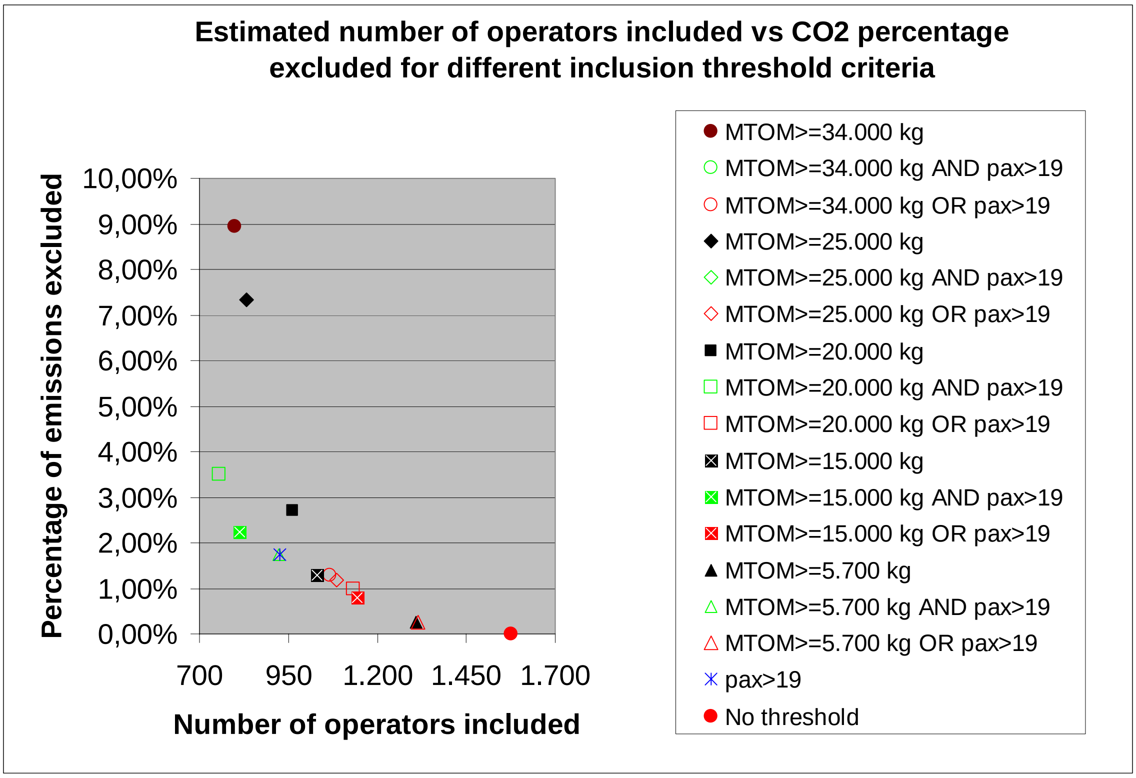

Figure 9: Threshold analysis for intra-EU scope

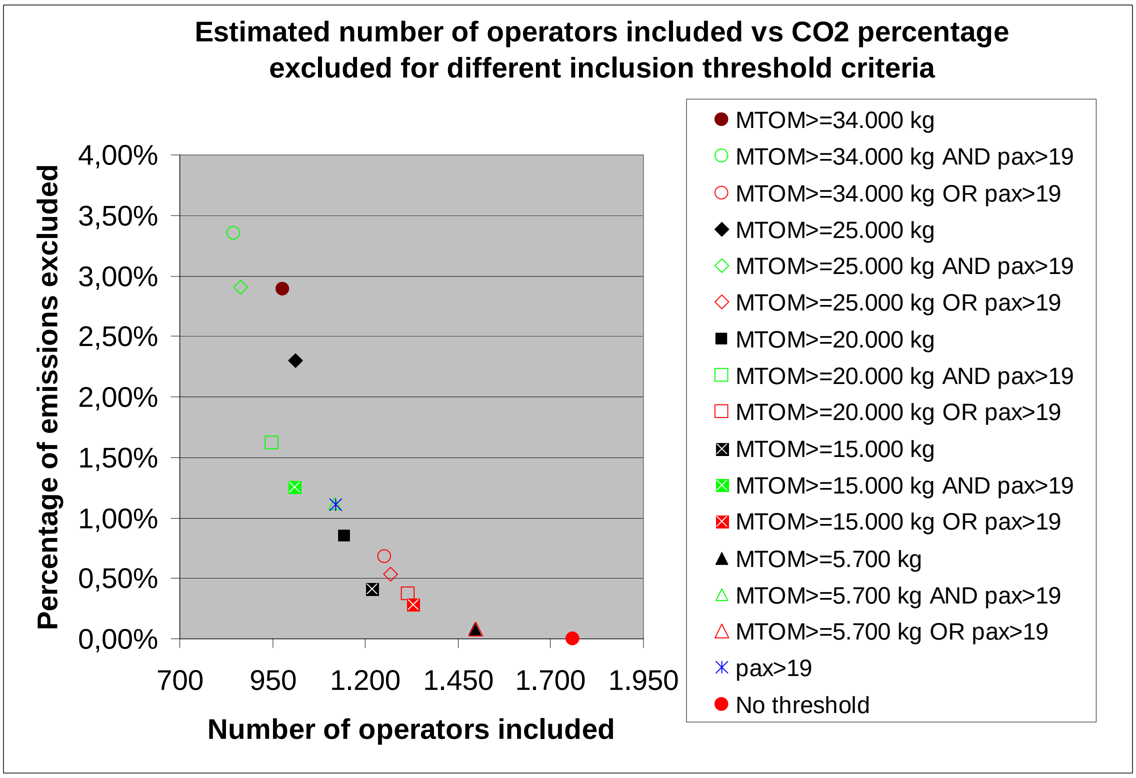

Figure 10: Threshold analysis for "all departing and all arriving flights" scope