EXECUTIVE MBA – MAJOR IN AVIATION INTAKE 2009

TEAM PROJECT RESEARCH

The European directive
To include aviation in the European CO2 Emission Trading Scheme, Consequences and strategic options for the aviation industry

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Foreword

This document is the production of a team of aviation and aerospace industry experts who have joined efforts and know-how for a 4 month strategic planning & research exercise as a part of the HEC Executive MBA – Major in Aviation program*.

In the light of the growing interest over the past ten years in the environmental impact of air transportation, we looked for a study subject that would concern the whole industry, reshape existing business models and create new opportunities while being very topical. We chose to focus on the consequences of the European Union directive to include the aviation sector into the European Union CO2 Emissions Trading Scheme from 2012.

We have tried to analyze both the context and the impact of this regulation on the aviation sector and raise strategic recommendations to stakeholders while identifying potential new business opportunities which remain confidential at this stage.

Input for this report comes from interviews with IATA (International Air Transport Association) executives and the French representative at ICAO (the United Nation body who internationally regulates Civil Aviation). We also interviewed key consultants in the industry and have digested numerous documents, articles and studies.

With the perspective of the upcoming 15th meeting of the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) in Copenhagen in December 2009, the ICAO declaration of 09 October 2009 sets the stage for future development towards a global sectorial approach of CO2 emissions reduction. This approach is backed up by IATA, CANSO, ACI and other international institutions of the aviation sector. However this might not be sufficient to counter other participant approaches such as bilateral agreements which the United States are working on with countries like China and India. Unfortunately to date such approaches have deadlocked without reaching consensus.

Though much will depend of the outcomes of the Copenhagen conference, we can expect the European Union directive to remain the sole international environmental regulation in force in the short term, thus shaping for the better or for the worse this complex business sector.

* http://www.emba.hec.edu

1 Executive summary

Background

Over time the world has witnessed developments that have affected the global aviation industry. In this generation and that of our children, global warming and how to reduce climate change will be such a recurring theme.

Air travel cost today in environmental terms is widely documented as contributing 2% to man made CO2 emissions and increasing at an average pace of 3% a year.

On the positive side, air transport is a pillar of global economy and social development. It is expected that by 2026 air transport will contribute 50 million jobs and around USD 3.6 trillion of GDP to the aviation industry, the associated transport industry and through the contribution of aviation to tourism.

In addition, aircraft fuel burn and emissions have reduced by 70% in the last 40 years. Modern large aircraft now consume around 3.5 liters / 100 passenger km. The next generation of aircrafts and engines target lower than 3.0 liters / 100 passenger km and a further reduction of 15% in the next 20 years.

It is in this context that the European Union has decided to include the aviation sector into the European Union CO2 Emissions Trading Scheme (EU ETS), as an administrative approach to control emissions through economic incentives.

Impact

Under this scheme, airlines are due to start paying for CO2 emissions from 2012. The related costs, be they the direct costs stipulated by the EU or the indirect costs of monitoring, reporting and verification, cannot simply be passed on to the passenger because demand for air travel is very price sensitive.

EU ETS will cost airlines around EUR 2.5 billion in 2012 and EUR 20 billion by 2020. These reductions in profits need to be considered alongside the low profitability of airlines: EUR 4,5 billion of net profits in 2007 – best year – for European airlines.

Being a limited regional approach, EU ETS will also lead to negative competition distortions for European carriers.

The way forward

Affected airlines need to devise innovative strategies based on technology, operations, infrastructure and economic measures to maintain competitiveness under EU ETS. New business models may also appear.

Looking to some of the impressive environmental strategies airlines have in place as well as the strategic positions of major aviation industry stakeholders, we see that continual efforts are being made in fleet management, route and air traffic optimization, fuel conservation and the development of sustainable aviation fuel. At international level it is encouraging to see the added value and enormous potential of programs like SESAR in the EU and NextGen in the USA to improving Air Traffic Management and thus reducing CO2 emissions globally.

One strategic approach for airlines is to look at EU ETS for competitive advantages by renewing fleets sooner, optimizing route planning and networking further or communicating their “green strategies” as positive marketing. Another approach is to integrate carbon price risk with other risk management activities such a fuel hedging in their strategic planning.

Strategic recommendations at airframe and engine manufacturers and at industry level include incorporating EU ETS impact into market forecasts and promoting the introduction and long term sustainability of Jet biofuels while watching over potential business development opportunities opened by the EU ETS.

2 Research analysis

2.1 EU ETS and inclusion of Aviation in EU ETS

On May 1992, United Nations Framework Convention on Climate Change (UNFCCC) was adopted in New York. This international treaty began to consider what can be done to reduce global warming and to cope with it.

On December 1997, after some industrialized countries failed to commit to emissions reduction, parties to the framework convention adopted the Kyoto Protocol, which has more powerful and legally binding measures. The Kyoto Protocol suggests various means, including cooperation mechanisms, namely emission permits, joint implementation (JI) and a clean development mechanism (CDM). This provides the foundation for the European Union Emission Trading Scheme (EU ETS).

On October 2003, an EU Directive established a scheme for greenhouse gas emission allowance trading covering carbon dioxide only and applying to energy activities, production and processing of ferrous metals, mineral industry, pulp and paper. Aviation is not included in this directive. Moreover, the ETS is the main tool established by EU to achieve a low carbon economy with a goal of a 20% CO2 emission reduction by 2020 (on a 1990 base), or 30% if the international community signs up.

On December 2006, European Commission issued proposals to include aviation in the EU ETS, covering all operations within the EU and flights into and out of the EU and including non-EU operators.

Since then, governments are globally moving towards negotiating a post Kyoto framework to tackle climate change. While there is now a global consensus that emission reduction must take place, and the G8 have agreed in principle that a 50% reduction in global emissions by 2050 should be the target, there is still disparity between nations on how this will be achieved. Proposals for a post Kyoto framework, which expires in 2012, need to be agreed at the conference of the UNFCCC parties in Copenhagen in December 2009 (COP15).

2.1.1 What is an Emission Trading Scheme (ETS)?

Emissions Trading is an administrative approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants – which is called cap and trade (see appendix 1 for details).

A central authority – usually a government or international body – sets a limit or cap on the amount of a pollutant that can be emitted. Companies are issued emission permits and are required to hold an equivalent number of allowances (or credits) which represent the right to emit a specific amount. The total amount of allowances and credits cannot exceed the cap, which limits total emissions to that level. Companies that need to increase their emission allowance must buy credits from those who pollute less. The transfer of allowances is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions by more than was needed. Thus, in theory, those who can easily reduce emissions most cheaply will do so, achieving the pollution reduction at the lowest possible cost to society.

There are active trading programs in several pollutants. For greenhouse gases, the largest is the European Union Emission Trading Scheme. In the United States, there is a national market to reduce acid rain and several regional markets in nitrogen oxides. Markets for other pollutants tend to be smaller and more localized.

2.1.2 What is the European Union Emission Trading Scheme (EU ETS)?

The European Union Emission Trading System (EU ETS) is the largest multi-national emissions trading scheme in the world and is a major pillar of EU climate policy. The ETS currently covers more than 10,000 installations in the energy and industrial sectors, which are collectively responsible for close to half of the EU's emissions of CO2 and 40% of its total greenhouse gas emissions.

Under the EU ETS, large emitters of carbon dioxide within the EU must monitor and annually report their CO2 emissions, and they are obliged every year to return an amount of emission allowances to the government that is equivalent to their CO2 emissions in that year. Emission allowances for any plant operator subject to the EU ETS are given out for a sequence of several years at once. Each such sequence of years is called a Trading Period. The 1st EU ETS Trading Period began in January 2005 and expired in December 2007. With its termination, the 1st phase EU allowances became invalid. Between January 2008 and December 2012, the 2nd Trading Period is under way. Currently, the installations get allowances for free from the EU member states' governments. Besides receiving this initial allocation on a plant-by-plant basis, an operator may purchase EU allowances from other installations, traders or governments. If an installation has received more free allowances than it needs, it may sell them as well.

In January 2008, the European Commission proposed a number of changes to the scheme, including centralized allocation (no more national allocation plans) by a EU authority, a turn to auctioning a greater share (60+ %) of permits rather than allocating them freely and inclusion of other greenhouse gases, such as nitrous oxide and perfluorocarbons. These changes are still in a draft stage; the mentioned amendments are only likely to become effective from January 2013 onwards, i.e. in the 3rd Trading Period under the EU ETS. Also, the proposed caps for the 3rd Trading Period foresee an overall reduction of greenhouse gases for the sector of 21% in 2020 compared to 2005 emissions. The EU ETS has recently been extended to the airline industry as well, but these changes will not take place until 2012.

2.1.2.1 Mechanisms

Under the EU ETS, the governments of the EU Member States agree on national emission caps which have to be approved by the EU commission, allocate allowances to their industrial operators, track and validate the actual emissions in accordance against the relevant assigned amount and require the allowances to be retired after the end of each year. The operators within the ETS may reassign or trade their allowances by several means:

- Privately, moving allowances between operators within a company and across national borders
- Over the counter, using a broker to privately match buyers and sellers
- Trading on the spot market of one of Europe's climate exchanges (the most liquid being the European Climate Exchange).

2.1.2.2 Allocation

In order to make sure that real trading emerges and that CO2 emissions are reduced, EU governments must make sure that the total amount of allowances issued to installations is less than the amount that would have been emitted under a business-as-usual scenario. For each Phase, the total quantity to be allocated by each Member State is defined in the Member State National Allocation Plan (NAP).

During Phase I, most allowances in all countries were given freely – known as grandfathering. This approach has been criticized as giving rise to windfall profits, being less efficient than auctioning, and providing too little incentive for innovative new competition to provide clean, renewable energy.

To address these problems, the European Commission proposed various changes in a January 2008 package, including the abolishment of NAPs from 2013 and auctioning a far greater share (ca. 60% in 2013, growing afterward) of emission permits.

2.1.3 Why includes Aviation in EU ETS?

2.1.3.1 Aviation contribution to EU emissions[1]

Regarding Aviation, the rationale for European Community action was analyzed 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% of the EU's value-added, it accounts for about 3% of the EU's direct greenhouse gas (GHG) emissions. If indirect impacts such as NOx emissions are included, 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.

As can be seen in appendix 2, 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.

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

[1] Extracted and summed up from "Impact Assessment of the inclusion of aviation activities in the scheme for greenhouse gas emission allowance trading within the Community" released by European Commission on December 2006

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.

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

The overall objective is 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, "the 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.
- Implementing a better internalization of the external costs of climate change.
- Providing stronger incentives for air transport operators to reduce their impact on the climate.

The Commission concluded "…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". 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.

The long-term goal is to achieve "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 stabilization can take place, followed by emissions reductions.

2.1.4 How to include Aviation in EU ETS?

2.1.4.1 Key characteristics of the Aviation inclusion in EU ETS

From 2012, all flights arriving in or departing from airports in the 27 EU member states (i.e. including trans Atlantic) will be included in the emissions trading scheme.

Each aircraft operator will be regulated and administered by a member state. Small aircrafts and certain flights will be excluded. Airline operator emission allowances will be calculated on 2010 emission levels, before the scheme starts in 2012.

Airline operators will be responsible for monitoring and reporting emissions and compliance with caps for domestic and international flights on a country-by-country basis. If an airline does not have an operating license from a EU country, the country with the highest amount of emissions from flights by that operator in 2006 will have to take supervision of the airline.

The sector benchmark emissions cap – from which future reductions will be measured – for the aviation sector as a whole would be 97 % of 2004 – 2006 average annual emissions in 2012 (the first period) and 95 % for the second period from 2013 to 2020.

In 2012, 85% of the allowances distributed to the operators will be free and 15% will be auctioned. An EU ETS review will determine further auctioning at a later date (likely to get to 100% auctioning by 2020). The EU wants the auctioning proceeds to be spent on climate change mitigation and adaptation measures and to promote research and development (including in particular the aeronautic and air transport sector). They could also be spent to support low-emission means of transport and projects to avoid deforestation.

There is still uncertainty over the exact figures that will be used for the 2004-2006 average for the industry benchmark emissions cap.

Finally, according to the Commission's directive, airlines will be allocated allowances free of charge for each trading phase based on their level of activity in the year ending two years before the start of the new phase. This activity will be assessed by multiplying the total payload (the weight carried) of an airline by the total number of kilometers between airports it travels. In the aviation sector, this is known as 'revenue ton kilometers' (RTK's) or 'ton-kilometers'.

2.1.4.2 Monitoring, Reporting and Verification

To qualify for free allowances, aircraft operators must submit a monitoring ('benchmarking') plan for approval that sets out the measures the operator will adopt to monitor and report ton-kilometer data and emissions data for each flight in 2010.

For the purpose of clarity:

- Ton-kilometers = Distance x Payload, where:
- Flight distance is measured by the great circle distance between two aerodromes plus a real world up-lift of 95km
- Payload is the total mass of freight, mail & passengers (excluding crew) carried. This can be calculated by using either actual measured weight or a default value of 100kg per passenger.

Emissions data are calculated by fuel consumption (including fuel consumed by the auxiliary power unit) multiplied by an emission factor. Default emissions factors are taken from the 2006 IPCC Inventory Guidelines and subsequent updates. Fuel consumed by each aircraft is to be measured by the amount of fuel contained in the aircraft tanks once fuel uplift is complete minus the amount of fuel contained in the aircraft tanks once fuel uplift for the subsequent flight is complete plus fuel uplift for that subsequent flight.

2.1.4.3 Penalties

Failure to submit emissions benchmarking plans by 31 August 2009 and verified monitoring and emissions reports by 31 March 2010 will result in the inability to claim free allowances up to 2020. This means that in order to comply with the ETS, the aircraft operator would have to buy all of its allowances each year at auction.

Whilst the submission of ton-km benchmarking plans is voluntary – but would result in no free allowances being allocated up to 2020 – submission of emissions plans is mandatory. Failure of an aircraft operator to submit an emissions benchmarking report by 31 August 2009 would incur a penalty.

A similar penalty would also be incurred should an aircraft operator fail to submit its verified emissions report by 31 March each year.

Should the aircraft operator fail to submit sufficient allowances before 30 April each calendar year (commencing 2013), then an automatic fine of €100 per ton of CO2 would be payable plus the full current market cost of purchasing outstanding allowances that are due for surrender. Failure to pay fines or surrender sufficient allowances may also result in the withdrawal of the aircraft operator's license and confiscation and sale of its aircraft.

For example, the average fuel burn for an intra-European flight is about 3-4 tons of kerosene, which produces approximately 10 tons of CO2 (see emission factors in appendix 3). Therefore, should an intra-European aircraft operator default on its obligations under the EU ETS, it could face penalties in excess of €1,500 per flight, equating to over €2,000,000 per aircraft per annum. Assuming the cost of allowances will be approximately €30 per ton in 2013, then the additional cost of surrendering overdue allowances would equate to approximately €100,000 per aircraft per annum. For medium and long haul aircraft operators, the cost could exceed two or three times this amount.

2.2 EU directive impacts

As the European ETS has been designed for fixed installations and because of its nature, integrating aviation in the ETS will be problematic and will generate multiple financial and logistic issues, which are detailed hereafter.

2.2.1 Financial impact on aircraft operators

2.2.1.1 Cost for aircraft operators

The inclusion of aviation into the EU ETS will place financial pressures on the profitability of the airlines as it involves the following potential cost factors.

First, airlines will have to purchase carbon credits on the market to cover the CO2 emissions exceeding their free allowances, and these free allowances will still have an associated opportunity cost if they are used to cover operator's emissions instead of being sold. CO2 emissions will therefore become a factor of production such as fuel, labor or capital and thus will have an impact on the profitability.

A report published in July 2009 by Point Carbon estimates the aviation could face a shortfall of 77 million tons of CO2 allowance when it enters into ETS in 2012. This shortfall seems likely to grow in 2013 and over the next decade as the total of allowances is reduced and air transport continues to grow.

Estimating the related cost to individual airlines is very complex, and being based on sensitive assumptions, vary from one source to another (see appendix 4, 5 and 6 for examples). According to Merrill Lynch[2], potential costs to airlines could be over € 2.3 billion in 2012, reaching a € 3.0 billion in 2015, when IATA estimates cost of EU ETS in 2012 will be € 3.5 billion / US$ 4.7 billion.

Whatever their accuracy these figures are very high when compared to the net profits made by airlines in a good year (US$ 5.3 billion in 2007 for European airlines US$ 12 billion in total– source IATA/ICAO) and therefore carbon credit charges may have a strong effect on airlines' financial statements. But on the other hand, the foreseen additional costs are much lower compare to those undergone under the jet fuel bubble in 2008 (US$ 31 billions) and largely responsible for the global industry loss of US$ 10.4 billions this same year.

Second, airlines will have to bear Monitoring, Reporting and Verification (MRV) charges. By August 2009, airlines will have to submit monitoring plans outlining how they will measure their CO2 emissions by defining the exact methodology of how they will go about accurately, reliably and transparently monitoring and reporting CO2 emissions and flown tons/kilometers. This will have to be done in compliance with the very specific and detailed MRV rules from EU and verified by independent accredited verifiers. The accuracy and reliability of these data will be of first importance as from 2011, emission reports, ton/kilometer reports and verification reports will be provided every year to competent authorities to serve as a basis for the emission allowance process. Please refer to appendix 13 for a sample airline CO2 calculation process.

The additional data collection and reporting requirements will add to these pressures from a resource and administrative perspective. In the early years of reporting, operators may have to make IT system changes and maintain a constant dialogue with verifiers in an attempt to develop workable and efficient solutions associated with appropriate internal verification systems. The opponents of the Aviation ETS argue that the administrative costs of the ETS could exceed many times the actual value of carbon credits.

Third, airlines will have to support additional costs for non compliance. As mentioned above, airlines will be forced to purchase an allowance from the free market for every ton of CO2 emitted. In case of non-compliance, a penalty of 100 € per ton of non surrendered allowance will be charged.

And lastly, airlines will have to support the costs of the operational and technical measures needed to reduce emissions, such as fleet renewal, engine retrofits or operation optimization aiming at reducing fuel consumption.

2.2.1.2 Impact on ticket price for passengers and on cargo rates for freight

It is foreseen that airlines will try to offset these ETS costs by passing them through the consumers. This will lead to impacts on ticket prices.

[2] « Aviation in EU ETS; an incentive for efficiency » - Merrill Lynch, 08 September 2008

A first estimate of the additional costs for airlines and passengers was performed[3] and led to the following figures:

- For a Lufthansa short-haul flight from Frankfurt to London Heathrow, the financial burden due to the ETS would amount to about 1,57 € per passenger. For a Ryanair flight from Hahn to London Standsted, the ticket's price may increase by 1,14 € per passenger. This leads to a lower price increase in value for the low cost company, due to its higher load factor. But this increase as compared to the ticket price (relative) would be more important for the low cost company.
- For long-haul flights, the price increase would be around 20 € for a Frankfurt-Singapore flight and around 8,20 € for Frankfurt-Dubai.

Once again, the accuracy of these estimations depends highly on sensitive assumptions and the real figures may largely exceed these estimations due to carbon credit volatility on the market.

2.2.1.3 Impact on air travel demand

This increase of ticket price could have an impact on air travel demand depending on the price elasticity of demand, which points out the relative change in demand in response to a relative change in price. Depending on the price-sensitivity of passengers, the above mentioned increase could lead to a negative impact on air travel demand, especially the leisure one which is traditionally very price sensitive.

Nevertheless, the ETS related effect on the demand may be limited if we consider that in early 2008 the majority of airlines were able to raise additional fuel taxes on ticket price to compensate for higher fuel costs without any significant impact on the demand at that time.

2.2.1.4 Financial, accounting and fiscal impact

From a financial point of view, at this stage, it is difficult for airlines to determine how much emissions trading will cost them, because there are still a number of uncertainties, particularly over the future percentage of emissions that will be subject to auctioning.

From an accounting point of view, at the moment, there is no authoritative accounting guidance within the International Financial Reporting Standards (IFRS) explicitly for transactions involving carbon allowances.

The International Accounting Standard Board (IASB[4]) and Financial Accounting Standard Board (FASB[5]) have launched a joint project on carbon emission accounting models but have not yet published a conclusion. As far as the IASB is concerned, an Exposure Draft should be presented in Q2 2010 and an accounting norm should be available first semester 2011.

This means that, as of today, there is no formal guidance yet to explain to airlines how to account for CO2 allowances, emissions, sales and purchases. In the meantime, companies must interpret the existing standards.

In addition, there are still uncertainties about the consistency between the various accounting frameworks: will the IFRS (International accounting standards), the US GAAP (American accounting principles) or the Singapore GAAP require the same accounting treatment of the Emission Trading Scheme?

From a fiscal point of view, there is still the question about differences between corporate tax treatment and accounting treatment. Even if the accounting rules were defined, how would be the fiscal rules according to ETS? And what would be the tax impact on such ETS?

Furthermore, though we can expect CO2 allowances as assets to mark the value of an aircraft operator on the mergers and acquisition market, it is still very difficult at this stage to evaluate such an impact. In case of merger or acquisition, the question will be how to assess the value of these assets during the due diligence process and how to transfer these assets from an airline to another?

[3] « European Commission Plans Emission Trading for Aviation Industry – A First Estimate of the Additional Costs for Airlines and Passengers » - Aerlines, e-zine edition, Issue 36

[4] IASB : International accounting standard setter

[5] FASB : American accounting standard setter

2.2.2 Involved competition distortion between operators

The new rules imposed by the inclusion of aviation into the EU ETS and the additional costs induced will also have a direct impact on the competition that is taking place between operators on the transportation market.

2.2.2.1 Business model competition between airlines

As mentioned above, in case of a ticket price increase, the capacity to pass the ETS cost through passengers could differ between the low cost carriers and legacy carriers due to the passenger price-sensitivity which is stronger for low cost consumers.

Besides, due to their cost structure, low cost carriers as well as small business jet operators may suffer from the cost burden of developing an efficient MRV process while bigger companies will have the means to develop robust data management systems that meet the ETS requirements.

Another important distortion factor will be the change of relative competition between operators in favor of those environmentally efficient who will be able to reduce their CO2 emission and pay less compare to the others. This can stand for an extra advantage for airlines with a younger hence more fuel efficient fleet and benefit to low cost carriers whose fleet average age is much lower than the mainline carriers' one.

On the opposite, developing countries airlines with ageing aircrafts are likely to be the hardest hit due to their high emissions profile.

Besides, growing airlines, particularly those growing after the 2010 benchmark year are exposed to significant ETS costs.

2.2.2.2 Competition between EU airlines and non EU airlines

The Aviation ETS will also place the European airlines at a competitive disadvantage against non-European rivals, because the European operators will have to bear the financial costs of their emissions for their entire network, whereas the non-EU carriers will be subject to this Directive only for a small part of their operations.

The non EU carriers will hence be able to absorb the extra cost induced on this small part by spreading it over all their flights. Cross-subsiding will allow them to limit air fare increases on the EU flights they operate and therefore will give them a competitive advantage to develop their market share on EU routes.

Moreover, the response of non EU based carriers might be to deploy their newest and cleanest aircrafts on routes falling under the scheme, while diverting older aircrafts to other routes.

Another problem may arise from countries like Switzerland, which is, on the one hand, not a member of the European Union and therefore not participating in the EU ETS, but, on the other hand, fully integrated in the EU air transport market with regards to safety regulations or market access. Furthermore, its central geographical position in Europe may result in a competitive advantage for airlines having their hub or home base in Switzerland. This case also applies, to a lesser extent, to Norway[6].

2.2.2.3 Hubs/airports competition between airlines

The Aviation ETS will also have impacts on the competition between airlines related to hubs and airports. Indeed, according to a study[1], the ticket price for a round trip non stop flight between Frankfurt and Singapore would increase by 40 € whereas on the same trip via Dubai hub, the increase in fares would amount to slightly more than 16 €.

This difference is explained by the fact that, in the second case, only roughly half of the flight distance is subject to the EU ETS. It can be expected that such effects could have an influence on the airline choice made by price sensitive passengers.

Even stronger price differences are likely to occur for intercontinental transfer passengers, traveling for instance between the Americas and Africa or Asia via European hubs. On a trip, from the US to India via a hub in the EU, all flight segments would be subject to the EU ETS. This may result in a price increase of up to 60 € due to the ETS, while the same trip via any non-EU hub would be free of any ETS-related costs.

[6] « European Commission Plans Emission Trading for Aviation Industry – A First Estimate of the Additional Costs for Airlines and Passengers » - Aerlines, e-zine edition, Issue 36

At the end of the day, this could lead to a competitive advantage for carriers on the Arabian Peninsula, serving cities as far as New York City, Houston, Toronto or Sao Paulo with non-stop flights and offering connections via their hubs in Abu Dhabi or Dubai to a large number of destinations in Asia and Africa[7].

2.2.2.4 Competition distortion, traffic diversion, carbon leakage– the ETS pernicious effects

All the examples above show that it will be difficult to include aviation into the EU ETS without causing any competitive distortions for EU-based airlines and hubs. Competitive distortions can only be avoided completely by introducing a global emission trading scheme for aviation.

The EU ETS can as well lead to traffic diversion to non EU countries or to other modes of transportation. Indeed, air freight and passengers originally departing from an airport falling inside the geographical scope of the ETS may, following its introduction, be first transferred by surface transport to airports just outside the EU to be then flown to their final destination.

Besides, polluters can simply move their emission to another part of the world to avoid paying for them. This known as emission leakage and it reduces the environmental benefit of the policy.

Ultimately, there could be a loss of jobs and reduction in service as international passengers bypass European hubs indicates Andy Kershaw, British Airways climate's change manager.

2.2.3 Influence on aircraft operators' relationship with other stakeholders of the industry

In order to reduce their ETS costs, airlines will also turn to other stakeholders of the industry such as aircraft or engine manufacturers, airport or air traffic controllers, to devise technical or operational solutions to cut their CO2 emissions through fuel efficiency improvement.

2.2.3.1 Manufacturers

Today's modern aircrafts consume average 3,5 liters per 100 passenger kilometers. This is similar to a small compact car but with 6 times the speed. Next generation aircrafts B787 and A380 are targeting fuel efficiencies below 3,0 liters per 100 passenger kilometers[8] and additional improvements are foreseen for future aircrafts or engines to achieve an additional 15% in the next 20 years. Please refer to appendix 7 for aircraft fuel efficiency trend illustration.

Aircraft manufacturers

Before investing on new aircrafts, airlines will check whether the expected fuel savings would be large enough to offset the cost of fleet renewal.

According to Merrill Lynch[9], this should be true for wide-bodies, but less sure for narrow-bodies. As a matter of fact, the European wide body fleet is from a relatively old design compared to the fuel reduction opportunity offered by recent airframes and engines, whereas most of the improvement on the narrow bodies could come from the engine technology upgrade rather than from the airframe one. Thus, the ETS impact for aircraft manufacturers should be a strong and solid wide-body growth ahead but a limited incremental demand for narrow-body aircrafts.

Aircraft manufacturers will also undergo an increased pressure from airlines to develop more fuel efficient aircrafts by making use of already existing technological innovations such as lighter materials, improved aerodynamic designs, winglets or drag reduction devices.

Regarding the narrow bodies, the airlines may also proceed to a short-term sizing up of their fleet to achieve a better fuel efficiency per seat. This could imply some shift within the European airlines' narrow body order book, as the A318/319 could look much less attractive than the A320/321, as it would be for the B737-700 compared to the rest of the B737 family. On a long-term point of view, an increase in the number of seats could ultimately determine the next-generation single aisle airframe design.

IATA estimates that airlines will likely need to spend a US$ 1.5 trillion on new aircraft by 2020, which will result in a 21% reduction of CO2 emission compared to a scenario without fleet renewal. This means 5 500 aircraft will be replaced by 2020, or 27% of total fleet.

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[7] « European Commission Plans Emission Trading for Aviation Industry – A First Estimate of the Additional Costs for Airlines and Passengers » - Aerlines, e-zine edition, Issue 36

[8] "Building a greener future", IATA, October 2008

[9] "Aviation in EU ETS, an incentive for efficiency", Merrill Lynch, September 2008

Engine manufacturers

Engine manufacturers have proved over the past decades their capacity to make technological progress toward more fuel-efficient engines by achieving a nearly 70% reduction of fuel consumption in the last 25 years.

Airlines will surely apply strong pressure on them to speed up the development of future emission efficient technologies such as geared turbofans, advanced turbofans or open rotors, and to foster their implementation into the next generation of commercial airliners. The demand for engine upgrades will also increase, especially for narrow-bodies, for which engine retrofit should be performed.

2.2.3.2 Fuel suppliers

Fuel suppliers will be involved as well in the global Research & Development effort of the industry to find technological solutions to reduce aircraft emissions and improve fuel efficiency. Alternative fuels, such as biofuels might be good candidates as recent tests have demonstrated that a reduction of 80% of CO2 emission can be achieved.

Both Airbus and Boeing have completed their first flight tests using fuels issued from hydrogenated vegetable oil or biomass. The target is to increase the use of alternative (synthetic or biomass) fuel by 25% in 2025. However this could be a long term process as ways to supply the quantity needed would require new investments and new infrastructure[10].

Aviation biofuels development will request that policy makers support industry R&D efforts by providing funds to scale-up pilot projects and demonstrate commercial viability.

Assuming availability of a 6% mix of 2nd generation (sustainable) biofuels by 2020, this would reduce aviation CO2 emissions by a further 5%, requiring industry and government investments of US$ 100 billion[11]. Furthermore, IATA has set a target to be using 10% alternative fuel by 2017[12].

Please refer to appendix 8 for additional details about biofuels.

2.2.3.3 Airports

A lot of the fuel savings and therefore the CO2 emission savings can also come from improved operational procedures for aircrafts either in flight or on the ground.

An optimized ground traffic management can lead to the reduction of taxiing time thus reducing the associated CO2 emissions. Airports can provide the relevant ground infrastructure improvements to address the airport capacity crunch and avoid ground traffic congestion.

Furthermore, the ground usage of APU or engines can be reduced through the implementation of additional electrical power points at parking stands or the extended use of push-back tractors during taxiing.

We can expect airlines to push airports to make these operational improvements and ground investments that will reduce their carbon bill.

2.2.3.4 Air navigation service providers and other stakeholders

With respect to flight operational procedures, fuel burn reductions and therefore CO2 emission reductions can be achieved at every step of a flight. Optimized take off procedures can lower both noise and fuel burn. The introduction of Reduced Vertical Separation Minima (RVSM), which shorten the vertical distance between aircraft, along with optimized flying routes (more direct), can lead to significant fuel savings while cruising. And during descent and landing, the implementation of a continuous descent process would also substantially cut fuel burn down.

According to ICAO's CAEP (Committee on Aviation Environmental Protection) unit, all these improvements in air traffic management could reduce aviation fuel burn by between 8-18%. Nevertheless, achieving such performance based navigation would require efforts from all sections of the industry (airports, unions, air navigation service providers, airlines, ICAO and governments) to be combined into large and sufficiently funded projects.

[10] "Aviation in EU ETS, an incentive for efficiency", Merrill Lynch, September 2008

[11] "4th Aviation & Environment Summit held in Geneva from 31 March to 1st April 2009- Summit Communiqué", Paul Steele, Executive Director

[12] "Aviation and climate change – Pathway to carbon neutral growth in 2020", IATA, July 2009

Such projects are under development at this stage with Single European Sky (SES) and Single European Sky Air Traffic Management Research (SESAR) in Europe or NextGen in the US.

- Single European Sky

As of today, the fragmentation of the European airspace places a huge burden on:

  - Passengers: delays are caused by bottlenecks in the sky, circuitous routings and holding patterns above airports
  - The environment: there are unnecessary emissions of CO2
  - The airlines: that bear unnecessary costs

Single European Sky[13] is an ambitious initiative launched by the European Commission in 1999 to reform the European Air Traffic management (ATM). It puts forward a legislative approach to meet future capacity and safety needs at a European rather than at a local level. The main objectives are:

  - To restructure European airspace as a function of air traffic flows, rather than according to national borders
  - To create additional capacity
  - To increase the overall efficiency of the air traffic management system

IATA claims that the program could save 12 million tons of CO2 and reduce drastically the 21 million minutes of delays experienced last year.

- SESAR

The Air navigation services and their support systems are not fully integrated and are based on technology, which is already running at a maximum. In order to accommodate future Air Traffic needs, a major change with an innovative technology is required.

SESAR aims to eliminate the fragmented approach to European Air Traffic Management (EATM), transform its system, synchronies all stakeholders and federate sources. With the necessary support and regulatory measures, SESAR will re-engineer the European ATM network to achieve environmental sustainability, efficiency and full integration and cost-efficiency, resulting in maximum safety.

- NextGen

NextGen is the sister initiative from across the Atlantic for global harmonization. The objective of this initiative is to transform the US air transportation system to meet the needs of 2025 while providing substantial near-terms benefits

According to IATA, the Single European Sky (SES/SESAR; 70% cut in route extension), Next Generation ATM in the USA (57% delay reduction), Pearl River Delta, RVSM over Russia, flex tracks, etc., would require investments of $58 billion[14].

We can expect the airline industry to foster these programs and call on air navigation service suppliers and governments to speed up and fund these programs that could lead to significant CO2 emission savings.

- Governments

Governments should be key actors of some of the initiatives mentioned above. They could establish the right legal and fiscal frameworks to facilitate and increase investment in new aircraft fleets, low carbon sustainable alternative jet fuels, as well as the potential use of cost-effective economic measures and full and unrestricted access to all available abatement measures outside the sector (offsets) [15].

They could also be the last resort to help impoverished airlines with financing the acquisition of new engines and aircraft or to allow airports to raise the funds to update stationary equipments.

[13] www.eurocontrol.int

[14] "Aviation and climate change – Pathway to carbon neutral growth in 2020", IATA, July 2009

[15] "Aviation and climate change – Pathway to carbon neutral growth in 2020", IATA, July 2009

2.3 Aviation industry stakeholders' position and strategy about EU directive

The political context of the aviation ETS directive is as complex as the aviation industry sector is, involving many stakeholders and international organizations with different positions and strategies with respect to that directive.

2.3.1 EU

2.3.1.1 EU Position: Include the aviation in the EU ETS in order to achieve its commitment

As international action to combat aviation emission has been limited in the ten years since the Kyoto process began, with no compulsory targets, emission trading, taxes or levies in place, the EU has decided to respond unilaterally[16].

The EU intends to "show world leadership on climate change and to help meet an internal goal to reduce greenhouse gas levels by at least twenty percent compared with 1990" by incorporating aviation into its existing ETS.

The EU Commission's Head of Unit for Clean Air and Transport further admits that Europe has agreed to a twenty percent reduction in greenhouse gases by 2020, which "has to come from somewhere." Whatever the reason, it appears that the EU has found a means to help it achieve its Kyoto Protocol emissions reduction target by incorporating the aviation industry into the existing EU ETS by the end of Phase II.

The absence of policies in place to actively address aviation emissions has led the EU to be highly critical of ICAO's role in tackling the issue.

2.3.1.2 EU Strategy (solutions)

EU intends to use the existing EU ETS framework to include worldwide airlines in the EU ETS and put pressure on other countries to adopt similar rules to achieve emission reductions. Despite complications relating to the international nature of the emissions for aviation, the EU Commission wishes to ensure all sectors are playing their fair role in mitigating emissions.

Members of the European Parliament admitted that although incorporating aviation "may not be the most effective tool to combat aviation emissions, it is among the most politically expedient."

2.3.2 ICAO

2.3.2.1 International Civil Aviation Organisation (ICAO) and environment

The International Civil Aviation Organization (ICAO), a specialized agency of the United Nations, was created with the signing in Chicago, on 7 December 1944, of the Convention on International Civil Aviation, which established the legal grounds for operation of international civil air services. With 190 contracting states as of 1 January 2009, ICAO is the permanent body charged with the administration of the principles laid out in the Convention[17].

ICAO's activities in the environment field are primarily focused on those problems that benefit most from a common coordinated approach, on a worldwide basis, namely aircraft noise and the impact of aircraft engine emissions.

Most of this work is undertaken through the ICAO Council's Committee on Aviation Environmental Protection (CAEP), which consists of Members and Observers from States, intergovernmental and non-governmental organizations representing aviation industry and environmental interests.

2.3.2.2 ICAO position and strategy (please refer to appendix 9 for details)

In September 2007, ICAO Council formed a new Group on International Aviation and Climate Change (GIACC) tasked to develop an aggressive Program of Action on International Aviation and Climate Change. Amongst several general statements and a basket of technical measures, outputs included two quantitative targets:

- The improvement of energy efficiency of 2% per year from 2012 to 2050

[16] Aviation and Climate Change, Alice Bows, 2009
[17] ICAO web site : www.icao.int

- Carbon neutral international aviation in 2020

It also acknowledged the idea of an aviation ETS as the best economical measure to reduce C02 emissions within a global framework to be defined by ICAO.

These outputs were validated end of June 2009 by the Counsel (36 States) and a Top Level Executive Meeting that will take place in October 2009 is to confirm this action plan with the 190 member States. Then, in December 2009, during Copenhagen 15, ICAO will present to UNFCCC its position and strategy, which are largely supported by the main aviation industry bodies such as IATA, ACI or CANSO.

2.3.3 IATA

IATA (International Air Transport Association) was founded in Havana, Cuba, in April 1945 as the prime vehicle for inter-airline cooperation in promoting safe, reliable, secure and economical air services worldwide. Today it has some 230-airline members from 126 nations and describes its mission as to "represent, lead and serve the airline industry" [18].

2.3.3.1 IATA position (please refer to appendix 10 for details)

As Charlotte Fantoli, Manager Industry taxation for IATA, states: "IATA is totally opposed to any form of fee that does not reinvest the revenue in the aviation industry. Such a fee is in contradiction of ICAO principles. Any government decision leading to an increase of the costs of air travel imposes a new barrier to the development of the aviation and tourism industries".

"The air industry having to absorb more taxes means that it will have fewer resources to invest in growth and remain financially stable. With airlines struggling to regain profitability since 2001 the last thing needed is to be hit with discriminatory taxes that treat air travel. IATA is strongly against these tax initiatives."

IATA agrees with ICAO that a global sectorial approach is the best option for aviation and believes that managing CO2 emissions reduction could be performed without restrictive economic measures (such as the ones imposed by EU ETS). They also consider that a global ETS should be seen as a part of a global package of measures to reduce CO2.

IATA cannot support the EU ETS, as it does no longer allow airlines to have the most effective outcome. In addition, the EU Directive would need some harmonization and some simplification, as IATA considers the EU ETS requirements to be very complex and unclear.

2.3.3.2 IATA strategy

According to IATA, the key principles for a global sectorial approach for aviation should be the full integration of aviation emissions in the UNFCCC framework with ICAO leadership in the UNFCCC process.

IATA believes that there should be the principle of equal treatment versus differentiated responsibilities integrated in a basket of measures with the active involvement of governments. IATA also advocates cost-effective economic measures with the use of ETS revenues to sponsor emission reduction plans.

IATA's strategy for addressing the industry carbon footprint is based on 4 pillars:

- Technology

IATA advocates accelerated development of cleaner, alternative fuels and more advanced technology for air traffic management, airframes and engines. IATA, manufacturers and fuel suppliers are jointly working on an action plan focusing on short, medium and long-term measures.

- Operations

IATA is compiling industry best practices, publishing guidance material, conducting airline visits and establishing training programs to improve existing fuel conservation measures.

- Infrastructure

Infrastructure improvements present a major opportunity for fuel and CO2 reductions in the near term. By addressing airspace and airport inefficiencies, IATA considers that governments and infrastructure providers could eliminate up to 12% of CO2 emissions from aviation.

[18] IATA web site : www.iata.org

- Economic Measures

IATA advocates the use of tax credits and direct funding as incentives to drive new technology programs. Emissions trading could be a more cost-effective solution as part of a global package of measures including technology, operations and infrastructure improvements.

2.3.3.3 IATA and COP15

On September 22, 2009, IATA presented its proposals for December's climate change talks to the UN Secretary General's Summit on Climate Change in New-York. The aviation sector is united in calling on world leaders to retain a global sectorial approach to reducing aviation emissions under the leadership of ICAO, working in cooperation with the sector through IATA.

2.3.4 Other organizations

2.3.4.1 FAA

The Federal Aviation Administration (FAA) is an agency of the United States Department of Transportation with authority to regulate and oversee all aspects of civil aviation in the U.S.

FAA is concerned that aviation could be subject to a California emissions cap-and-trade program, especially if the state decides to link its program with the European Union's Emissions Trading Scheme.

A report prepared for the California Air Resources Board, a division of the state's Environmental Protection Agency, recommends creating a cap-and-trade system that eventually would extend to all greenhouse gas-emitting industries. Transportation, which includes aviation, is the largest contributor of greenhouse gases in the state, accounting for 40% of the total.

The report suggests that linking a California emissions plan with other programs "demonstrate[s] the compatibility of systems and increase[s] the likelihood of a national system." Linkage to other programs would increase the economic efficiency and environmental benefits of a California system. In order to "promote a global carbon market," a California emissions trading system should "encourage linkage only with other mandatory systems, including the existing EU ETS," the report says.

If California's plan is fuel-based, domestic airlines can circumvent it by buying fuel in other states and tankering it into the state. Thus, the report recommends using flight tracking data and jet fuel burn rates to track downstream emissions for flights into, out of and within California.

FAA opposes the plan, particularly the proposal to link to a non-U.S. program. "Aircrafts are highly mobile sources that cross not only state but national boundaries each day," FAA spokesman Hank Price said. "Even without legal constraints, it makes little sense to manage this highly mobile source through one state's decision for an emissions trading system."

Price said, "Aircraft emissions standards are set nationally and aircraft are pre-empted from state regulations." [19]

European leaders expressed interest in linking the EU ETS with a California plan in 2007[20].

Now in 2009, the US legislative process is just starting. In mid-May, a 900+ page bill (HR 2454) was released for consideration and debate this summer. The goal is to pass it this year. The proposed legislation has a potential profound impact on business and general aviation because of the proposed future caps. The overall goal is to reduce CO2 emissions in 2050 to 17% of what they were in 2005. The intermediate goals are as follows: 97% of 2005 CO2 levels in 2012, 80% in 2020 and 58% in 2030.

The FAA is against EU ETS because they want to avoid California joining a similar system. EU-ETS and US-ETS harmonization will largely depend on the outcome of the UN Climate Change Conference in Copenhagen December 2009

Besides, US House recently passed domestic cap and trade. On June 26, 2009, the US House of Representative voted in favour of creating a domestic cap and trade programme for greenhouse gas (GHG) emissions. The House bill also directs the Environmental Protection Agency (EPA) to create emissions standards for new aircraft and new engines by

[19] Aviation Week July 2007
[20] Aviation Daily July 2007

December 31, 2012. Targets include cutting emissions below 2005 levels by 3% in 2012, by 17% in 2020, by 43% in 2030 and by 83% in 2050[21]. The Environmental Protection Agency would consult with the Federal Aviation Administration in setting the aircraft emissions standards, according to the bill.

At the same time, the bill calls on the US to promote, via ICAO, a "global framework" to regulate civil aircraft GHGs.

2.3.4.2 ACI

Airports Council International (ACI) is a non profit organization, whose prime purpose is to "advance the interests of airports and to promote professional excellence in airport management and operations."[22]

Emissions from fuel combustion in aircraft represent 2 to 4 percent of the total global GHG inventory. Based on airport emission inventories prepared to date, emissions from non-aircraft airport-related operations represent an additional 0.1 to 0.3 percent of the global total.

One of the most significant sources of emissions is related to transportation of employees and passengers to and from the airport, and they may be accounted for elsewhere in "on road" transportation emissions inventories. While the airport contribution can be relatively small, many improvements can still be made.

ACI maintains that it is important to distinguish between aircraft emissions and those emissions directly associated with airports. Most discussions of the impacts of global aviation emissions refer to aircraft emissions.

The best approach for addressing aviation's climate change emissions, including those from airports, is a long-term strategy that identifies and phases in environmentally effective, economically efficient, and politically viable measures for each category of emissions. The first step is to identify emission sources and their contributions, so that emissions reductions can be implemented. CO2 is the most common GHG, and it may serve as the best starting point for an airport GHG inventory.

ACI position with respect to the EU ETS is to say that the main emissions are due to aircraft and not to airports. Though they do not feel concerned, they are going to support IATA and ICAO positions.

2.3.4.3 CANSO position and strategy

Civil Air Navigation Services Organization (CANSO) represents air navigation service providers throughout the world. It was established in January 1998. CANSO has two categories of membership: Full and Associate. Full members are organizations established for the provision of air navigation services. As of April 2009 there are more than 50 full members. Associate members may be any other organization, including suppliers of goods and services to the broad ANS industry, academic institutions and aircraft operators.

- CANSO position

CANSO members maintain that aviation is a global industry and that global measures create a fair and equitable market environment. CANSO believes that an Emissions Trading Scheme is preferable to further taxation on air transport, but it should be designed in such a way as to ensure global participation and deliver genuine reductions in emissions. The political priority should be to encourage practical schemes to reduce CO2 wherever possible. In Europe this includes Single European Sky which offers a huge opportunity to achieve considerable emissions reductions, through optimized and efficient use of airspace across the EU. Regretfully longstanding political hurdles continue to keep Air Navigation Service Providers from realizing the maximum benefit of Single European Sky.

In view of the EU ETS decision, CANSO Members are concerned that there has been no study of the impacts of an ETS on flight-efficiency and airspace capacity around the periphery of the EU. The re-routing of aircraft to avoid European ETS airspace will have implications for capacity, and could have negative environmental impacts if aircraft have to fly further to avoid a European charge. [23]

CANSO is not comfortable with EU ETS, as the organization is more interested in SESAR and wants to see more emphasis on efficient routine. According to CANSO, the EU ETS is not the right solution.

- CANSO strategy

[21] Air Transport Intelligence news, June 2009

[22] ACI policies and recommendations handbook 2008

[23] CANSO press release November 2008

On the 9th September 2008, the IATA, the CANSO and Eurocontrol signed a five-point Flight Efficiency Plan to implement short-term measures to reduce annual fuel consumption in European airspace by 470,000 tons, which would save an estimated 1.55 million tons of CO2 emissions per year. Airlines could hope to be able to trim their fuel bills by around 390 million euros based on today's prices.

However, the Flight Efficiency Plan is seen as having little overlap with SESAR and yet is expected to achieve nearly 10% of SESAR's emissions-reduction target within 18 months.

2.3.5 Airlines

2.3.5.1 European airlines

The European airlines are the most influenced by the EU ETS for natural reasons; therefore they've been spending biggest efforts to improve the EU Directive. The peak of criticism was in 2006-2007, while the authorities were still hesitating about scheme launch. For example Lufthansa's CEO Mr. Wolfgang Mayrhuber said he was considering repositioning airlines German hubs to Switzerland in order to avoid emission charges.

Despite the criticism, the EU ETS plans remained unchanged. At the same time, public concern over environmental problems became much higher in 2007-2008, so airlines changed their attitudes to environmental policy completely, making it one of the cornerstones of customer communication strategy. Starting with TAP – Air Portugal in June 2009, several airlines have launched Emission offset programs designed by IATA, allowing their customers to pay for their carbon footprint.

Failing to prevent ETS launch in EU, the European carriers now promote spreading carbon trading to the world level, in order to avoid uncompetitive position. The common view of European airlines, represented by Association of European Airlines (AEA), for a global approach is based on the following key elements:

The International aviation should be included as a sector in any post-Kyoto multilateral agreement on climate change. It is ICAO's role and responsibility to represent the aviation sector at the Copenhagen negotiations.

With a global approach, there should be the reconciliation of the Chicago principle of non-discrimination between operators and the Kyoto principle of differentiated responsibilities between countries. More than that, AEA believes that the countries should be grouped into three blocks according to the maturity of their aviation activities and market and that a differentiated target-setting should be implemented for the three blocks, but with an equal treatment of all air carriers operating within the same block.

AEA has developed a concept that moves away from individual states to a global-sector wide approach. The concept adheres to the Kyoto principle of common but differentiated responsibility and allows for different levels of environmental stringency, depending on the stage of economic development, without causing competitive distortion[24].

Looking closer at the airlines position and strategy relating to EU ETS, the major carriers fully describe their environmental strategy and their fleet strategy to reduce CO2 emission. They do not hesitate to point out their concern about this issue, mentioning facts and figures to justify the outcome of their actions.

- British Airways
    - Environmental strategy

British Airways now claims that it aims to be the world's most responsible airline. To this end, the environment is one of the prime areas on which it focuses as part of its "One Destination" corporate responsibility program.

British Airways has already delivered a 28 per cent improvement in fuel efficiency since 1990 – equivalent to three times its annual carbon emissions.

In 2001, British Airways joined the UK Emission Trading Scheme (ETS). The company was asked by the UK Government to set voluntary emission reduction targets covering its domestic air services and UK facilities. During this time it reduced CO2 emissions by 23 per cent. Its ultimate aim is to reduce net carbon emissions by 50 per cent by 2050 with an intermediate goal of becoming 25 per cent more carbon efficient by 2025.

[24] "AEA outlines global emissions trading scheme for aviation" – Flightglobal, March 23, 2009

These goals will be achieved by concentrating on four main areas: investing in cleaner aircraft, promoting the use alternative fuels, using more efficient flight routings and operational procedures and campaigning for the spread of emissions trading from Europe to the whole world.

- Fleet management strategy and other actions taken to reduce CO2 emissions

British Airways has orders for new cleaner, quieter Airbus A380s and Boeing 787s, which will reduce emissions by up to 30 per cent per aircraft. It is working with engine manufacturer Rolls-Royce on a test program on practical alternative fuels to jet kerosene. Progress in this area has been very encouraging.

The airline is also trialing various procedures to improve operational performance and reduce fuel burn - taxiing aircraft with one engine switched off, for example, and testing advanced navigation systems to aid aircraft arriving at Heathrow.

British Airways was the first airline to offer customers the chance to offset their flight emissions, and the first airline to produce an environmental report, back in 1992, and has done so annually since.

British Airways is a member of the Aviation Global Deal Group, which is calling for carbon emissions from international aviation to be included in a new global climate deal. The airline believes carbon trading is the most effective and economically efficient way to reduce net carbon emissions.

- Position regarding EU ETS

Jonathon Councell, British Airways' Head of Environment said: "We do wholly support a trading scheme because it incentivises companies to develop more carbon efficient technology. The most effective way to have the world reduce its carbon emissions is to put a price on carbon and provide a financial and economic incentive for people to reduce their emissions. *And* because aviation competes globally it doesn't make sense to include aviation in climate change national policies which is why we are pushing for a global sectorial approach[25]".

- Air France KLM
  - Environmental strategy and CO2 emissions reduction

Air France reduced its fuel consumption and carbon dioxide emissions by 12% between 2000 and 2006 with similar improvements expected by 2012 due to the introduction of new aircraft, the actions taken to save fuel such as: reducing taxiing and waiting times, cutting aircraft weight through lighter seats and onboard equipment, adapting flight procedures to ensure more direct routes and continuous descent approaches; and other actions taken to reduce CO2 emission.

In its Corporate Social Responsibility Report, Air France – KLM indicated some Initiatives to cut CO2 emissions in all its activities such as fleet renewal/fleet modernization, flight optimization/fuel efficient operations, reducing the impact of ground operations, reducing fuel consumption/fuel efficient operations, optimizing airspace, improving air traffic management.

- Position regarding EU ETS

Air France-KLM made a public statement relating to EU ETS in its Corporate Social Responsibility Report 2008-2009, indicating that: "the Group supports the principle of ETS, as taxation is generally not a solution that generates environmental benefits. It will continue to try to ensure that the ETS applies to non-EU traffic, so that it will not distort competition or divert traffic to non-EU hubs. The revenues generated by government as a result of auctioning of emissions rights should be allocated to combat climate change within the sector, e.g. by modernizing air traffic management stimulating innovation to reduce CO2 emissions".

As such, Air France-KLM is determined to play its allotted role in combating climate change. The Group supports the integration of international air transports, at the December 2009 United Nations Conference in Copenhagen, in an industry-specific agreement that is effective, pragmatic and fair.

2.3.5.2 US airlines

Air Transport Association (ATA) and its airlines are strong supporters of improved GHG efficiency, but express grave concerns about the application of one-size-fits-all cap-and-trade legislation to airlines. Such legislation would operate as an additional tax on aviation, siphoning away the very funds that the airlines need to invest in new aircraft and other advances. The arguments are:

[25] http://www.newenergyworldnetwork.com/alternative-energy-knowledge-bank/newnet-csr-profile-british-airways.html

- The U.S. airlines have a strong environmental track record. And it's getting even stronger.
- The airlines already are motivated by market forces to improve fuel and GHG efficiency.
- If such legislation is to be applied, it should be carefully calibrated to take key considerations into account.

Meanwhile ATA called European Aviation Emissions Trading Scheme 'Contrary to International Law and Bad Policy': these measures threaten to stifle the growth of the industry, compromise our environmental progress and, ultimately, raise prices for consumers, leaving them to take alternative, less safe, higher emitting modes of transportation.

- American Airlines
    - Environmental strategy

In 2007, American Airlines established a long-term goal of increasing fuel efficiency 30 per cent between 2005 and 2025. American Airlines remains committed to this goal despite the difficult times the company, as well as the rest of the airline industry, is enduring. After three years, efficiency improved 3.2 per cent versus a target improvement of 4.5 per cent. The airline has a plan to get itself back on track.

    - Fleet management strategy and other actions taken to reduce CO2 emissions

Its fleet replacement program began in 2009 with the delivery of new Boeing 737s to replace its less efficient MD80s. In coming years, American Airlines will also take delivery of 42 Boeing 787 "Dreamliners", which Boeing promised to be the most efficient aircrafts of their size. These modern 737s and 787s are also expected to be a great deal quieter than the aircraft they replace.

Meantime, the airline is also adding winglets to its established aircraft – and these not only save fuel burn but also make them quieter too.

American's Fuel Smart program has matured into a steady source of fuel savings initiatives that in 2008 resulted in a reduction of 111 million gallons of fuel. The goal is to increase this to 120 million gallons by the end of 2009.

American Airlines actively participates in industry efforts to promote environmentally friendly alternative fuels. The airline continues to work with the Commercial Aviation Alternative Fuels Initiative (CAAFI), which is a consortium of airlines, government agencies, manufacturers, airports, and current and prospective fuel suppliers.

2.3.5.3 Asian & Pacific airlines

Association of Asia Pacific Airlines (AAPA) blasted EU Directive in July 2008. Director General, Mr. Andrew Herdman, said: "We support emissions trading, but as far as international aviation is concerned, we need a consensus on a globally harmonized solution. Consistent with Article 2 of the Kyoto Protocol, ICAO is the only forum in which all 190 States can reach such an agreement. We look to the recently formed ICAO Group on International Aviation and Climate Change (GIACC), which includes representatives from Europe, as the key to resolving the current political impasse, and urge them to make every effort to move the international debate forward[26]."

- Singapore Airlines (SIA)
    - Environmental strategy and position relating to ETS

In the SIA Environmental Report Mr. Bey Soo Khiang, Senior Executive Vice President Operations and Planning says: "Emerging regional and domestic emissions trading schemes could impose significant costs on airlines and have a crippling impact on our competitiveness. Aviation is a global business and a global solution is needed whereby all airlines are treated fairly. We cannot be burdened by an impractical situation whereby different schemes apply in a multitude of emissions trading zones.

SIA recognizes that climate change is a major global challenge. Mitigating its effects requires the commitment and responsibility that must be borne by all parties of society. We strive to lead by example, by showing that business can be competitive, yet still act in a responsible manner. As such, we will continue to collaborate with aircraft and engine manufacturers as well as other suppliers to make their products cleaner, greener and quieter. "

    - Fleet management strategy and other actions taken to reduce CO2 emissions

Singapore Airlines' commitment to fleet renewal continues to deliver better fuel efficiency and reductions in carbon emissions. During the 2008-09 financial year, the Airline took delivery of 12 new aircraft – three Airbus A380s, five

[26] http://www.aapairlines.org/resource_centre/AAPA_PR_Issue12-Environment%20EU%20ETS-09Jul08.pdf

Boeing 777-300ERs and four Airbus A330-300s. These new aircraft deliver substantially less fuel burn per seat mile, improved emissions and lower noise levels. At the same time, the Airline retired six Boeing 747-400s that were comparatively less fuel-efficient.

Other initiatives were also adopted to improve the Airline's environmental performance. These include: the development of shorter and more direct routings with airport authorities, the introduction of improved operational measures such as cost index flying, the setting of optimum speeds for climb, cruise and descent of flight, the selection of alternate airports that are closer to destination cities, and tailored water uplift to reduce aircraft weight and fuel usage.

Singapore Airlines remains committed to continual improvement of environment performance and will take appropriate measures to reduce carbon emissions with the eventual goal of achieving carbon neutral growth.

- Japan Airlines
    - Environmental strategy

For more than 15 years, Japan Airlines (JAL) has been implementing a variety of measures designed to reduce and offset the impact its business activities have on the environment. It aims to reduce its environmental footprint by cutting fuel consumption and the CO2 emissions by 20 per cent in the 20 years to 2010 and has already achieved a 15 per cent reduction since 1990.

    - Other actions taken to reduce CO2 emissions

JAL has also been actively participating in projects that encourage the use of more fuel-efficient flight operation methods at various airports and, most significantly, it strongly supports the search for a viable, sustainable, second-generation biofuel for commercial use by the aviation industry. In January 2009, it successfully operated a demonstration flight partially powered by a biofuel blend comprising primarily of camelina, a high-oil content, energy crop.

JAL has been supporting the Boreal Forest Fire Control Initiative and other similar projects to prevent or contain wild fires that damage these forests through early detection, information gathering and analyses. JAL's pilots flying over Siberia, Alaska and Indonesia have been reporting any fire outbreaks they spot, with more than 500 blazes reported in the past five years.

- Qantas
    - Environmental strategy

Qantas is committed to being an environmentally responsible organization across all business areas and levels of the group. It is working to reduce the emissions, with a long-term strategy based on:

    - Robust measurement and reporting of its carbon footprint
    - Investment in advanced technologies and fuel-efficient aircraft
    - A continuous focus on fuel conservation
    - Active involvement in industry efforts to develop sustainable aviation fuel

The group supports many environmental sustainability initiatives in the community including the Qantas Award for Excellence in Sustainable Tourism and national education campaign, Clean Up Australia Day, Saving the Tasmanian Devil and Earth Hour. Qantas made an initial donation of A$2 million to the Qantas Foundation Environmental Sustainability Fund which is being used to support initiatives that include Landcare Australia and the Great Barrier Reef Foundation.

    - Fleet management strategy and other actions taken to reduce CO2 emissions

During the past year, Qantas took delivery of the first three of its new Airbus A380s, the cornerstone of its fleet renewal program. The A380 cuts carbon emissions per revenue ton-kilometer by up to 10 per cent against the type of aircraft it is replacing. It is also quieter, reducing take-off noise by half. The inaugural A380 service between Los Angeles and Melbourne flew, a "perfect flight path gate to gate" saving thousand of kilograms of carbon emissions under a joint initiative with Airservices Australia and the Asia and South Pacific Initiative to Reduce Emissions group (ASPIRE). Such initiatives highlight that co-operation between governments and the aviation industry, which would allow airlines to fly the most fuel efficient flight paths, delivering significant reductions in fuel burn and impact on the environment.

The group supports voluntary action and continues to provide customers with the option to "fly carbon neutral" by offsetting their own share of flight emissions. In the past year alone, passengers flying on Qantas and its Jetstar associate (which is not part of Oneworld) paid A$2 million (US$1.7 million) to offset their emissions. The Group is also maintaining its commitment to offset travel by its employees and for its ground vehicles – covering some 300,000 tons of carbon emissions in the past year.

The group calls its broad environmental improvement program "Begreen". It is designed to provide the framework for environmental management and build internal support for environmental initiatives. It has set fuel, energy, water and waste improvement targets, aiming to save 2 million tons of greenhouse gases by 2011. Longer term it intends to cut its emissions by more than 25 per cent by 2020.

Qantas is also actively involved in the industry efforts to develop cleaner jet fuels that are commercially viable and generate lower carbon emissions.

- Position relating to ETS

Qantas continues to press for harmonized and equitable global climate change policies to reduce competitive distortions between airlines, industries and regions and to give airlines time to adapt. It is preparing to meet mandatory reporting requirements in Australia and the European Union, investigating lowest cost carbon abatement and integrating the cost of carbon into business planning and financial systems.

2.3.5.4 Russian airlines

In Russia there are two airlines of considerable size in which operating flights to EU take significant part: Aeroflot and state-owned "Rossiya", based in St.Petersburg.

- Environmental strategy

As a full member of the SkyTeam alliance, Aeroflot has developed its environmental policy in accordance with the Statement of Corporate Social Responsibility adopted by IATA in June 2008. As both part of the IATA strategy implementation and Aeroflot's own environmental policy, in 2007 the company introduced the system for environmental management and operational control.

In its statement, Aeroflot mentions that its air fleet complies with the standards of ICAO for emissions of noise and other pollutants to the atmosphere. This is quite symbolic, since historically Aeroflot is more oriented on working with governmental organizations like ICAO or directly with countries authorities on bilateral basis, rather than cooperating with new global entities, like EU. It is worth mentioning that Russian Civil Aviation Authorities (Rosavatsyia) filed protest to EU about Directive for non-compliance with ICAO legislation, signed by Mt. Valery Okulov (former Aeroflot CEO).

- Fleet management strategy

For all Russian airlines without exemption the major carbon-footprint reduction improvement is in the fleet renewal program, since most of them still have aged soviet-built aircraft in their fleet. The most popular Tupolev-154 designed in 70th, consumes twice as much fuel per seat-kilometer compared to similar A320 or B737. For example, S7 Airlines have reduced its fuel consumption per seat-kilometer by 40% in one year, having grounded all Tupolev fleet in late 2008. Still more than 50% of total ASK in Russian aviation operated by soviet era fleet.

- Position relating to ETS

Regarding EU Directive 2008/101/EC in September 2009 Aeroflot has created dedicated committee for communication with EU aviation authorities. Publicly Aeroflot communicated that is not supporting unilateral restrictive measures contradicting the Chicago Convention.

3 Potential strategic approaches

As the Aviation ETS introduces a radical shift in the business, operators will have to review and adapt their strategy to that new, complex and fast changing political and legal environment.

Because of the expected negative impact on their operations, airlines' first reaction will probably be to challenge the EU ETS to avoid its burden.

3.1 Challenging aviation ETS

3.1.1 Why implementing the EU ETS for aviation?

- Aviation accounts for only 2% of the total CO2 emissions

According to IATA, aviation's contribution to climate change accounts for 2% of total man-made CO2 emissions. This could reach 3% by 2050. Between 2000 and 2004, aviation's CO2 emissions rose 4,5% from 675 to 705 million tons. During the same period, the worldwide CO2 emissions increased by 13%.

Therefore, the aviation is not such a big contributor to the CO2 emission and the aviation sector managed to contain at a lower rate than the worldwide emission.

- Air transport is in constant growth but aviation carbon footprint is growing less fast

While air travel is growing at a rate of 5% per year, the carbon footprint is growing at a much lower pace of 3%. This is the direct result of a significant and continuous investment in fleet modernization, infrastructure improvements and operational advancements.

- Aviation is a catalyst of economic and social progress and it is the most efficient way of traveling

Aviation is known to contribute to 8% of the world's GDP and to generate globally 32 millions jobs (2007 figures). Aviation stimulates the economy, trade and tourism, generating business opportunities and enhancing quality of life in both developed and developing countries. Air transport is essential as it brings people to business, products to markets, tourists to holiday destinations and unites families and friends around the world.

According to this, with a foreseen negative impact on the development of the aviation sector and a limited impact on the world CO2 emissions, the interest of implementing the EU ETS for aviation is questionable.

3.1.2 Disputing the legacy of aviation ETS scheme

- The EU ETS for aviation and the international law

The Air Transport Association of America (ATA) claims that aviation's inclusion in the ETS violates the international law.

The Convention of Chicago Article 15 prohibits imposition of fees, dues or other charges in respect solely of the right of transit over, entry into or exit from a state's territory, the Open Skies bilateral agreement between EU and US requires parties to give operators "fair and equal opportunity", and the Kyoto Protocol Article 2(2) asks Parties to "work through" the ICAO. Hence, the EU directive raises legal concerns and may face potential legal action under the Chicago convention, bilateral agreements, the UNFCCC or Kyoto protocol.

- The EU ETS for aviation is an unilateral decision from the EU with consequences for the worldwide air transport

The EU has taken a unilateral decision, which has an impact on all the airlines flying from or to the European Union. Any violation of the Directives will be punished by a ban to land on the 27 EU airports. This means the EU assumed the right to pin the entire worldwide air transport. This was made in a unilateral way despite the defeat of a majority of members of ICAO in 2007.

- The EU ETS for aviation is not incorporated into national law of the member states

In addition, no EU country has incorporated the EU Directive into its domestic law yet. When this will be implemented, it is expected that some non EU airlines or governments will take legal actions against these specific laws.

3.1.3 Questioning the work performed by the EU

- Lack of preparation and experience

According to the opponents of the EU ETS, the scheme fails international aviation. They consider that the European regulators are currently under prepared to include aviation in their ETS, because there is a lack of vital information on the complex procedure and because the monitoring and reporting requirements remain unclear.

Nancy Young, Air Transport Association of America, vice-president of environmental affairs, states that "Europe's experience with emission trading is limited to stationary suppliers. Rules you might apply to a single fixed facility do not really work. They have not sufficiently tailored the requirements for the way we actually operate".

- The 31st of August deadline

All airlines flying into European Union airports were required to send their reporting plans to various supervising national authorities by a 31st August 2009 deadline.

During the summer 2009, some airlines said delay was needed because the European Commission had not finalized which airline will be regulated by which administrating EU member state after publishing a preliminary list in February 2009.

US carriers also requested more time to submit their emission plans because of difficulty to obtain fuel data from multiple sources at airports around the world. For instance, carriers must provide Europe both fuel quantity and fuel density, even though fuel suppliers generally do not measure fuel density. The carriers argue it is difficult when airlines refuel using many different suppliers.

In July 2009, UK announced it would give airlines three additional months to register and submit their plans from the time the European Commission finalizes administering assessments. In August 2009, Germany has become the second European Union member to postpone airlines' first emissions trading deadline. Sweden and Italy have since followed.

- The final list of aircraft operators

The European Commission adopted on the 5th of August 2009 a list of aircraft operators that have undertaken a relevant aviation activity on or after January 1st, 2006, specifying the administering Member State for each aircraft operator. The list was published in the Official Journal on August 22nd, 2009 with about 4000 concerned airlines.

- Contestation of the calculation performed by the EU

According to the EU Directive, airline emissions are to be capped at 97% of the average 2004-06 levels in 2012. The first calculation performed by the EU is 216 million tons of CO2, which means a cap at 210 million tons of CO2. This figure is highly disputed as IATA considers that this amount should be increased by 10 to 20%.

- EU regulators need more time to verify airline emissions data before deciding a cap

As a consequence of this dispute and in order to perform additional check of the data underlying their calculations, the European Commission did not published a 2012 emissions cap for flights in August 2009 as it was previously planned. The European Commission rather announced on September 29, 2009, that it has opted to postpone their cap verdict. The figures could be ready in the first quarter 2010 but will more realistically be published halfway through the year, according to Philip Good, a commission official, speaking at Platts' European Emission trading Conference in Brussels.

According to Andreas Hardeman, Assistant Director, Environment Policy and Outreach for IATA, this reflects that the steep learning curve is not only for Airlines but also for EU commission & governments.

3.2 Mitigating the cost of ETS

3.2.1 Charging the cost to customer

In recent years, as fuel costs have increased, airlines have raised fuel surcharges. Despite this, until very recently, airlines successfully passed on these fuel surcharges to customers with no adverse effect on demand[27].

Therefore, as indicated earlier, airlines are likely to pass the ETS cost through the consumers in order to mitigate the impact of rising costs on their profit margin.

[27] "Aviation in EU ETS, an incentive for efficiency", Merrill Lynch, September 2008

3.2.2 Reducing CO2 emissions

The ultimate aim of the EU ETS is to reduce emissions from the aviation sector. A key driver of emissions reduction will come from fuel efficiency. This can mainly be attributed to the original equipment manufacturers (OEMs – typically Airbus or Boeing). But other airline strategies to reduce CO2 emissions include increasing the load factor thus minimizing fuel consumption per passenger, operating more efficient route networks, and applying more pressure for air traffic management systems improvement.[28]

In order to tackle their carbon footprint, the airlines can rely on three main topics:

- Technological progress:
    - Improved airframe technology, lighter materials, more aerodynamics designs
    - New generation of fuel-efficient Engines
    - Addition of CO2 neutral biofuels in aviation fuel mixes
- Infrastructure improvements:
    - Full implementation of more efficient air traffic management (ATM) and airport infrastructure with the Single European Sky, Next Generation ATM in the USA, Pearl River Delta, RVSM, etc.
- Operational measures:
    - Increase load factor
    - Improved operational practices, including more efficient flight procedures, and weight reduction measures such as lighter carbon fiber seats, lighter food trolleys, more accurate estimates of the drinks and water needed during a flight, less reading materials in seat pockets
    - Landing and take-off procedures that reduce fuel consumption and noise
    - Increase use of push-back tractors during taxiing electrical ground power for air-conditioning, lighting and control systems while the aircraft is parked at the boarding gate, therefore reducing the ground use of engines or APU
    - Airframe & engine maintenance: aircraft performance monitoring for fuel efficiency

There will be an increasing need across the air transport industry for monitoring, reporting and verification – not just for emissions themselves, but also for operational practices which contribute towards helping reduce those emissions[29].

3.2.3 Mitigating monitoring and reporting costs

As detailed in paragraph 2.2.1.1, airlines will have to organize the Monitoring, Reporting and Verification (MRV) of their CO2 emissions. The accuracy and reliability of these data will be of first importance as they will serve as a basis for the emission allowance process, but the burden of MRV can weight heavily on the operators' internal cost. Therefore their strategic approach should be to develop workable and efficient MRV solutions that could provide them the most accurate data at the best cost.

3.3 Managing CO2 emissions

3.3.1 Compensating CO2 emissions

As a complement to CO2 emission reduction programs, airlines can develop clean development mechanism projects and use offset programs.

3.3.1.1 Clean development mechanism projects

Airlines may be able to reduce the cost of CO2 emission allowance by investing directly into clean development mechanism projects allowable to credits under the Kyoto Protocol. These credits will then provide them with a discount on the carbon price they have to pay for their CO2 emissions.

[28] « Aviation in EU ETS; an incentive for efficiency » - Merrill Lynch, 08 September 2008
[29] The Air Transport Industry and the Environment, SITA 2009

3.3.1.2 Airlines carbon offset

Carbon offset programs are action which airlines are taking for aviation and the environment. Offsets designate the emissions reductions from project-based activities that can be used to meet the objectives of airlines with regards to greenhouse gas (GHG) mitigation. Airlines avoid or reduce GHG emissions in one place so as to offset such emissions occurring in another place.

3.3.1.3 Airlines' customers can participate to offset programs

An offset is a compensating equivalent. In the context of addressing climate change concerns, offsetting is a voluntary action by individuals to compensate for greenhouse gas emissions arising from their use of commercial aviation. The offset can be equivalent in part or in whole to the associated emissions by financing a reduction in emissions elsewhere (forest protection programs, reforestation and renewable energies development programs).

3.3.2 Trading CO2 emissions

Under the aviation ETS, airlines will have to choose between investing into a CO2 emission reduction or buying an allowance for this emission. This choice will depend on the level of free allocation versus the total requirements for the airlines' operations. They will therefore need to develop skills and resources in order to be able to make such a trade off and also to buy and sell CO2 emissions allowances efficiently.

CO2 emission allowance trading can either be done directly as an agreed exchange between two airlines, as an Over The Counter (OTC) transaction through a broker, or by buying or selling allowances on the existing spot carbon markets.

Carbon market is a young and volatile market with futures available. In order to cover for volatility, airlines may have to implement carbon hedging programs similarly to what is already done for fuel.

Bilateral or multilateral agreements for exchange of CO2 emission allowance between airlines can also be organized.

4 Team strategic recommendation and action plan

In order to cope with aviation ETS reality, the research team proposes some recommendations for the main aviation industry stakeholders to adapt their strategic planning.

4.1 Recommendation at airline level

Though the EU directive can be challenged on international law field, the probability to change the European Union decision to implement aviation in EU ETS is low.

A lot of arguments exist in favor of aviation ETS so we can expect that this directive would only be a first step to a more global ETS implying aviation and taking place in the near future.

We hence suggest aircraft operators to make the EU ETS constraints an opportunity to prepare a future where CO2 emission management will become not only a cost factor but also a competitive factor requiring specialized know-how and resources.

4.1.1 Look upon Aviation ETS as a competitive opportunity

4.1.1.1 Develop energy efficiency

With the aviation ETS, there will be a bonus for emission efficient operators as the stress imposed by emission allowance reduction will be lower for them and they will need to buy less carbon credits on the market. Therefore operators early implementing an emission efficient strategy will benefit from a competitive advantage.

Developing emission efficiency means achieving emission reductions through emission reduction actions such as the ones described in paragraph 3.2.2. As most of the CO2 emissions reductions are linked to a cost effective fuel consumption reduction, this will add to the competitive advantage of these emission/energy efficient operators.

Airlines with young fleets such as Easyjet, will take advantage of their recent and energy efficient aircraft while others will have to address the trade off between committing to newer technologies (aircraft or engines) with a 30 year life cycle, that come at a high price, and reducing fuel consumption and thus costs and CO2).[30]

Funding fleet renewal will be the key issue to develop energy efficiency. This issue will be detailed in paragraph 4.4.4.3

4.1.1.2 Optimize route planning, hub & airport competition strategic networking

In order to minimize their EU ETS costs, airlines will have to review their business model and operations – that could mean making strategic right-sizing fleet decisions on certain routes, and assess their network & alliance strategy taking into account the following aspects:

- Aircraft selection
- Network and schedule alterations
- Timing of transition/usage on European routes

We advise that airlines consider flying their most emission efficient aircraft on the route strongly impacted by emission allowances.

Within the EU, as flying point-to-point produces lower emissions than flying hub & spoke because of a shorter distance, we also advise airlines to optimize their route planning accordingly.

As detailed in paragraph 2.2.2, the opportunity of a hub location close to the EU territory but not submitted to the EU directive (such as Switzerland or Norway) should also be considered by airlines as it could allow a dramatic reduction of its ETS impact.

In a given bilateral agreement (code sharing) or alliance, the airlines operating the segments within the EU will be bearing the ETS costs for the transport of their partners' revenue passengers and should be compensated for that.

[30] « Aviation in EU ETS; an incentive for efficiency » - Merrill Lynch, 08 September 2008

Thus devising route operation, route selection, hub positioning, alliances and code sharing strategies according to the ETS impact could help airlines to sharpen their competitive advantage.

4.1.1.3 Improve load factor and benefit from windfall profits to fund emission reduction programs

As described in paragraph 3.2.1, airlines will try to pass CO2 emissions cost to customers by charging the equivalent of emission charges for a flight on the flight fares. However, the operators do not face a corresponding increase in all their costs because emissions allocation is based on grandfathering, i.e. a certain percentage of allowances are given them for free (85% in 2012). Consequently, although companies will face an added 'cost of carbon' at the margin of their operations this will not apply across the main part of their cost base allowing them to develop windfall profits that they could wisely reinvest into emission reduction programs.

This will also become a load factor improvement incentive, as with a higher load factor more passengers will be able to cover the emission charges on a flight.

4.1.1.4 Make positive marketing of green flying

To improve their image and their brand, we advise airlines to communicate early about their "green strategy" and make a positive marketing about their implication in the environmental issues. The implementation of the aviation ETS will be a good opportunity to promote their green attitude. Virgin and Easyjet are relevant case to consider.

Several airlines including Air New Zealand, Virgin, Continental Airlines, and Japan Airlines have received global publicity after trial flights with CO2 neutral biofuels mixed with Jet A1.

4.1.2 Evolve towards a low carbon strategy

4.1.2.1 Understand and integrate regulatory requirements

First of all, airlines should put their effort to understand and integrate regulatory requirements and impacts of the ETS such as ETS registration and monitoring requirements or the compliance milestones so as to be compliant with the EU ETS directive.

In order to do so, they will have to implement a new organizational and management approach. IATA has now developed an expertise to support its member in that field.

4.1.2.2 Implement skilled staff and relevant infrastructures and processes

The airlines should also invest to develop and optimize monitoring protocol, to monitor/forecast emissions and to ensure validation and verification of reported data as these will be of key importance to benefit from free allowances within the EU ETS. Early maturity of such internal processes might be a strong competitive advantage.

Airlines will require specialized know-how and resources and have to get in place the staff and infrastructure to be able to put in place a carbon strategy. IATA has also now developed an expertise to support its member in that field, for instance, see IATA carbon tool calculator in appendix 11.

4.1.2.3 Implement a low carbon strategy

With the EU ETS, emission management becomes not only a cost factor but also a competitive factor. The airlines will have to find solutions for allowances shortages and will have to evaluate what would be the most appropriate strategy when it comes to forward purchasing CO2 allowances.

Under the scheme, airlines will have three mixable options:

- Reduce emissions through operational improvements
- Buy allowances either at market price or according to a hedging position
- Invest in CDM projects or offset programs under the Kyoto mechanism

According to IATA offset mechanisms could help "to close the gap" of emission reduction plans: "90 million tons of CO2 will need to be offset by 2025 to mitigate emissions to 2020 levels and achieve carbon-neutral growth. By 2025, this will cost an additional USD 7 billion per year to achieve". [31]

The airlines will have to optimize carbon market strategy through various strategic decisions by taking into account the level of free allocation versus total requirements, the mitigation potential, the allowance sourcing options and the link with fuel hedging program. We strongly recommend airlines to early devise such a low carbon strategy.

4.1.3 Integrate carbon risk into risk management process

Such as fuel cost management, emissions management will also become a new business risk with impacts on corporate and finance strategies. There will be interdependence between carbon market and overall strategy. Then, the airlines will have to:

- Estimate future emissions liabilities, assess the current and future route network and the current and future fleet structure in order to optimize their business model
- Integrate with strategic and financial planning, the competitive environment, the network planning decision, the fleet planning and acquisition and the financial and risk management

In such a framework, we believe that carbon risk has to be integrated into airline risk management. This will help airlines to prepare themselves to exploit a maximum strategic advantage over less environmentally sound competitors.

4.1.4 Reassess alliance and M&A strategy

With the implementation of EU ETS for aviation, the future allowances will become a core component of airlines alliances and M&A strategy.

The allowances will be an asset of the airlines. Some interesting issues are then raised such as the determination of the free CO2 allowances value and its evolution in the future. For instance, this value could be weighted against the cost of CO2 emission reduction or taken into account in airline valuation in case of potential alliances or M&A due-diligence talks.

The energy efficiency of an airline, its knowledge, skills and know-how about green flying should also be taken into account in the goodwill value.

In terms of alliance, ETS might modify current airlines strategies. For instance, some European airlines could be tempted to open their alliance to positive CO2 transportation means and, for instance, take benefit of the fast development of high-speed railway infrastructures throughout Europe connecting major cities. Short-haul airline network could then be reconfigured in the coming fifteen to twenty years.

Other ideas might be explored such as CO2 exchange between airlines members of the same alliance for enhanced CO2 asset and risk management.

4.2 Recommendation at aviation industry level

The EU ETS clearly puts additional burden on airlines economics and then threaten European customers of the major engine and airframe manufacturers. Some positive actions may be initiated at industry level.

4.2.1 Lobby, a vital action for aviation industry

Though most of the recent years lobbying actions of aviation sector stakeholders have been directed against the inclusion of aviation into EU ETS, we truly believe it is now time to take the ETS as an opportunity and focus lobbying on:

- Claiming more generous free allowances or a lower rate reduction curve
- Claiming for adapted regulation that could make it easier to handle (MRV rules simplification & support, avoidable distortion, favorable methods for allowance calculation)
- Claiming for an adapted strategic planning (emission reduction actions take time to bear fruits)
- Developing interaction with other European projects such as SESAR aiming at increase aviation efficiency

[31] "Aviation and climate change – Pathway to carbon neutral growth in 2020", IATA, July 2009

- Increasing European Commission funding support to SESAR in order to accelerate its foreseen positive outcome (new CO2 efficient ATM procedures, etc.)
- Claiming for government and/or European Commission subsidies to fund the required fleet renewals and airport infrastructures. Why not imagine mechanisms like the ones already existing to support car industry (car scrap premium/incentive/tax cut). Such mechanisms will certainly help airlines to access to capital markets and get sufficient liquidity to be able to renew their fleet with new fuel efficient and lower emissions aircraft
- Claiming for action plans & sufficient funding to develop airframe and engine efficiency through comprehensive R&T projects such as CLEANSKY
- Claiming for the development of "aviation" biofuel with ambitious certification lead-time objectives. IATA has recommended to its members to use 10% aviation biofuel by 2017
- Claiming for the development of an efficient and dedicated biofuel supply chain for aviation industry with economical incentive such as tax premium. Boeing claim that we may see biofuels in commercial aviation within 3 years

This list of non-exhaustive lobbying actions may be consider as a way to reduce the overall cost of EU ETS for aviation by pushing European Commission to support aviation industry toward a lower carbon business model. IATA, ICAO and main engine & airframe manufacturers have a key role in such a framework.

4.2.2 Integrate the implication of EU ETS in IATA's mission

As far as the EU ETS is concerned, IATA has a major role to play in order to help creating the right framework to deal with aviation emissions.

IATA's mission is to protect the interest of its members but not to intervene in their business model. For that particular reason, IATA cannot be directly involved in CO2 market trading (nor in fuel trading) on behalf of its members, as price fluctuation represents a financial risk that can only be assumed at airline or alliance level.

Nevertheless, we recommend that IATA should be more involved in:

- The data management process to help airlines to report data requested by EU ETS directive
- The CO2 credits and allowances management between airlines through the existing clearing house

Thanks to its legitimacy, IATA should request the UNFCCC during the next Copenhagen environment Summit to include aviation emissions into the post 2012 Kyoto protocol in order to back-up already achieved CO2 emission reductions and clean development mechanisms. In parallel, IATA interest is to lobby for the inclusion of aviation in a global worldwide ETS (or a dedicated aviation worldwide ETS if not possible) with ICAO in the driving seat and IATA in the machinery.

4.2.3 Confirm and reinforce the leading role of ICAO for a global aviation ETS

Considering that ICAO is the appropriate UN body for fostering a global sectorial approach to address aviation emissions, and taking into account the action plan agreed on June 2009 by the ICAO Council, some key issues remain opened:

- Is ICAO able to implement effectively this challenging action plan at worldwide level?
- In what kind of framework? At this stage this action plan is under ICAO direct responsibility.

According to Pierre Pape, Alternate Representative of France on the Council of the International Civil Aviation Organization, "These two issues must be solved for the next ICAO General Assembly in 2010".

- Will a global aviation ETS be one of the output of this action plan?
- What would be the link with the EU ETS?

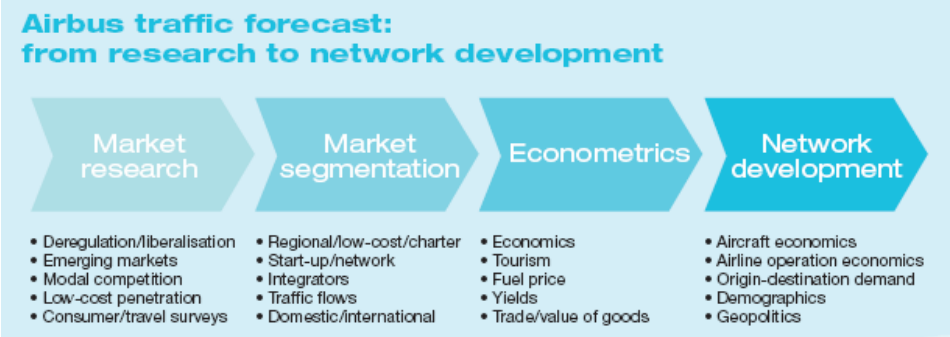
We believe it is of strategic importance for the worldwide ICAO credibility to clarify these points and to urgently set up the political and operational framework for a global aviation ETS.

4.3 Recommendation at engine & airframe manufacturers level

In addition to the recommendations already listed in the above paragraphs, the following ones could be addressed to aircraft and engine manufacturers.

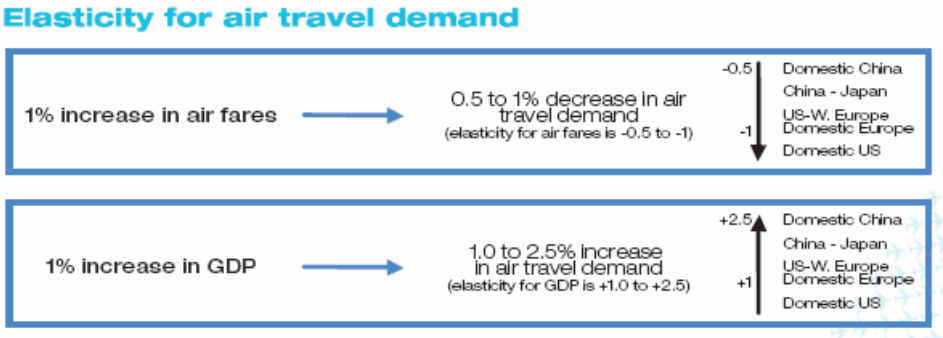
4.3.1 Integrate the EU ETS impact within manufacturer market forecast for a quick strategic planning update

In terms of energy, current Global Market Forecasts mainly focus on the effect of oil price on the evolution of the traffic and aircraft demand. By analyzing the methodology generally used and synthetically illustrated in the graphs here below, we have noticed that EU ETS is not taken into account to make market forecast at manufacturer level.



Source: 2009 Airbus Global Market Forecast

We recommend to carefully look at the impact of such additional costs into econometrics assessment and hypothesis. Some impact on the fleet renewal process might be expected.



Source: 2009 Airbus Global Market Forecast

According to the figures disclosed in paragraph 2.2.1.2, we can roughly assume the application of ETS to European aviation will implies a 2% average increase of air fares on European domestic market. By considering the demand/price/GDP elasticity relationships here above, and the expected 2% average GDP growth in the coming years, we can conclude that the negative effect of the EU ETS due to fare increase will hardly be compensated by the GDP growth and that **the Western European air travel demand is expected to remain constant after 2012**, date of entry into application of EU ETS for aviation. Nevertheless, the 2009 Airbus Global Market Forecast expects an average 4% growth of air travel demand.

If confirmed by in-depth further analysis, this identified gap in air travel demand will strongly impact air transportation industry in Europe. We can expect an even more accelerated consolidation process. Depending on passenger behavior (already willing to travel or not), two complementary scenarii may occur:

- If we focused on already captured passengers' traffic demand then LCCs might jeopardize legacy carriers' business thanks to their pricing and cost competitive advantage.
- Else, LLCs' business is put in danger by acknowledging an highly probable limited growth of leisure traffic demand, the core engine of LCCs business future, due to ETS related fare increase not being compensated by GDP .growth.

This conclusion is furthermore confirmed if the cost of CO2 is translated in equivalent cost of fuel. For instance, with the current cost of oil (70$/bbl), one ton of CO2 at 14,4$ costs 10% of one ton of jet fuel; with a barrel at 90$, one ton of CO2 at 30$ (expected cost in 2012) will cost 17% of one ton of jet fuel.

4.3.2 Develop "low carbon" aircraft renewal and modernization global offers

The only way to sustain air transportation industry in Europe is then to urgently develop a low carbon transportation business model. For that, as identified in the 2009 Airbus Global Market Forecast, the renewal of poor efficient aircraft is a key issue, in which enhanced engine technologies are cornerstones.

Renewal means **deconstruction** of older aircraft in an environmental friendly way (with massive investments to do in the near future to cope with the demand) but means also **production of carbon efficient aircraft**.

For that, two options are possible, if airlines are able to invest accordingly:

- Deliver even more new aircraft. But knowing that current production rate has reached a record level, the ability of current airframe manufacturers to increase their production rate to cope with this demand is questionable.
- If not, develop the capability to replace old engines fitted on existing aircraft in operations by more efficient engines (LEAP from CFM, Gear Turbo Fan from P&W). This will implies a complex new development for airframe and engine manufacturers but presumably at a more reasonable cost for airlines.

4.3.3 Reinforce current fuel and carbon efficiency innovations

Currently, aircraft manufacturers work on developing new technologies, which will contribute in a near future to a greener aviation. For instance, on Airbus side[32]:

- Development of alternative energy sources for aviation
- Exploration of the potential for fuel cells
- Development of alternative fuels - For instance, "to help lead the industry, Airbus has defined a global roadmap on alternative fuels, integrating research, partnerships, test flights and co-operation with fuel standard certification authorities"

4.3.3.1 Promote the use of aviation biofuel

Under EU-ETS legislation, biofuel use is zero rated for carbon emissions. As such there is a direct connection between the future of these fuels and the EU-ETS. Other future policies could reduce tax levels for low carbon fuels. Many governments around the globe are making significant investments in sustainable 2nd and 3rd generation biofuel development.

- Convincing more airlines to fly demo biofuel flights will earn them carbon credits and green advertising.
- The pace of development of second and third generation biofuels for aviation will largely depend on the price of oil. Clearly airlines are keen to see an alternative given Jet A1 price and volatility.

The initial target was to certify several biofuels as safe for aviation use by 2013 but the latest information is that a 50/50 blend of biofuel mixed with Jet A1 called "BioJet" could be certified before 2011.

Making airlines aware how soon 50/50 biofuel mix will be available could change their strategies (fuel hedging...). It may be a while before we see commercial jet aircraft burning 100% biofuel; however mixes of biofuel with Jet A1 are already proving their merits. Second generation biofuels exist which are chemically very similar to Jet A1 and which can be "dropped in" to existing fuels. IATA recommends its members to use 10% such biofuels by 2017 and 15% by 2020. ATAG's vision is that biofuels will make up 50% of airline fuels by 2040.

4.3.3.2 Acknowledge positive impact of EU ETS on biofuel economic viability

It is estimated today that 85% of aviation biofuel production costs relate to the cost of feedstock. As technology to harvest and process progresses and they become available in commercial quantities the price will drop. Given the volatility of oil prices (USD 147 in June 08 to USD 40 in Dec 08) it is difficult to predict when biofuels will become competitive. The best indications are that this will occur before 2020.

The introduction of the EU-ETS and possible future trading schemes in the rest of the world make aviation biofuel more attractive. Add to this the potential of policies to reduce tax on aviation biofuels. For these reasons many companies are developing ways to refine advanced biofuels.

[32] Extracted from 2009 Airbus Global Market Forecast

See appendix 8 for more information on biofuels development.

4.4 Strategic planning recommendations

Beyond the above-mentioned recommendations, we suggest that all actors from the industry integrate the timeframe of the Aviation ETS in their strategic and financial planning. There will be some short-term strategic actions as well as long-term strategic planning decisions to implement in the coming years.

4.4.1 Understand and integrate regulatory requirements

First step should be dedicated to the identification and understanding of the ETS requirements in terms of registration and monitoring requirements, milestones compliance, organisational and management approach and future liabilities.

This step should be taken as early as possible as it will impact the whole operator strategy in fields such as route operating, fleet structure, pricing strategy, network and growth.

Moreover, according to the EU directive, the operators should provide their monitoring plan by August the 31st, 2009.

4.4.2 Growth management

The first monitoring period of actual emissions and benchmark data is scheduled to start on January 1st, 2010. It is the Revenue Ton Kilometers (RTK) data gathered for the following 12-month period (benchmark year) that will be the basis of an airline's free allocation of emissions credits for the eight following years from 2012 to 2020. This will decide how big a slice of the cake each airline will get. The carriers with a fast growth by RTK since 2006 will now take a large share of the allowance and growing airlines, particularly growing EU flying after the 2010 benchmark year, will be exposed to significant ETS costs.

"Revenue tonne kilometres next year will determine [operators'] cut of the carbon cake over the following eight years of the trading period. Operators with high load factors in 2010 will gain a competitive advantage for the full trading period[33]".

The same conditions will apply for the following monitoring periods, therefore we suggest operators to take into account the ETS timeframe in there strategic planning for the following growth management options:

- Higher load factor
- Larger aircraft size (fleet/network considerations)
- Timing of growth (contemplate accelerating growth prior to benchmark year or defer shrinking)
- Timing of transition/usage on European routes.

4.4.3 CO2 emission management

4.4.3.1 CO2 emission reduction planning

Though aircraft operators should early prepare their CO2 emission reduction plans to be ready in 2012 when the ETS starts, emission reduction planning should be paced according to the ETS schedule, with regular savings to cover free allowances reduction over time.

In addition, particular attention should be paid in scheduling fleet renewal, as manufacturer delivery time slots are limited. We strongly recommend early booking to airlines.

We also suggest airlines to undertake frequent operational planning review in order to mitigate future exposure to carbon costs according to carbon market value.

4.4.3.2 CO2 emission trading planning

As the high complexity of the carbon market requires the implementation of professional processes and the development of cost-efficient and risk reducing portfolio and trading strategy, we strongly suggest airlines to start up developing skills in that field as soon as possible and make use of existing offset programs as bridges to bring-up system to maturity.

[33] « Carbon confusion », Flight International, August 14, 2009

For Chris Essex, who heads business development at UK low-cost carrier EasyJet, emissions trading for most airlines will be owned by the finance department. “That reality provided much of the motivation for EasyJet's launch of its carbon offset programme, allowing our treasury function to gain experience in this field."

Moreover, the carbon market is a young, pure financial and high volatile market which is exclusively regulatory driven. Any regulatory change such as free allocation reduction or extension of the aviation ETS to a worldwide global ETS including the US and/or the BRICs in a post-Kyoto arrangement, could transform the whole picture for carbon pricing. In this context, a smart carbon hedging strategy could become a strong competitive advantage. We believe that to develop such a strategy, a good start can come from linking carbon hedging to fuel hedging.

4.4.4 Risks to be taken into account

The EU ETS will introduce additional risks operators will have to assess when devising their strategic and financial planning.

4.4.4.1 Fraud on the CO2 market

In August 2009, a massive VAT fraud of 40 million euros on the European CO2 market was discovered, which raised questions about the efficiency of this market to reduce CO2 emissions. There were a lot of movements on the CO2 market due to swindlers who purchased CO2 exclusive for VAT in countries and sold them inclusive of tax in other countries, pocketing the VAT at this occasion.

Beginning of June 2009, the record of 20 million tons a day of CO2 exchanged on the Bluenext market was broken. This exchanged volume has fallen between 2 to 5 million tons per day, after the VAT was suppressed in France on June 8, 2009.

4.4.4.2 The green bubble

As mentioned above, speculation on carbon can be expected once the volume of such a market will become large enough. Related artificial price increases could form a bubble such as the one which blew on the fuel market at fall of 2008.

Moreover, all the “green” business could benefit from an existing or future positive marketing effect around sustainable development, leading to an artificial price increase of emission reduction activities that could suddenly reverse if scientists later prove that either these emission reductions do not achieve their goal of reducing the greenhouse effect or that the greenhouse effect reduces by itself naturally as a climate cycle.

According to Pierre Cinq-Mars, an independent consultant for the aviation industry, “The concerns of international bodies such as IATA, ICAO, supranational organizations (EU, UN) over the climate effect of the GHG emissions generated by the commercial aircraft industry, as well as of fuel reduction objectives, have created a technological bubble for aircraft engine manufacturers; and consequently aircraft manufacturers.”

4.4.4.3 Funding emission reduction

As often, sufficient funding might be the key issue of a success story.

According to experts, large projects such as SES, SESAR or Clean Sky, considered as the most promising in terms of European aviation emission reductions, are not sufficiently funded by the community to bear their fruits in due time for the EU ETS.

Besides, air transportation is in a down turn cycle and therefore most of airlines are not profitable. Their ability to finance their fleet renewal is therefore highly questionable. While aircraft manufacturer finances are largely impaired by new aircraft developments, current situation analysis shows that only engine manufacturers have enough cash flow to finance new aircrafts. Though structures already exist, within which engine manufacturers such as General Electric or Roll-Royce are financing their customers, the question about how to have engine manufacturers funding the required fleet renewal remains open.

4.4.4.4 A challenging timeframe

Beyond the many technological and operational barriers on CO2 emissions reduction pathway, institutional and social barriers to the required changes put at risk the ability of the aviation industry to reduce their CO2 emissions at a the pace required by the EU ETS – a much higher pace that the average 3 to 5% of air traffic yearly growth.

With fuel being one of the air transport industry's biggest costs, reducing fuel burn makes sound business as well as environmental senses. Nonetheless, aviation is a vital enabler of global economic prosperity, and the benefits of economic growth should not be carelessly thrown away. Instead, efforts must be focused on limiting emissions in every way possible while managing growth across the sector. [34]

The emission reduction pathways will require unprecedented efforts across the industry and significant investment, time and sustained political will.

[34] "Aviation and Climate change: lessons for European policy", Alice Bows with Kevin Anderson and Paul Upham, Routledge 2009 – see appendix 12

5 Appendices

5.1 Appendix 1: Emissions Trading Scheme

5.1.1 History of Emission Trading Scheme

The efficiency of what later was to be called the "cap and trade" approach to air pollution abatement was first demonstrated in a series of micro-economic computer simulation studies between 1967 and 1970 for the National Air Pollution Control Administration (predecessor to the United States Environmental Protection Agency's Office of Air and Radiation) by Ellison Burton and William Sanjour. These studies used mathematical models of several cities and their emission sources in order to compare the cost and effectiveness of various control strategies. Each abatement strategy was compared with the "least cost solution" produced by a computer optimization program to identify the least costly combination of source reductions in order to achieve a given abatement goal. In each case, it was found that the least cost solution was dramatically less costly than the same amount of pollution reduction produced by any conventional abatement strategy. This led to the concept of "cap and trade" as a means of achieving the "least cost solution" for a given level of abatement.

The development of emissions trading over the course of its history can be divided into four phases:

Gestation: Theoretical articulation of the instrument and, independent of the former, tinkering with "flexible regulation" at the US Environmental Protection Agency.

Proof of Principle: First developments towards trading of emission certificates based on the "offset-mechanism" taken up in Clean Air Act in 1977.

Prototype: Launching of a first "cap and trade" system as part of the US Acid Rain Program, officially announced as a paradigm shift in environmental policy, as prepared by "Project 88", a network-building effort to bring together environmental and industrial interests in the US.

Regime formation: branching out from the US clean air policy to global climate policy, and from there to the European Union, along with the expectation of an emerging global carbon market and the formation of the "carbon industry".

5.1.2 Some details on EU ETS mechanisms

The EU scheme used to be a system of climate change policy that was completely independent of International Climate Change Policy such as the United Nations' Framework Convention on Climate Change (UNFCCC, 1992) or the Kyoto Protocol that was subsequently (1997) established under it. When the Kyoto Protocol came into force on 16 February 2005, the EU ETS had already become operational. Only later, the EU decided to accept Kyoto flexible mechanism certificates as compliance tools within the EU ETS. The "Linking Directive" allows operators to use a certain amount of Kyoto certificates from flexible mechanism projects in order to cover their emissions.

The Kyoto flexible mechanisms are:

Joint Implementation projects (JI) defined by Article 6 of the Kyoto Protocol,

the Clean Development Mechanism (CDM) defined by Article 12,

International Emissions Trading (IET) defined by Article 17.

IET is relevant as the reductions achieved through CDM projects are a compliance tool for EU ETS operators. These Certified Emission Reductions (CERs) can be obtained by implementing emission reduction projects in developing nations that have ratified (or acceded to) the Kyoto Protocol. The implementation of Clean Development Projects is largely specified by the Marrakech Accords, a follow-on set of agreements by the Conference of the Parties to the Kyoto Protocol. The legislators of the EU ETS drew up the scheme independently but called on the experiences gained during the running of the voluntary UK Emissions Trading Scheme in the previous years, and ensured its units and mechanisms were compatible with the design agreed through the UNFCCC.

Under the EU ETS, the governments of the EU Member States agree on national emission caps which have to be approved by the EU commission, allocate allowances to their industrial operators, track and validate the actual emissions in accordance against the relevant assigned amount, and require the allowances to be retired after the end of each year. The operators within the ETS may reassign or trade their allowances by several means:

Privately, moving allowances between operators within a company and across national borders

Over the counter, using a broker to privately match buyers and sellers

Trading on the spot market of one of Europe's climate exchanges (the most liquid being the European Climate Exchange). Like any other financial instrument, trading consists of matching buyers and sellers between members of the exchange and then settling by depositing an allowance in exchange for the agreed financial consideration. Much like a stock market, companies and private individuals can trade through brokers who are listed on the exchange.

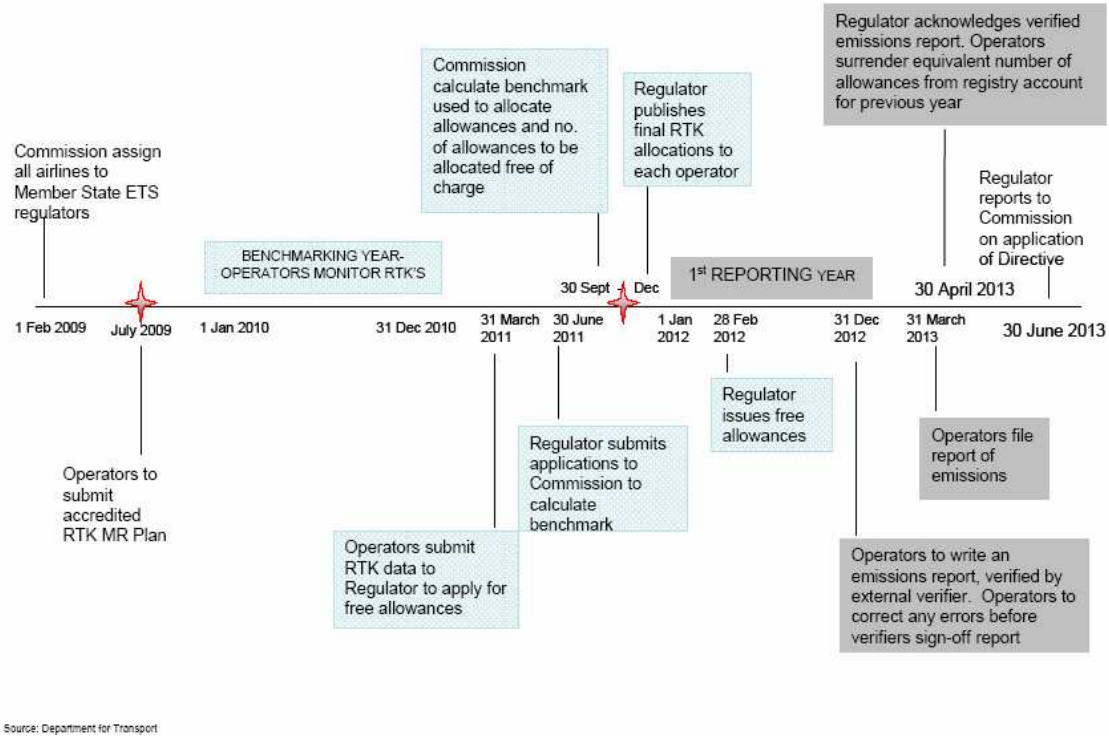
When each change of ownership of an allowance is proposed, the national registry and the European Commission are informed in order for them to validate the transaction. During Phase II of the EU ETS the UNFCCC will also validate any change that alters the distribution within each national allocation plan.

Like the Kyoto trading scheme, the EU scheme allows a regulated operator to use carbon credits in the form of Emission Reduction Units (ERU) to comply with its obligations. A Kyoto Certified Emission Reduction unit (CER), produced by a carbon project that has been certified by the UNFCCC's Clean Development Mechanism Executive Board, or Emission Reduction Unit (ERU) certified by the Joint Implementation project's host country or by the Joint Implementation Supervisory Committee, are accepted by the EU as equivalent.

Thus one EU Allowance Unit of one ton of CO2, or "EUA", was designed to be identical ("fungible") with the equivalent "Assigned Amount Unit" (AAU) of CO2 defined under Kyoto. Hence, because of the EU's decision to accept Kyoto-CERs as equivalent to EU-EUAs, it will be possible to trade EUAs and UNFCCC-validated CERs on a one-to-one basis within the same system. (However, the EU has announced that this facility is being delayed, until it can overcome its technical problems connecting to the UN systems.)

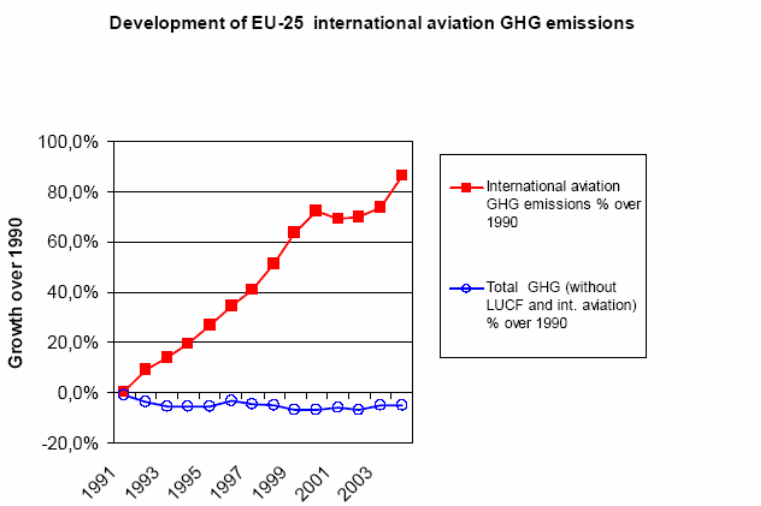
During Phase II of the EU ETS, the operators within each Member State must surrender their allowances for inspection by the EU before they can be "retired" by the UNFCCC.

5.1.3 Timeline for a 2012 start



Source: Department for Transport

5.2 Appendix 2: Evolution of international aviation GHG emissions as compared to total GHG



5.3 Appendix 3: Aviation Fuels Emission factors

Emission factors for aviation fuels

Fuel	Emission factor (tCO_2/tfuel)
Aviation gasoline (AvGas)	3,10
Jet gasoline (Jet B)	3,10
Jet kerosene (Jet A1 or Jet A)	3,15

5.4 Appendix 4: Merrill Lynch study "Aviation in EU ETS, an incentive for efficiency", September 2008

Table 3: Aviation and ETS - Level of emissions and potential cost to airlines in 2012

	2006 CO2 Emissions (mn)	2012 Forecast CO2 Emissions (mn)	With 97% Cap (mn)	85% Free Allowances (mn)	Allowances to Buy through auctioning (mn)	Cost of Auctioning, EURmn at EUR30/tonne	No. of Passengers (mn)	Cost per Passenger (EUR)
easyJet	3.0	5.7	2.6	2.2	3.5	104.1	65.6	1.59
Ryanair	3.8	6.8	3.6	3.0	3.8	112.0	74.9	1.50
AF-KLM	26.9	30.3	25.5	21.6	8.7	260.1	80.8	3.22
BA	17.6	19.9	16.4	14.0	5.9	176.8	40.6	4.35
Iberia	6.1	6.8	6.0	5.1	1.8	53.0	30.7	1.73
Lufthansa	21.9	24.7	20.7	17.6	7.1	211.7	71.0	2.98
Other	138.7	156.1	129.2	109.8	45.4	1390.6		
Total	**218.0**	**250.2**	**203.9**	**173.3**	**76.9**	**2308.3**		
						Average cost - low cost	Ryanair & easyJet	EUR 1.54
						Average cost - mainline	BA, Lufthansa, AF-KLM	EUR 3.52

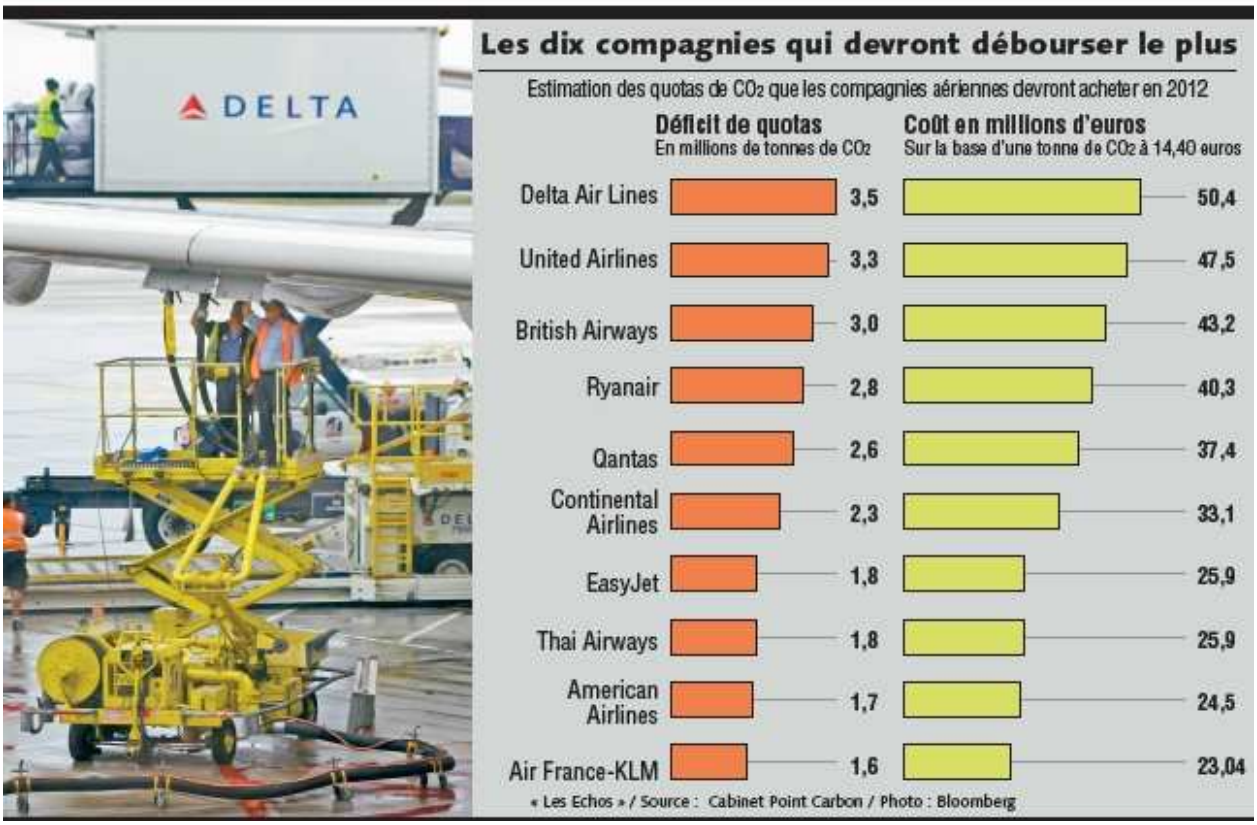
Source: Company data, Frontier Economics, Merrill Lynch

Table 4: Aviation and ETS - Level of emissions and potential cost to airlines in 2015

	2015 Forecast CO2 Emissions (mn	With 95% Cap (mn)	85% Free Allowances (mn)	Allowances to Buy through auctioning (mn)	Cost of Auctioning, EURmn at EUR30/tonne	No. of Passengers (mn)	Cost per Passenger (EUR)
easyJet	7.8	2.5	2.2	5.6	168.0	92.1	1.82
Ryanair	9.0	3.4	3.0	6.0	180.9	105.2	1.73
AF-KLM	32.2	24.9	21.2	11.0	329.2	85.7	3.84
BA	21.1	16.1	13.7	7.4	221.9	43.1	5.15
Iberia	7.3	6.2	5.0	2.3	68.7	32.5	2.11
Lufthansa	26.2	21.3	17.2	8.9	267.8	75.3	3.56
Other	165.7	133.2	107.5	58.2	1745.3		
Total	**269.1**	**210.2**	**169.7**	**99.4**	**2981.7**	**434.0**	
					Average cost - low cost	Ryanair & easyJet	EUR 4.18
					Average cost - mainline	BA, Lufthansa, AF-KLM	EUR 1.77

Source: Company data, Frontier Economics, Merrill Lynch

5.5 Appendix 5: Les Echos "Gaz à effet de serre : les compagnies aériennes mettent Bruxelles sous pression", August 18, 2009



5.6 Appendix 6: Comparison of Merrill Lynch and Point Carbon studies on an airline basis

A report published in July 2009 by Point Carbon estimates the aviation could face a shortfall of 77 million tones of CO2 when it enters into ETS in 2012. This equates to € 1.1 billion at July spot price of €14.4 per tones of CO2.

Point Carbon	Shortfall of quotas in 2012 in million tonnes	€/T	M€	%
Delta Airlines	3,50	14,40	50,40	5%
United Airlines	3,30	14,40	47,52	4%
British Airways	3,00	14,40	43,20	4%
Ryanair	2,80	14,40	40,32	4%
Qantas	2,60	14,40	37,44	3%
Continental Airlines	2,30	14,40	33,12	3%
EasyJet	1,80	14,40	25,92	2%
Thai Airways	1,80	14,40	25,92	2%
American Airlines	1,70	14,40	24,48	2%
AF KLM	1,60	14,40	23,04	2%
Other	52,60	14,40	757,44	68%
	77,00		**1 108,80**	**100%**

Source : Cabinet Point Carbon, July 2009

According to Merrill Lynch, the allowances to be bought in 2012 should amount to € 2.3 billion with a CO2 price of € 30 per ton of CO2. If assessing the ton of CO2 at the same price €14.4, the cost for airlines would be € 1.1 billion.

Merrill Lynch	Quotas to be bought in 2012	€/T	M€	%
EasyJet	3,49	14,40	50,26	5%
Ryanair	3,74	14,40	53,86	5%
AF KLM	8,63	14,40	124,20	11%
British Airways	5,96	14,40	85,82	8%
Iberia	1,70	14,40	24,48	2%
Lufthansa	7,11	14,40	102,31	9%
Other	46,28	14,40	666,43	60%
	76,90		**1 107,36**	**100%**

Source : Merrill Lynch Study "Aviation in EU ETS, an incentive cost for efficiency", September 2008

IATA estimates the cost at € 2.4 billion at a carbon price of € 30 per ton the first year in 2012, which means around 80 millions tones of CO2. Revising the price per ton at €14.4, the amount in 2012 would be € 1.2 billion.

The outcome of these studies is close with a cost for airlines in 2012 around € 1 billion and between 77 to 80 tons of CO2 to be bought.

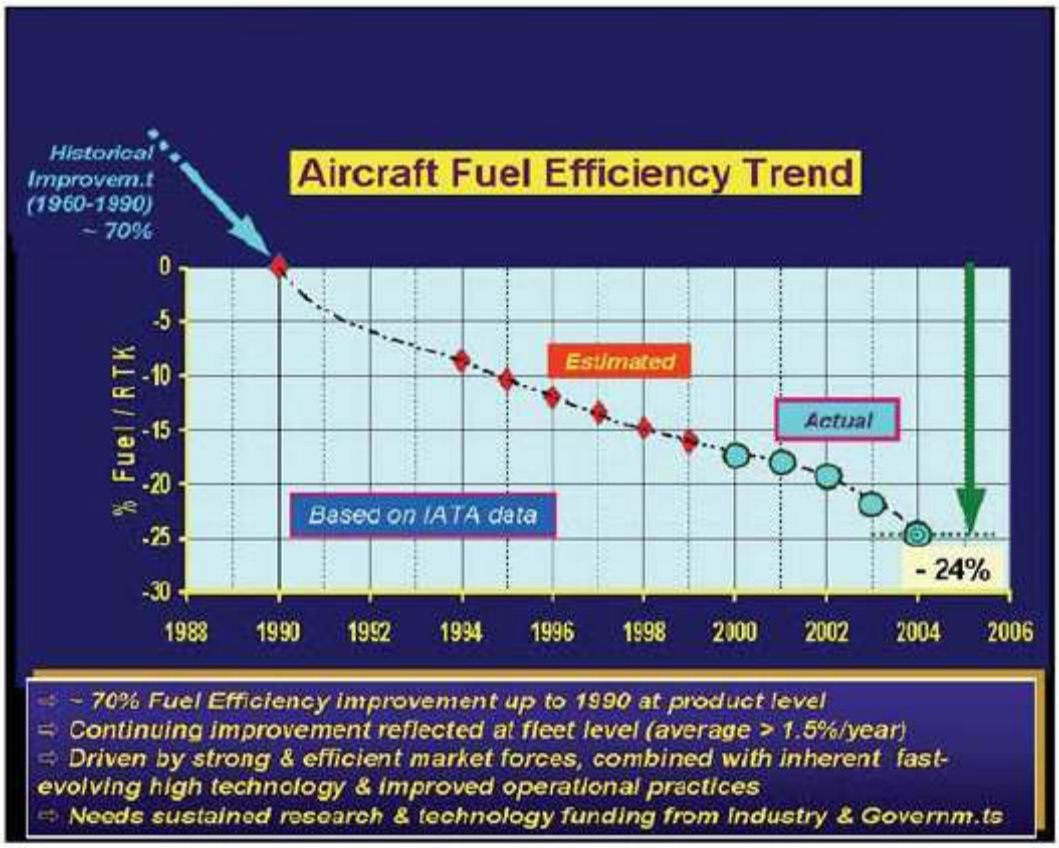
Looking closer into details, it appears that the estimation per airline is totally different between these studies.

According to Point Carbon, some major American airlines will be the hardest hit by the EU ETS, followed by British Airways (€ 43 million – 3 million tons) and some low cost carriers (Ryanair € 40 million – 2,8 million tons and EasyJet € 26 million – 1,8 million tons). Air France-KLM legal carrier should be less impacted (€ 23 million – 1,6 million tons).

According to Merrill Lynch study, it appears that the European legacy carriers will be the most impacted (Air France KLM € 124 million – 8,6 million tons and British Airways € 86 million- 5,7 million tons) followed by low cost carriers (Ryanair €54 million – 3,7 million tons and Easyjet € 50 million – 3,5 million tons).

These inconsistencies emphasize the fact that it seems difficult to estimate the cost of the EU ETS due to the uncertainties of the assumptions underlying such calculations.

5.7 Appendix 7: Aircraft fuel efficiency trend



Source: IATA

5.8 Appendix 8: Aviation biofuels

Some of the important events within the last 12 months:

- 24th Feb 2008, Virgin flew a 747-400 with 20% coconut and babassu oil biofuel mix on one engine.
- 8th Dec 2008 Continental flew a 737-800 on a 50/50 mix of algae based biofuel. Fuel consumption was reportedly lower than Jet A1
- 30th Dec 2008, New Zealand flew a 747-400 with 50/50 jatropha biofuel on one engine.
- 30th Jan 2009, Japan Airlines flew a 747-300 with 50/50 mix camelina/jatropha/algae biofuel in one engine. Fuel consumption was confirmed lower than Jet A1 by Pratt & Whitney. The company hopes to offer biofuel revenue passenger flights within 3-5 years.
- May 2009, Geneva based Air Transport Action Group ATAG publish the "Beginners Guide to Aviation Biofuels" with the support of Airbus, Boeing and CFM.
- 22nd September, US based BioJet announce a 4 million gallon contract for aviation biofuels with Las Vegas oil and fuel broker E85. Both companies expect demand to exceed 280 million barrels per year with jatropha based fuel being the short term feedstock.

5.8.1 Technical challenges

Most first generation biofuels such as ethanol and bio-diesel are not suitable for commercial aircraft as they do not meet the high safety specifications for jet fuel. Second and third generation fuels are in development which meet and exceed Jet fuel specifications. At present the industry is focused on biofuels which are "drop in" replacements to jet fuels meaning they do not require modifications to the aircraft or fuel distribution resources. Drop in fuels can be combined with Jet A1 as a blend or a 100% replacement.

Safety is the aviation industries top priority so aviation biofuels must undergo dozens of experiments in laboratories, on the ground and in the air.

Implementation of biofuels for aviation is easier than for other publicly available fuels once a suitable fuel has been identified as there are relatively few airport fuel depots: 1679 airports handle 95% of the world's passengers.

5.8.2 Certification

Following the initial trial flights, biofuels need to be certified as safe and appropriate for commercial use. The aviation industry is working closely with fuel certification bodies such as American Society for Testing and Manufacture ASTM. The initial target was to certify several biofuels as safe for aviation use by 2013 but the latest information is that a 50/50 blend of biofuel mixed with Jet A1 could be certified before 2011.

The approval process has three parts, the test program, the OEM internal review and a determination by the specification body as to the correct specification for the fuel.

Test flights have already been performed by airlines, Airbus and Boeing. Test and analysis are taking place in parallel.

5.9 Appendix 9: Minutes of the meeting with M. Pierre Pape, Alternate Representative of France on the Council of the International Civil Aviation Organization – Montreal, July16th, 2009

5.9.1 The EU aviation ETS directive background

The Kyoto protocol in the §2.2 mentions that under OACI control, the States will have to decrease CO2 emissions.

The Kyoto protocol does not really put pressure on the States, as it mentions "the States are invited to look at the opportunities to …"

Some countries are particularly cited in the Annex 1, mainly the developed countries, but some developing countries are not included in this list. For instance, China, Brazil, India (BRIC)

Aviation is formally excluded.

5.9.2 First step: the EU in an isolated position

Based on such background, the developing countries argue that:

(i) the Kyoto protocol does not concern the aviation industry

(ii) the Kyoto protocol does not include some of them and only concerns the developed countries

The initial drafted Directive of the European Union (EU) on the Emission Trading Scheme (ETS) includes the possibility to apply this system to third party operators that fly to Europe.

In the first step, the EU was quite isolated. 2 blocks of countries were against this drafted EU Directive: on one hand developed countries outside Europe, on the other hand developing countries such as BRIC. The latest argue that aviation is considered as one of their main vectors for growth and development.

They indicated that the EU wanted to force these countries to apply on a unilateral basis some measures that will lead to competition distortion and that penalize these countries.

These countries stated that there was no way to apply such Directive except if there was a common worldwide framework.

5.9.3 The evolution

5.9.3.1 In 2007

During the 2007 ICAO general meeting, the US managed to vote a resolution n°36-22 Appendix L stating that "concerning the ETS, every State or group of States can not impose a system of emission right to third party States except if there is a previous bilateral agreement.

5.9.3.2 Today

As of today, this resolution is still applicable till the next general meeting in 2010. We can notice a slight change in the position of some States since the arrival of Barack Obama's administration. ETS is now considered with interest by USA, Australia and Canada.

5.9.3.3 General resolution on the environment

5.9.3.3.1 Creation of the **GIACC**

In 2007, as a result of the 2007 ICAO general meeting, a specific group was created to deal with international aviation and climate change: GIACC (Group of International Aviation on Climate Change).

5.9.3.3.2 Mission

- to define a framework in order to implement measures that will contribute to a decrease in emissions in the aviation industry
- to draw an action plan to define the various measures

5.9.3.3.3 Members

There are 15 countries in the GIACC including US, Russia, UK, Australia, France, India, China, Saudi Arabia, Canada, Japan, Brazil, etc.

5.9.3.3.4 Work performed

This group began its mission in February 2008 and should finish in May 2009. There were 4 plenary sessions held in Montreal (Canada) in order to draw the reference framework.

The task was quite difficult as the members had different points of views, particularly China and Brazil who keep strong positions.

The goal was to reach a consensus in order to agree on an action plan in order for ICAO to present proposals at the Copenhagen meeting in December 2009 and to set short term to long term objectives.

5.9.3.3.5 Final result

The final result of this group was a catalogue of measures including:

- The improvement of energy efficiency of 2% per year from 2012 to 2050
- Carbon neutral international aviation in 2020
- A basket of measures such as
  - technical improvements of new generation aircraft (engine, airframe, systems)
  - acknowledgement of the relevance of ETS within a global framework to be defined by ICAO
  - improvement of operational procedures, air traffic management, new and more direct routes : SESAR, Nextgen
- Recognition of common but differentiated responsibilities
- Recognition of non discrimination principle

5.9.3.3.6 Next step

The result of the GIACC has been validated end of June 2009 by the Counsel (36 States), which means this is the official position of ICAO.

This actions plan is now officially and politically agreed. This is then a major step for ICAO in order to keep its leadership on the regulation of the international civil aviation.

The next step is the Top Level Executive Meeting that will take place in October 2009 to confirm this action plan with the 190 States.

Then, in December 2009, during Cop 15, ICAO will present its position.

5.9.3.4 Change in the State position

Before, there was EU against the others.

Now, EU has got support from other states except China, Brazil, India, etc. who state that it is not useful to anticipate anything before Copenhagen 15. They prefer to wait for the result of this conference to see what will happen for the aviation industry.

5.9.4 Key Future Issues

Considering the action plan agreed on June 2009 by the ICAO Council, some key issues remain opened:

- Is ICAO able to implement effectively this challenging action plan at worldwide level?
- In what kind of framework? At this stage this action plan is under ICAO direct responsibility.

These issues must be solved for the next ICAO General Assembly in 2010.

The most important point is that the main concerned relevant bodies such as IATA, ACI, CANSO, etc support current ICAO position.

5.10 Appendix 10: Minutes of the meeting with Charlotte Fantoli, Manager Industry taxation and Andreas Hardeman, Assistant Director, Environment Policy and Outreach, IATA – Geneva, August 31th, 2009

5.10.1 Presentation by Charlotte Fantoli, Industry taxation

IATA seeks to help its member airlines to handle the constantly increasing number of taxes and fees. IATA is proactively fighting any unfair tax treatment of the aviation industry. This includes working towards removal of ticket tax or at least to reduce the global tax burden through lobbying governments at different levels.

IATA provides reference tools to worldwide ticket taxes, charges and fees by identification, classification and publication.

Every registered fee, when imposed on a per passenger basis, to be identified separately on air tickets receives an IATA tax code: more than 500 in use, at the time of the meeting there were only 55 two letter codes left available. The industry will soon move into three digit codes (alpha/numeric).

Huge increase in the number of taxes during the last years; in average, more than 30 additional tax codes are assigned by IATA each year.

Ticket price = fare + government taxes + airport charges+ surcharges (Q) + various fees

The former 'Tax Box' on the air ticket has been re-named "TAX/FEE/CHARGE"

Taxes & charges collection is very complex and still not harmonized, neither centralized

IATA provides tax reference products that provide information and help to collect taxes starting with lists and details of approved taxes/fees/charges (all surcharges excluded).

A revenue accounting group, an industry taxation committee exists at IATA but no tax / charge collection/remittance overall guidelines are available. Governments issue tax laws and collection and remittance procedures are handled according to the legal requirements. Airport authorities levy charges and collection methods are dealt with by the individual airlines.

Airlines, members of IATA, pay US$ 43,5 billions per year of Taxes/Fees/Charges for airport and ATM infrastructure costs.

Contrary to other modes of transport, aviation does not benefit from state subsidiaries.

A small department in ICAO exists for taxation.

5.10.2 Open discussion with Andreas HARDEMAN, Environmental Policy and Outreach

Since 90's, IATA, ICAO and others have conducted studies & analyses that lead to the conclusion that a global ETS is the most cost effective way to handle emission reduction issue.

Nevertheless, IATA does not support the EU ETS due to the complexity, the restrictions that have been applied to trading and to the fact that not being global, it induces competitive distortion in the business.

In 2004 and again in 2007, IATA has tried to push ICAO to develop a global ETS but EU countries opposed.

Mr Hardeman considers that EU is clearly trying to promote their own approach as the blueprint for a potential global approach.

IATA highlights that the EU ETS is not harmonized and is very complex to implement and is calling for increased harmonization and simplification.

IATA considers the EU directive for the inclusion of aviation into the EU ETS as a half baked directive. Requirements, directly issued from the fixed structure ETS, are very unclear and cannot be easily adapted to aviation operators.

In the past years, IATA has mostly been active in the legislative process (lobbying to EU) to avoid big damages from the ETS directive writing.

Now IATA is engaged in a more operational and practical way through workshops and training organization including manufacturers, operators, fuel suppliers.

The conclusion is that the steep learning curve is not only for A/L but also for EU commission & governments, therefore the agreed delays for the august 31st milestone.

Training courses are starting to be organized with GHG Management Institute and other consultants.

The aim of IATA is to develop knowledge and understanding in both way : Aviation stakeholder with respect to ETS & carbon trading and ETS and environment experts with respect to aviation industry. Indeed, within the recent years, and along with the development of environmental issues perception by the political sphere, a major shift has taken place. Now It is no longer the: Aviation & Transport Minister that is dealing with environmental issues, but the Environment Minister that is dealing with aviation.

IATA position is that the aviation industry is far more complex and specific that to be considered similarly to another sector (even a transport sector) and states that: the solutions developed for other sector cannot be easily adapted to aviation.

Based on existing global experiences in other areas such as IOSA for safety, or the IATA clearing house, IATA agrees that they potentially have the knowledge and technical structure to handle a global ETS but there is still a lot of political opposition to be considered. Certain governments do not want to see aviation self regulated.

To help A/L funding emission reduction plan, IATA is lobbying governments to cut taxes.

Carbon trading is rather similar to fuel purchase and management. A/L are well autonomous on that and IATA is only proposing courses & trainings about carbon market but no consultancy.

IATA is investigating the possibility to trade CO2 emission for A/L but as its primary concern is to protect the interests of its members, putting IATA in the position of a CO2 or a fuel trader could be a sensitive issue. Therefore, IATA has not explored this opportunity yet.

IATA has recently launched a global offset scheme for interested airlines, which has been designed to be simple, low cost and standardized. It is hence too far apart from the EU ETS to make a bridge.

IATA believes that a lot will depend on what is decided in Copenhagen about CO2 reduction targets for aviation. If a strong short term target is adopted, then emission trading will become a key issue. If not, then technical and operational improvements (including fleet management, ATM improvement and biofuels) should be sufficient to meet targets (long term). However, the EU ETS is expected to carry on regardless of the Copenhagen outcome.

IATA points out that there is no clear information yet about what the money collected upon the EU ETS will be used for.

IATA, which is not directly represented at the Copenhagen meeting, has asked ICAO to ask UNFCCC to include Aviation emission in the post Kyoto protocol in order to back-up the emission reductions that they could implement as a first step to a global & sectoral approach to tackle aviation GHG emissions.

The objectives of IATA for the Copenhagen meeting are first that ICAO remains in the driving seat to develop a global sectoral agreement for Aviation and second to avoid a new tax to be imposed.

IATA also recommends to consider in addition Tax Break option (the team assumes in a coordinated and global way) in order to support A/L investment in fleet renewal to help achieve the 2020 IATA carbon neutral growth target (for our team research project, we propose to reinforce our recommendations to quote fleet renewal investments costs on a yearly basis in order to reach 2020 targets, to assess production increase for main aircraft manufacturers in comparison with current yearly delivery rate; it should be a good hint).

From an aviation impact on environment perspective, IATA considers that at this stage the responsibility sharing needs to be clarified.

Once the regulatory basis is settled, IATA is ready to take part in aviation ETS' operations with their technical capacity and knowledge.

Mr Hardeman states that it is too early at this stage for governments or airlines to take legal actions against the directive as it first has to be transposed into domestic laws to be legally challenged.

According to recent traffic forecast, IATA is expecting the burden of CO2 allowances to be of about 2,5 b$ in 2012 (revised figures) and 18,8 b$ in 2020.

5.10.3 Conclusions

- According to IATA, a global sectoral approach is the best for aviation. IATA believes that managing CO2 emissions reduction could be performed without restrictive economic measures (as imposed by EU ETS). A global ETS should be seen as a part of a global package of measures to reduce CO2.

- IATA can not support the EU ETS, as it no longer allows airlines to have the most effective outcome. The EU Directive would need some harmonization and some simplification, as IATA considers the EU ETS to be very complex and unclear.

- Role of IATA in a clearing house for the EU ETS

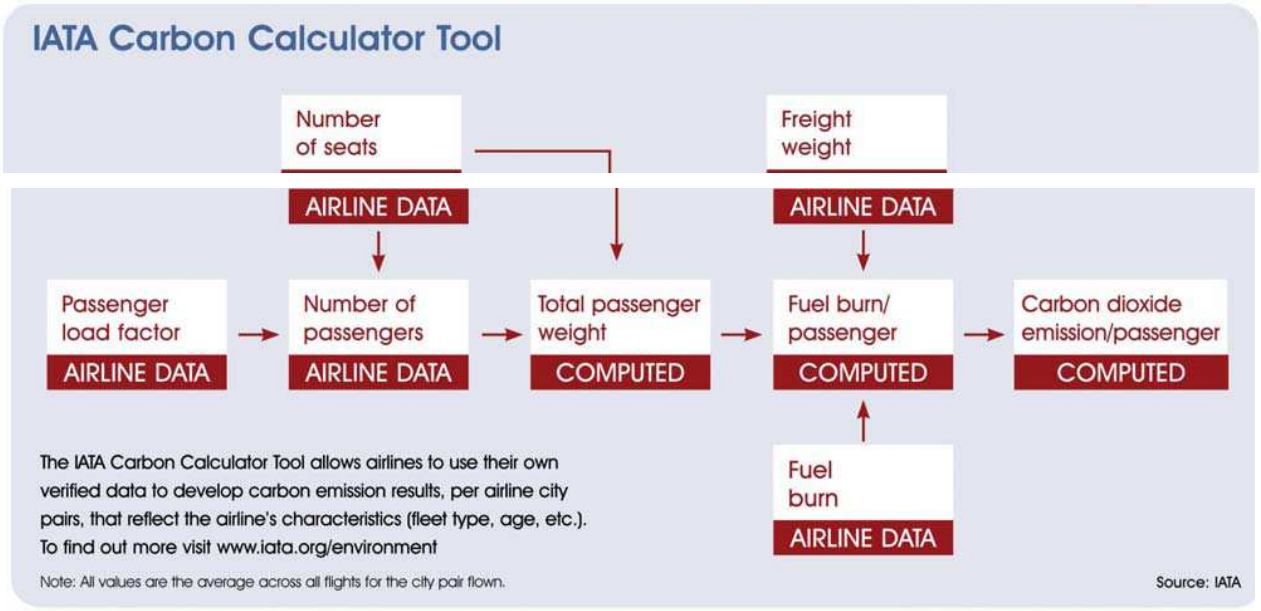
IATA 's primary role is to protect the interest of its members. It seems difficult for IATA to reconcile this role with managing CO2 trading. CO2 trading is a financial business risk for the airlines as the allowances of CO2 will have to be bought on a market with fluctuations of the price of the ton of CO2 depending of external factors. This risk has to be taken at A/L level (or alliance level).

Why not implement a kind of pool of CO2 credit or offset? IATA has not explored this option yet.

- The role of IATA/ICAO is more oriented on the data management. Airlines could report to IATA who would keep track of the CO2 related data.

- Copenhagen 15
  - IATA and ICAO will have a common position
  - A position paper is currently under review at IATA level (should be soon available) to be transmitted to ICAO
    - International aviation should be included in a global scheme
    - Role of ICAO/IATA to manage accounts and to track records
  - What should be the message delivered at Copenhagen
    - There should not be a new tax to handle CO2 emission reduction
    - ICAO must remain in the driving seat to develop the framework of a global approach

5.11 Appendix 11: IATA carbon tool calculator



5.12 Appendix 12: Extracts of "Aviation and Climate change: lessons for European policy", Alice Bows with Kevin Anderson and Paul Upham, Routledge 2009

Although the EU is now engaged with the climate change issue, there are many technological and operational barriers to change, not least in relation to the long time lag involved in a comprehensive global fleet renewal (page 4).

One indisputable issue is the long lag in bringing about change given the lifetime of current aircraft (page 45).

Given the long lifetimes of current aircraft (up to forty years when considering the conventional business model), and the institutional barriers to change such as airport configuration and negotiations over, for example "the Single European Sky" concept, the fuel efficiency of the whole fleet is likely to improve slowly. Taking a European rather than a global view, slow rates of fleet renewal in many European nations have traditionally led to efficiency improvements per passenger-km over the previous 20 years of around 1-2% per year. Therefore, without continuing pressure on the industry to mitigate CO2, similar rates may continue.

Motivation to mitigate emissions within the industry has significantly increased. If this continues to be the case, perhaps fuel efficiency per passenger-km of the order of 2 to 3% per year or even higher may again be possible in the coming decades. However, only if fuel efficiency per passenger-km exceeds rates of growth, will emission from the aviation industry remain constant or fall. Unfortunately, from a climate change perspective, With passenger-kms flown increasing rapidly (5,7% during the past 20 years for the EU), stabilizing and ultimately reducing aviation emissions currently appears highly unlikely within the coming decades (page 59).

There are numerous of available options for mitigating aviation's impact on the climate. However, given the industry's relative high baseline and very rapid rise in emissions against the backdrop of stringent carbon-reduction pathways, measures to curb growth in passenger-km will undoubtedly form a necessary element of any meaningful policy portfolio.

The emission reduction pathways will require unprecedented efforts across all sectors in relations to fuel-shifting, improving technologies and operational efficiency and modifying energy-consuming practices by organizations and individuals. These changes will need significant investment, time and sustained political will. Unfortunately, despite binding and non binding emissions-reduction targets, neither the UK nor the EU are close to seeing even moderate CO2 emission reductions year-on-year. Even if emissions do begin to reduce at the rates required from other non-international sectors, the continued growth in emission from the aviation sector will significantly undermine, if not negate, any reduction made. (page 76)

Given that the aviation industry has significantly fewer technological and managerial options to reduce CO2 emissions in the short-to medium term than do most other sectors, and that any improvements made will likely be outstripped by growth, 2 clear courses of action emerge:

- Industrialized nations must urgently reduce energy consumption, improve energy efficiency and roll out low-carbon supply options across all sectors of the economy. Only a portfolio of all these measures will deliver the decarbonization required.
- Industrialized nations must curb growth and stimulate innovations within the aviation industry until the sector's annual growth in CO2 emissions can be offset by their annual improvements in fuel efficiency or ultimately carbon efficiency.

If industrialized nations do not begin to follow these two lines of action immediately an in earnest, EU governments will miss their 2050 targets and more significantly will forgo any real opportunity to stabilize emission at levels appropriate to 2°C.(conclusion page 126)

With fuel being one of the air transport industry's biggest costs, reducing fuel burn makes sound business as well as environmental senses. Nonetheless, aviation is a vital enabler of global economic prosperity, and the benefits of economic growth should not be carelessly thrown away. Instead, efforts must be focused on limiting emissions in every way possible while managing growth across the sector.

5.13 Appendix 13: The sample Airline calculation of CO2 emissions

CALCULATION OF CO_2 EMISSIONS

6 Activity data

(a) Please specify the methodology used to measure fuel consumption for each aircraft type.

In each case, the method chosen should provide for the most complete and timely data combined with the lowest uncertainty without incurring unreasonable costs.
Note that the Aircraft types are automatically taken from section 4(a).

Method A: Actual fuel consumption for each flight (tonnes) = Amount of fuel contained in aircraft tanks once fuel uplift for the flight is complete (tonnes) - Amount of fuel contained in aircraft tanks once fuel uplift for subsequent flight is complete (tonnes) + Fuel uplift for that subsequent flight (tonnes)

Method B: Actual fuel consumption for each flight (tonnes) = Amount of fuel remaining in aircraft tanks at block-on at the end of the previous flight (tonnes) + Fuel uplift for the flight (tonnes) - Amount of fuel contained in tanks at block-on at the end of the flight (tonnes)

Generic aircraft type (ICAO aircraft type designator) and sub-type	Method (A/B)	Data source used to determine fuel uplift	Methods for transmitting, storing and retrieving data
B734	Method A	As measured by fuel supplier	Recorded in aircraft technical log
B738	Method A	As measured by fuel supplier	Recorded in aircraft technical log
	Please select	Please select	Please select
	Please select	Please select	Please select
	Please select	Please select	Please select
	Please select	Please select	Please select
	Please select	Please select	Please select
	Please select	Please select	Please select
	Please select	Please select	Please select
	Please select	Please select	Please select

Please continue on a separate sheet as required.

(b) If the chosen methodology (Method A/Method B) is not applied for all aircraft types, please provide a justification for this approach in the box below.

n/a

(c) Complete the following table with information about the systems and procedures to monitor fuel consumption per flight in both owned and leased-in aircraft.

The procedure must include the selected tiers, a description of the measurement equipment, and the procedures for recording, retrieving, transmitting and storing information.

Title of procedure	Fuel Measurement
Reference for procedure	Fuel Measurement Process Chart; Fuel Measurement Data Flow
Brief description of procedure	The pilot takes the fuel level in tanks before fueling from the onboard FQIS and enters it into the flight report. After fueling the supplier provides a fuel receipt containing information on fuel uplifted and the temperature information to convert volume in mass according to a density correlation table. The pilot checks the data on the receipt with the onboard FQIS and enters it into the flight report. After the flight the documentation is passed on to our Flight Department in paper where it is entered into ASIA. The paper records are stored in an archive of the department.
Post or department responsible for data maintenance	Flight Department
Location where records are kept	Flight Department Archive
Name of system used (where applicable).	ASIA

(d) Please specify the method used to determine the density used for fuel uplifts and fuel in tanks, for each aircraft type.

Actual density values should be used unless it is shown to the satisfaction of the Competent Authority that actual values are not available and a standard density factor of 0.8 kg/l shall be applied.

Generic aircraft type (ICAO aircraft type designator) and sub-type	Method to determine actual density values	Justification for using standard value if measurement is not feasible, and other remarks
B734	Temperature of uplift	
B738	Temperature of uplift	
	Please select	
	Please select	
	Please select	
	Please select	
	Please select	
	Please select	
	Please select	
	Please select	

Please continue on a separate sheet if required.

(e) Please specify the source of temperature-density correlation tables, if applicable.

Only complete this section if you have selected at least once "Temperature of uplift" in table 6(d) above.

The temeprature-density calculations are performed by the fuel supplier. So the correlation tables also belong to the fuel supplier as he presents the amount of fuel in litres AND kg on the fuel receipt.

(f) Complete the following table with information about the procedures for measurement of the density used for fuel uplifts and fuel in tanks, in both owned and leased-in aircraft.

The procedure must include a description of the measurement instruments involved, or if measurement is not feasible, justification for applying the standard value.

Title of procedure	see 6d and 6e
Reference for procedure	see 6d and 6e
Brief description of procedure	see 6d and 6e
Post or department responsible for data maintenance	see 6d and 6e
Location where records are kept	see 6d and 6e
Name of system used (where applicable).	see 6d and 6e

(g) If applicable, provide a list of deviations from the general methodologies for determining fuel uplifts/fuel contained in the tank and density for specific aerodromes.

Where necessary due to special circumstances, such as fuel suppliers who cannot provide all of the required data for a certain methodology, a list of deviations from the general methodologies should be given for specific aerodromes. For example, if a fuel supplier at a specific aerodrome cannot provide the actual density data, specify the alternative approach proposed. Please list aerodromes using their ICAO designator, separated by semicolons.

Type of deviation	Justification of special circumstances	Aerodromes for which deviation applies
n/a		
n/a		
n/a		
n/a		
n/a		

Please continue on a separate sheet if required.

7 Uncertainty Assessment

(a) Where on-board systems are used for measuring fuel uplifts and the quantity remaining in the tank, please provide uncertainty associated with the on-board measurement equipment.

Where fuel uplifts are determined solely on the invoiced quantity of fuel or other appropriate information provided by the supplier, no further proof of uncertainty level is required.
Uncertainty values should be taken from the calibration certificate, where applicable, or otherwise from equipment manufacturer's specification. An estimate using the ranges in the drop-down list should be used only if more precise values are not available.

Generic aircraft type (ICAO aircraft type designator) and sub-type	Uncertainty of measurement of fuel remaining in the tank	Are fuel uplifts determined solely by the invoiced quantity of fuel or other appropriate information provided by the supplier?	If no:		
			Are on-board measurement devices for fuel uplift supported by calibration certificates?	Measurement equipment uncertainty (+/-%)	Location of evidence of routine checks (if no calibration certificate)
B734	<2.5%	Yes	Please select		
B738	<2.5%	Yes	Please select		
		Please select	Please select		
		Please select	Please select		
		Please select	Please select		
		Please select	Please select		
		Please select	Please select		
		Please select	Please select		
		Please select	Please select		
		Please select	Please select		

Please continue on a separate sheet if required.

(b) Please identify the main sources of uncertainty and their associated levels of uncertainty for your fuel consumption measurements.

You are not required to carry out a detailed uncertainty assessment, provided that you identify the sources of uncertainties and their associated levels of uncertainty. Uncertainties for other components than those listed in 7(a) may be based on conservative expert judgement.

Source of uncertainty	Level of uncertainty	Comments on level of uncertainty
Wrong entry in Flight report	unknown	Pilot produces a writing error when entering numbers from fuel receipt into Flight Report. Risk is very low as invoices
Wrong entry by specialist entering data into ASIA	unknown	The specialist entering the data from flight report might do a typing error when trasnferring data into AISA. The

Please continue on a separate sheet if required.

(c) Please provide details about the uncertainty threshold you intend to meet for each source stream (fuel type).

For each source stream (fuel type), specify the estimated annual CO_2 emission from the source stream, whether the source stream is considered to be a major, minor or de minimis source and the corresponding measurement uncertainty threshold (representing the maximum measurement uncertainty during the monitoring year) you will meet.

Please use the blank fields in column C to name any alternative and/or biofuels which you will use. State the estimated fossil CO2 emissions arising from each listed fuel type, in order to provide evidence for the correct tier choice. Please ensure that the total emissions are consistent with the answer given in section 4(g)

	Source stream (Fuel type)	Estimated annual fossil CO_2 emissions from each fuel	% of total estimated CO_2 emissions	Source stream classification	Fuel consumption uncertainty	Tier number
Std Fuels	Jet kerosene (Jet A1 or Jet A)	350 000	100,0%	Major	<2.5%	2
	Jet gasoline (Jet B)		0,0%	Please select	Please select	
	Aviation gasoline (AvGas)		0,0%	Please select	Please select	
Alternatives			0,0%	Please select	Please select	
			0,0%	Please select	Please select	
			0,0%	Please select	Please select	
			0,0%	Please select	Please select	
Biofuels			0,0%	Please select	Please select	
			0,0%	Please select	Please select	
			0,0%	Please select	Please select	
			0,0%	Please select	Please select	
	Total for all fuel types:	**350 000**	**100,0%**			
	Estimate given under section 4(g):	350 000				
	Difference:	0	0,0%			

(d) Complete the following table with information about the procedure used to ensure that the total uncertainty of fuel measurements will comply with the requirements of the selected tier.

The procedure must demonstrate that the uncertainty of fuel measurements will comply with the requirements of the selected tier, referring to calibration certificates of measurement systems, national laws, clauses in customer contracts or fuel suppliers' accuracy standards.

Title of procedure	Cross-check of fuel receipt
Reference for procedure	no documentation available
Brief description of procedure	The onboard FQIS measures the amount of fuel with a maximum uncertainity of 1% according to the manufacturer. By cross-checking the amount of fuel uplifted stated on the fuel receipt with the FQIS a maximum deviation of 1% can be immediatly tracked and the fuel provider can immediatly be informed.
Post or department responsible for data maintenance	Pilot
Location where records are kept	Flight Department Archive
Name of system used (where applicable).	

(e) Complete the following table with information about the procedure used to ensure regular cross-checks between uplift quantity as provided by invoices and uplift quantity indicated by on-board measurement.

Where deviations are observed, corrective actions must be taken in accordance with Annex I section 10.3.5 of the Monitoring and Reporting Guidelines.

Title of procedure	see 6c and 7d
Reference for procedure	see 6c and 7d
Brief description of procedure	see 6c and 7d
Post or department responsible for data maintenance	see 6c and 7d
Location where records are kept	see 6c and 7d
Name of system used (where applicable).	see 6c and 7d

8 Emission factors

(a) Please confirm that you will use the following standard emission factors for commercial standard aviation fuels

Type of aviation fuel	Default IPCC value (tonnes CO_2 /tonne fuel)	Confirm
Jet kerosene (Jet A1 or Jet A)	**3,15**	☑ Yes
Jet gasoline (Jet B)	**3,10**	☑ yes
Aviation gasoline (AvGas)	**3,10**	☑ Yes

(b) If applicable, please provide a description of the procedure used to determine the emission factors, net calorific values and biomass content of alternative fuels (source streams).

Title of procedure	n/a
Reference for procedure	n/a
Brief description of procedure	n/a
Post or department responsible for data maintenance	n/a
Location where records are kept	n/a
Name of system used (where applicable).	n/a

(c) If applicable, please describe the approaches used for sampling batches of alternative fuels.

For each source stream, succinctly describe the approach to be used for sampling fuels and materials for the determination of emission factor, net calorific value and biomass content for each fuel or material batch

Source stream (fuel type)	Parameter	Description	conform with Standard (ISO, CEN,...)	Frequency
n/a	Please select			Please select
n/a	Please select			Please select

(d) If applicable, please describe the approaches used to analyse alternative fuels (including biofuels) for the determination of net calorific value, emission factors and biogenic content (as relevant).

For each source stream, succinctly describe the approach to be used for analysing fuels and materials for the determination of emission factor, net calorific value and biomass content for each fuel or material batch (if applicable to the selected tier).

Source stream (fuel type)	Parameter	Description	conform with Standard (ISO, CEN,...)	Frequency
n/a	Please select			Please select
n/a	Please select			Please select

(e) If applicable, please provide a list of laboratories used to undertake the analysis and confirm whether the laboratory is accredited for this analysis according to ISO17025, or otherwise describe the quality assurance measures in place.

Name of laboratory	Analytical procedures	Is laboratory ISO17025 accredited for this analysis?	If no, specify quality assurance measures
		Please select	
		Please select	
		Please select	
		Please select	

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6.3 Specific studies

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- Flightinternational

"Carbon complexities" – Flight International, April 30, 2009
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"Aviation and Climate change – Law & Policy" – February 2009

6.5 Internet websites

Air France-KLM corporate website : www.corporate.airfrance.com
Airbus website : http://www.airbus.com/
Boeing website: http://www.boeing.com/
Eurocontrol website: www.eurocontrol.int
ICAO web site : www.icao.int
IATA web site : www.iata.org

7 Glossary

AAPA	**A**ssociation of **A**sia **P**acific **A**irlines
AAU	**A**ssigned **A**mount **U**nit
ACI	**A**irports **C**ouncil **I**nternational
AEA	**A**ssociation of **E**uropean **A**irlines
APU	**A**uxiliary **P**ower **U**nit
ASPIRE	**A**sia and **S**outh **P**acific **I**nitiative to **R**educe **E**missions
ATA	**A**ir **T**ransport **A**ssociation
ATAG	**A**ir **T**ransport **A**ction **G**roup
ATM	**A**ir **T**raffic **M**anagement
BA	**B**ritish **A**irways
BRIC	**B**razil, **R**ussia, **I**ndia and **C**hina
CAEP	**C**ommittee on **A**viation **E**nvironmental **P**rotection
CANSO	**C**ivil **A**ir **N**avigation **S**ervices **O**rganisation
CDM	**C**lean **D**evelopment **M**echanism
CER	**C**ertified **E**mission **R**eduction
COP15	**Cop**enhagen **15** (United Nations Climate Change Conference on December 7-18, 2009)
EPA	**E**nvironmental **P**rotection **A**gency
ERU	**E**mission **R**eduction **U**nit
ETS	**E**mission **T**rading **S**cheme
EU	**E**uropean **U**nion
EUA	**E**uropean **U**nion **A**llowance
EU ETS	**E**uropean **U**nion **E**mission **T**rading **S**cheme
FAA	**F**ederal **A**viation **A**dministration
FASB	**F**inancial **A**ccounting **S**tandards **B**oard
GDP	**G**ross **D**omestic **P**roduct
GHG	**G**reen**h**ouse **G**as
GIACC	**G**roup on **I**nternational **A**viation and **C**limate **C**hange
IASB	**I**nternational **A**ccounting **S**tandard **B**oard
IATA	**I**nternational **A**ir **T**ransport **A**ssociation
ICAO	**I**nternational **C**ivil **A**viation **O**rganisation
IET	**I**nternational **E**missions **T**rading
IFRS	**I**nternational **F**inancial **R**eporting **S**tandard
JAL	**J**apan **A**irlines
JI	**J**oint **I**mplementation
LCC	**L**ow **C**ost **C**arrier

LUCF	**L**and **U**se **C**hange and **F**orestry
M&A	**M**erger and **A**cquisition
MRV	**M**onitoring, **R**eporting and **V**erification
NAP	**N**ational **A**llocation **P**lan
OEM	**O**riginal **E**quipment **M**anufacturer
OTC	**O**ver **t**he **C**ounter
P&W	**P**ratt & **W**hitney
RTK	**R**evenue **T**on **K**ilometer
RVSM	**R**educe **V**ertical Separation **M**inima
SES	**S**ingle **E**uropean **S**ky
SESAR	**S**ingle **E**uropean **S**ky **A**ir Traffic Management **R**esearch
SIA	**S**ingapore **A**irlines
UNFCCC	**U**nited **N**ations **C**onvention on **C**limate **C**hange
US GAAP	**US G**enerally **A**ccepted **A**ccounting **P**rinciples
VAT	**V**alue **A**dded **T**ax