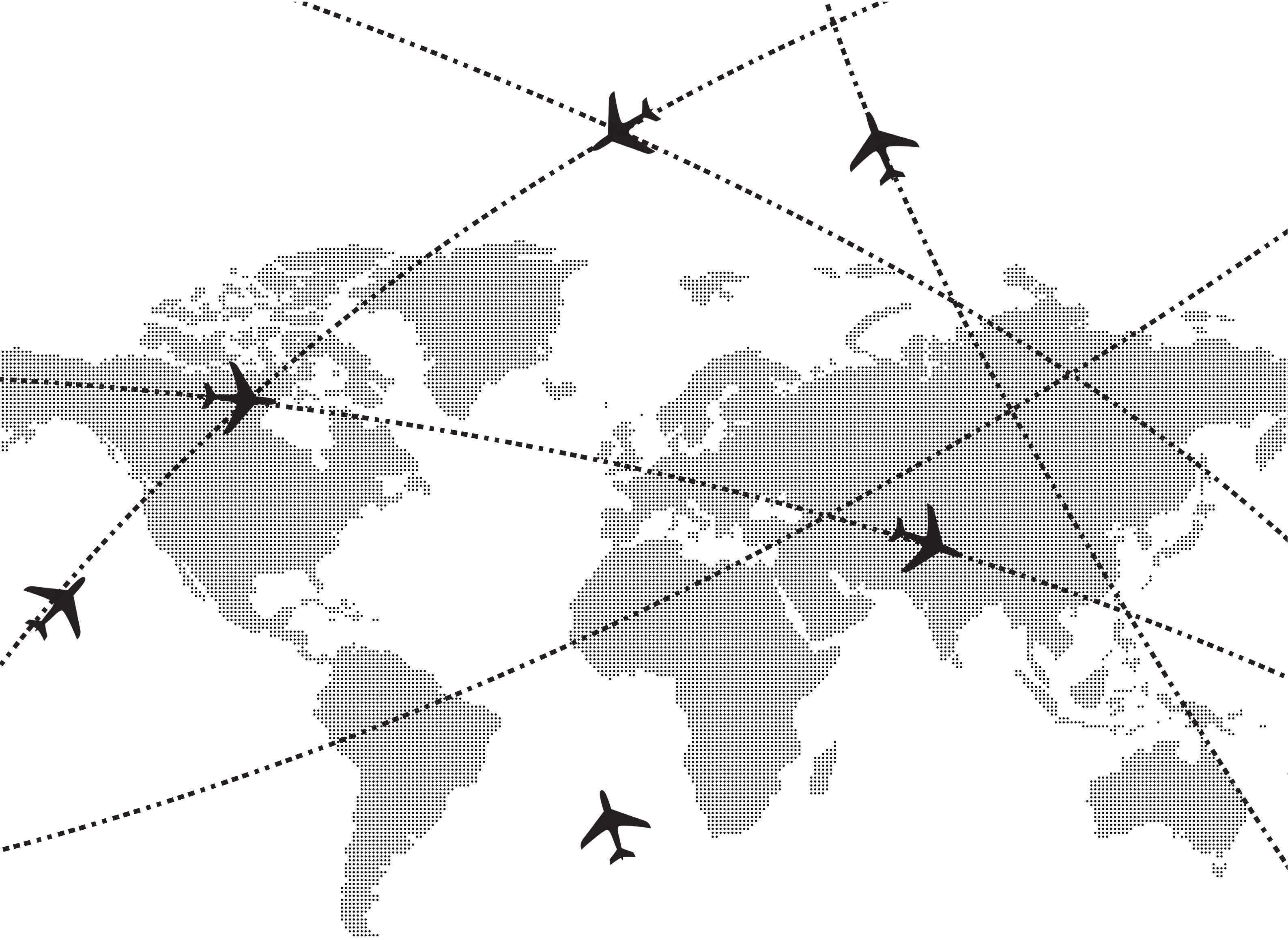

A New Flightplan

Getting global aviation climate measures off the ground

Background report for the conference held in Brussels, 7 February 2012

Produced with financial support from the Mission of Norway to the EU

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aef Aviation Environment Federation

A New Flightplan: Getting Climate Measures for Aviation off the Ground

Background report for the conference held in Brussels, 7 February 2012

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Context

The total climate impact of aviation is estimated at 4.9% of the global total. This figure includes the impact of CO_2 emissions and non-CO_2 impacts including NOx emissions at cruise and the warming effects of contrails and induced cirrus clouds.

In 1997 the parties to the Kyoto Protocol agreed that greenhouse gas (GHG) emissions from international aviation should be 'limited' or 'reduced' by developed countries working through the International Civil Aviation Organization (ICAO).

Almost 15 years after Kyoto, international efforts through ICAO to control aviation emissions have not yet led to any agreements on concrete action.

Aviation is the fastest growing source of transport greenhouse gas emissions and the most climate-intensive form of transport on the planet. Emissions have more than doubled in the last twenty years and, in 2008, the sector, together with shipping, accounted for a quarter of total transport emissions. The sector's growth has been aided by preferential treatment in the form of fuel and value added tax exemptions.

In the absence of global progress on mitigation measures, the EU included aviation, both domestic and international, in its emissions trading scheme (EU-ETS) from January 2012. But the aviation industry, and a number of non-EU states have been highly critical of Europe's approach.

The 37^{th} ICAO Assembly in 2010 resolved to develop a framework for international action by 2013 and agreed guidelines for global market based measures (MBMs) but little progress has been made on this work.

A process is now underway in ICAO to develop a fuel efficiency standard for new aircraft but progress has also been slow, industry is reluctant and it is not yet clear what will result.

This publication and the conference it accompanies is intended to inform and assist the process of moving towards global action to address aviation emissions. It has been organised by members of ICSA, the International Coalition for Sustainable Aviation, which is the environmental NGO observer at ICAO.

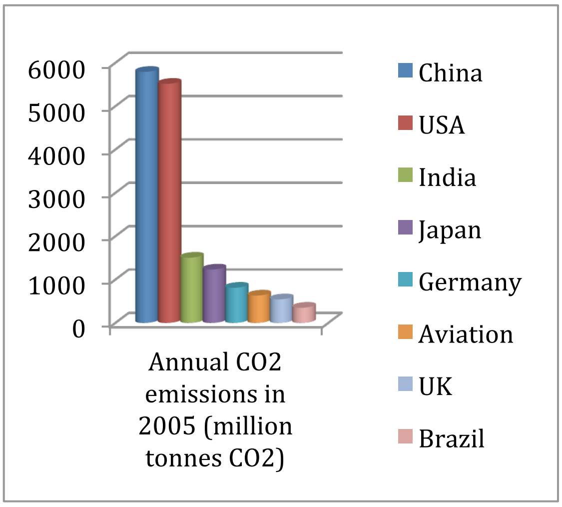
The organisers would like to thank the Mission of Norway to the EU for financial support.

Part 1
Aviation and climate change

1.1 Aviation and climate change[1]

Author: Tim Johnson, Aviation Environment Federation

Global carbon dioxide emissions from the civil aviation sector in 2005 were 630 million tonnes according to estimates by the International Civil Aviation Organisation (ICAO). This represents over 2% of global CO_2 emissions and is 15% greater than the CO_2 emissions from the entire UK economy in the same year.



The transport sector accounts for approximately a quarter of the world's CO_2 emissions, with aviation's contributing 9% of all transport-related CO_2 emissions.

But aviation's impact on climate change is not confined to its carbon emissions alone: aircraft generate significant impacts upon radiative forcing[2] with net additional warming effects over shorter timescales. Taking the CO_2 and non-CO_2 impacts together, aviation accounts for 3.5% of the total warming of the climate attributed to anthropogenic activities, rising to 4.9% if the effect of aviation-induced cirrus cloud formation is included.

Aviation's non-CO_2 effects

Aircraft emissions of nitrogen oxides (NO_x), water vapour and sulphate and soot aerosols have direct or indirect impacts on the Earth's climate. NO_x emissions at altitude react to increase atmospheric ozone concentrations and decrease the concentrations of methane which has a warming and cooling effect of the Earth's surface respectively. These effects are not uniform and occur in different regions. When averaged globally, NO_x emissions have a net warming effect.

When compared with CO_2 and NO_x, the impact of water vapour, soot and sulphates is relatively small: water vapour released by aircraft engines into the lower stratosphere acts as a greenhouse gas (below this altitude it is removed by precipitation), while aerosol concentrations from aviation fuel use have a small direct warming (soot) and cooling (sulphate) effect, although they may play a role in enhanced cloud formation.

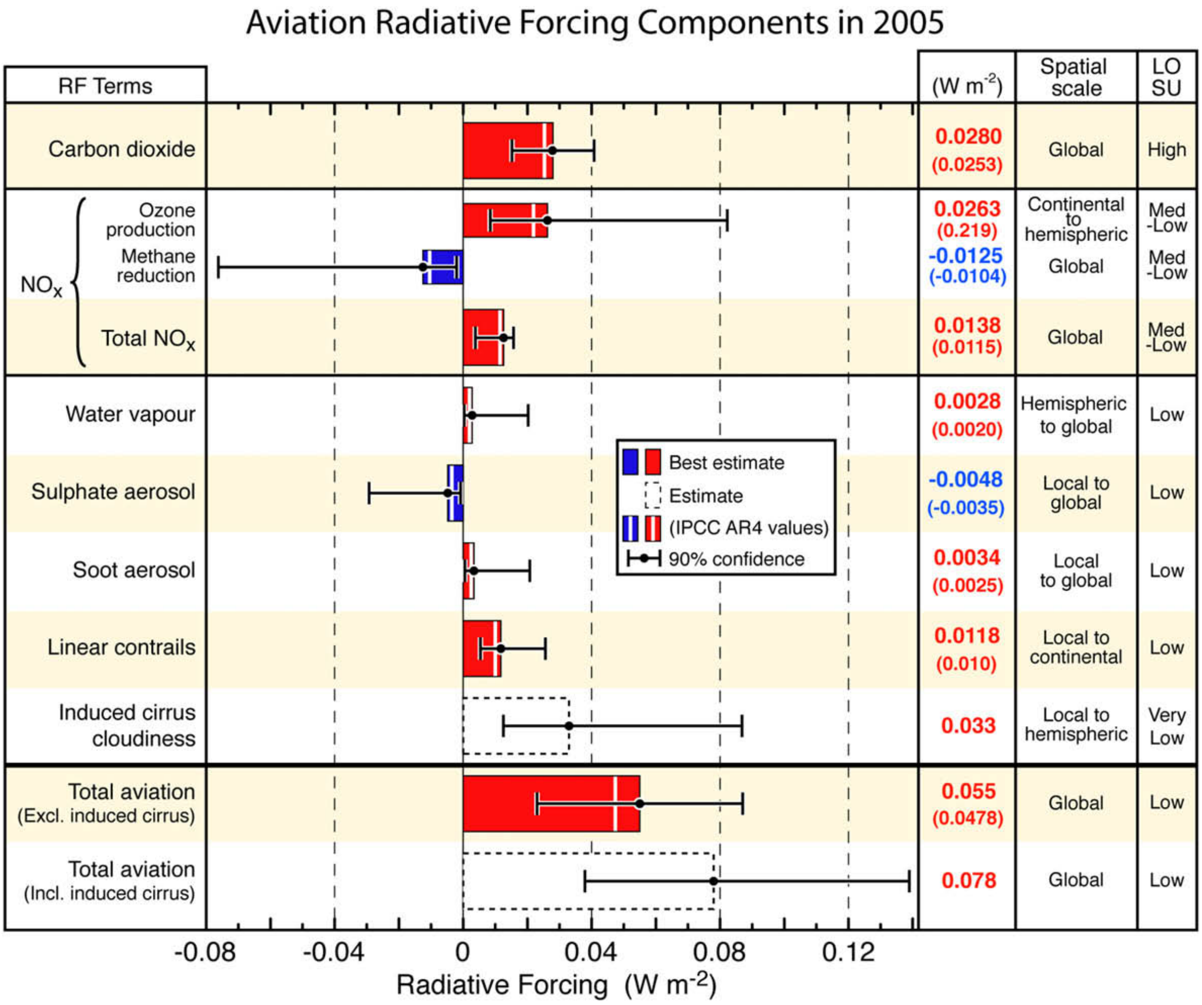
Depending on the atmospheric humidity, the hot air from aircraft engine exhausts can combine with water-vapour in the atmosphere to form ice crystals which appear as linear condensation trails (or contrails). These usually last a few hours, but can, in certain conditions, persist and spread into cirrus-like clouds which may last a few days.

Cirrus (COSIC), http://www.cosic.leeds.ac.uk/; Transport impacts on atmosphere and climate: Aviation, David S. Lee et al, http://www.atmosphere.mpg.de/enid/ATTICA/Aviation_63y.html

[2] Radiative forcing (RF) is a measure of changes to the energy balance of the atmosphere in watts per square meter (Wm^{-2})

Cirrus cloud formation following persistent contrail formation is less understood than other impacts, but both contrails and cirrus are thought to have warming effects. It is likely that condensation trails have a greater impact at night because they also act to reflect incoming radiation during daylight.

The chart below shows the relative contribution of each of these effects.



Excluding the effects of induced cirrus, the overall radiative forcing by aircraft is a factor of 1.9 times greater than the forcing by aircraft carbon dioxide emissions alone. However, to date, the focus of efforts in the EU and ICAO has been on CO_2, justified by a lower level of scientific certainty surrounding the non-CO_2 effects and an ongoing debate on a suitable metric (although alternative, temperature-based metrics are already emerging).

It is essential that the sector's total impact on the atmosphere is reflected in policy decisions, with appropriate measures to tackle CO_2, NO_x and contrail impacts taken in parallel.

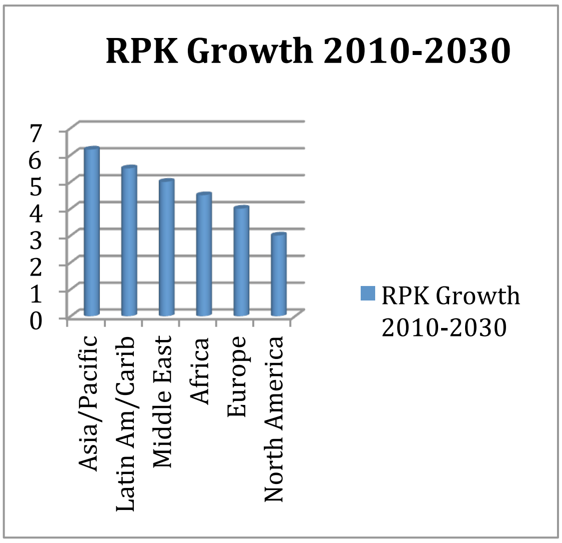
1.2 Aviation emissions forecasts to 2050[3]

Author: Tim Johnson, Aviation Environment Federation

Without further action, aviation emissions will increase significantly over the next 40 years. A review of available projections[4] published in *Bridging the Emissions Gap* (UNEP, 2011) shows emissions from the sector rising as high as 1.16 $GtCO_2$ by 2020 (compared to a 0.63$GtCO_2$ baseline in 2005). While other forecasts are lower, these depend to some extent on the introduction of new technologies. The clear message is that without technologies or policy intervention, it is very unlikely that emissions from the aviation sector will remain at or below today's level.

Projections out to 2050 demonstrate the scale of this challenge. ICAO's 2010 *Environment Report* includes modelled fuel burn forecasts for the period 2006 to 2050. From a baseline on 187Mt of fuel in 2006, the most "optimistic" scenario for the introduction of aircraft technology, coupled with advanced operational improvements, is still over 700 Mt of fuel by 2050 (or over 2,200 Mt of CO_2).

The biggest issue is that the rate of growth in the aviation sector outstrips the improvements in efficiency. At its Assembly in 2010, ICAO agreed to an environmental goal to improve the efficiency of the global fleet by 2% per annum out to 2020 and to aspire to continue this rate of improvement out to 2050. This is far less than the assumed growth in air traffic demand, as shown in the following illustration of average growth rates by region:



UNEP warns of the dangers of not tackling the rise in emissions from aviation (and shipping): under any scenario, these combined emissions will account for an increasing share of the total, representing as much as 5.7% and 32.5% of the median total emissions in 2020 and 2050 respectively. UNEP concluded that *"...it follows that the sum of emissions from all other sectors would have to proportionately decrease to ensure that total emissions do not exceed the emissions level consistent with a 2°C target."*

Rather than increase the burden of emissions cuts on other sectors, it is critical that aviation makes a fair and proportional effort to reducing its emissions. ICAO has set an aspirational goal to keep net emissions at 2020 levels while the Air Transport Action Group (ATAG) is looking to a 50% net reduction in emissions below 2005 levels by 2050.

To achieve this, industry and ICAO efforts have focussed on the role of operational and technological measures and the development of alternative fuels. The likely contribution from each of these components was assessed in *Bridging the Emissions Gap*. The estimated available efficiency improvements from operations (making more optimal use of airspace) is 3-10% although reconciling optimal operations with increasing traffic will be difficult.

[3] Sources fort his section: Bridging the Emissions Gap, UNEP (2011); Environmental Report 2010: Aviation and Climate Change, ICAO (2010); Meeting the UK aviation target – options for reducing emissions to 2050, Committee on Climate Change (2009)

[4] These include Aviation and the Global Atmosphere, IPCC (1999), CONSAVE (2005), QUANTIFY (2010), and ICAO (2009).

Technology improvements have been linked to the use of lighter airframe materials and changes in engine technology towards "open rotor" and "geared turbofan" engines. If realised, these technologies are likely to contribute more in the medium- to long-term. UNEP estimates the potential fuel efficiency improvements to be in the range 19-29% by 2020 (relative to current technology) and 26-48% by 2030, although an effective ICAO CO_2 standard for aircraft could ensure that this is realised on time.

The development of alternative fuels for aviation, including test flights, has dominated the media in recent years. While this demonstrates the technical feasibility of powering aircraft using biofuels, concerns still remain about accounting accurately for lifecycle emissions, as well as sustainability issues surrounding scaling up production and land-use change. Competition from other sectors for available biofuels is also placing a constraint on the uptake by aviation. Consequently, a review by the UK's Committee on Climate Change (CCC) concluded that *"concerns about land availability and sustainability mean that it is not prudent to assume that biofuels in 2050 could account for more than 10% of global aviation fuel"*. The CCC estimated that in its "likely scenario", the uptake of biofuels by 2020 would be no less than 2%, a view acknowledged by UNEP.

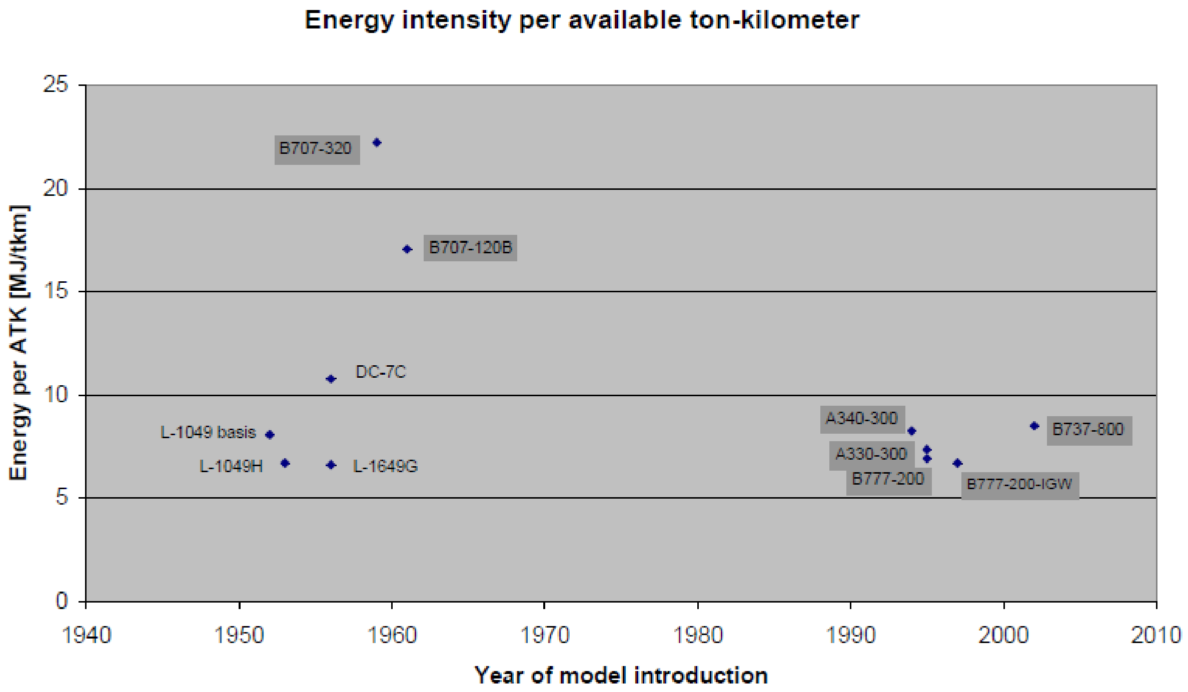
The policy gap: the case for market-based measures

Taken together, the likely reduction in emissions from technology, operations and alternative fuels is estimated at around 0.1 $GtCO_2e$ in 2020. While the scale of these reductions will increase with time, it simply will not keep pace with the forecast growth in demand, explaining why both ICAO and industry targets are based on net rather than absolute emissions reductions. Policy instruments, most notably market-based measures, are required to address the shortfall urgently.

1.3 By how much has aviation fuel efficiency improved?

Author: Mazyar Zeinali, International Council on Clean Transportation

In 2005 the Dutch Aerospace Laboratory (NLR) analysed for T&E the fuel efficiency of commercial aircraft since their introduction in the 1930s. They found that the last piston powered aircraft (Lockheed Super Constellation and Douglas DC-7) of the late 50s were as fuel efficient as today's modern jets and in fact at least twice as fuel efficient as the first jet-powered aircraft. These first jets had higher (40%-80%) cruise speed and about the same range capability as the last piston aircraft. NLR also concluded that the transition to jet aircraft was made predominently to increase aircraft speed and altitude (and to some extent range). Fuel consumption was only an issue in terms of range not cost. The B777-200 and B737-800 were found to be slightly more fuel efficient per available seat kilometre than the last-piston aircraft and and even less so per available ton-kilometer but in general NLR concluded that aircraft fuel-efficiency per available seat kilometre had not improved since the mid fifties.



In 2009 the ICCT published original analysis of the efficiency trends of new commercial jet aircraft from 1960 – 2008. The analysis was based on fuel burn modelling (using Piano-X, an industry and ICAO-recognised aircraft performance and emissions database) of representative aircraft covering the more than 27,000 new commercial jet aircraft sold worldwide since 1952. The fuel burn of the representative aircraft was then weighted by actual aircraft sales and estimated activity to create industry average efficiency trends for newly delivered aircraft. The ICCT found that, contrary to previous estimates (eg IATA claims of a 70% improvement[5]) the average fuel efficiency of new passenger aircraft approximately doubled since 1960 on both a seat-km and ton-km basis. Moreover it was found that new aircraft efficiency improved substantially in only two of the last five decades and has in fact stagnated in recent years. Since 2000 fuel efficiency has remained flat on a seat-km basis and improved only 0.29% annually on a ton-km basis. The ICCT found that diminished efficiency gains were correlated with historically low fuel prices between 1987

5 http://www.iata.org/whatwedo/environment/pages/fuel_efficiency.aspx

and 2004 and a tripling in the average age of aircraft and engine manufacturer production lines since 1989. The ICCT also noted the significant non-fuel burn related performance of new passenger aircraft as measured by their design range, cruise speed, customer amenities offered and cargo capacity – all of which impose a fuel-efficiency penalty by boosting aircraft empty weight and cruise drag. Concurrently, analysis of historical trends in aircraft fuel efficiency has shown a matching trend with range, payload and speed.[6] These trends suggested to the ICCT that aircraft manufacturers reacted to low fuel prices by devoting an increasing share of efficiency improvements to boosting the performance of passenger aircraft instead of reducing fuel burn and emissions; a not dissimilar conclusion to that drawn by the NLR; that other performance attributes notably speed and range were prioritised over fuel efficiency during the transition from piston-driven to jet aircraft in the late 50s.

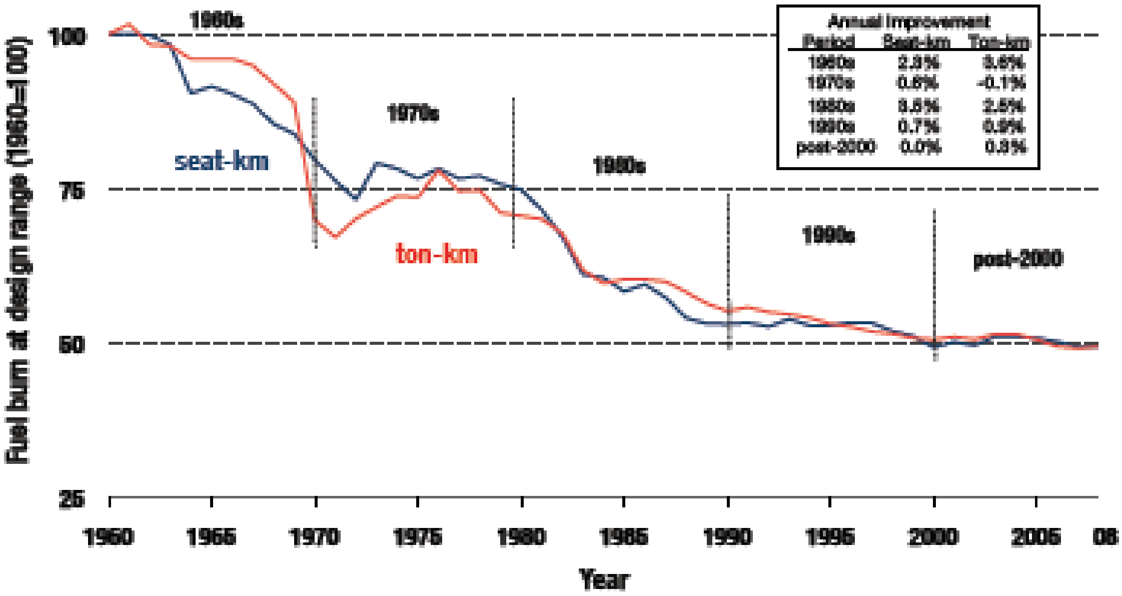


FIGURE 1. AVERAGE FUEL BURN FOR NEW AIRCRAFT, 1960-2008

Overall the ICCT analysis suggested that fuel price alone has failed to continuously promote new aircraft efficiency since 1960.

6 Trends in Aircraft Efficiency and Design Parameters, ICCT 2010 (http://theicct.org/trends-aircraft-efficiency-and-design-parameters)

ICAO's Record on Climate Change

1994

Considerable discussion of bunker fuels at Rio Earth Summit.

1995

COP1 asked SBSTA to examine 8 options for allocation and control of bunker fuels. Options reduced to 5; **no agreement reached.**

1996

ICAO Council resolves that any environmental levies on aviation should be in the form of charges **not taxes.**

1997

COP 3 (Kyoto Protocol) asks Annex 1 countries working through ICAO to limit/reduce aviation emissions.

1998

ICAO 32nd Assembly commissions 3 year study of technology and global standards; operational measures to reduce fuel burn and role of market-based measures.

2001

- CAEP 5 **opposed closed emission trading schemes for aviation.**
- CAEP 5 **ruled out establishing a GHG emissions standard for aircraft.**
- 33rd ICAO Assembly endorses 1996 decision preferring charges **not fuel taxes** and the development of an open emissions trading system for international aviation

2004

- CAEP 6 agreed an **aviation-specific emissions trading system would not to be pursued further**
- 35th ICAO Assembly endorsed voluntary emissions trading by Parties together with guidance to be prepared by ICAO.
- 35th ICAO Assembly agrees **three-year moratorium on GHG emission charges**

2007

- 36th ICAO Assembly votes to require "mutual agreement" before Parties include foreign carriers in their emissions trading schemes. EU countries dissent.

  Assembly decision included in ICAO guidance on emissions trading

- 2007 Group on International Aviation & Climate Change (GIACC), to **develop non-binding aspirational goals** as framework of measures Parties might adopt.

2008/9

No consensus reached in the GIACC. Short term 'aspirational' 2% annual efficiency improvement goal to 2012 agreed.

2009

- ICAO High Level Meeting (HLM) extends 2% efficiency goal to 2020 and agrees to develop a framework for market-based measures in international aviation.
- ICAO Conference on Aviation & Alternative Fuels endorsed use of sustainable drop-in fuels for aviation and adopted a global framework for their development.

2010

- CAEP 8, reversing 2001 decision, agrees to work on a new aircraft CO_2 standard.
- 37th Assembly agrees guiding principles for aviation MBMs and calls for development of a framework for global market-based measures by 2013.

2011

ICAO Council in non-binding resolution **calls on EU to exclude foreign carriers from its emissions trading scheme.**

Part 2
Progress so far on global and regional measures

2.1 ICAO: the long road to reducing greenhouse gas emissions from global aviation

Author: Annie Petsonk, Environmental Defense Fund

For almost two decades, international aviation has enjoyed a curious status in the climate treaty talks. On the one hand, reducing global warming pollution from flights between and among nations has been the subject of narrow but intense policy and technical interest. On the other hand, the airline industry has achieved a perfect record of evading regulation of its greenhouse gas emissions - until now. Effective 1 January 2012, all flights landing or taking off from airports in the European Union are subject to modest, legally binding caps on their global warming pollution. In response, the aviation industry has launched a massive multinational effort. Unfortunately, rather than directing this effort at finding new ways to cut pollution from their operations, the industry is aiming its energies at throwing spanners into the works of the EU system - in courts, in the political arena, and in the International Civil Aviation Organisation (ICAO). If the EU enforces its law, the environmental benefits could be substantial - the equivalent, in carbon terms, of taking 30 million cars off the road every year through 2020[7] - and the cost tiny, as revealed by the decision of Delta Air Lines to hike its trans-Atlantic fares by a whopping $3/ticket (half of what Delta sells a can of beer for on its domestic US flights[8]).

This chapter explores (a) why the international aviation sector has been the subject of such intense policy and technical interest, (b) how it has managed to escape regulation to date, and (c) new possibilities for achieving a consensus in ICAO on frameworks to regulate this industry's global warming pollution.

A. Why international aviation?

Historically, policy-makers have focused on limiting greenhouse gas emissions from the aviation sector for several reasons. First, the sector alone accounts for roughly as much carbon pollution as a mid-sized industrialized country like the United Kingdom - and its global warming impact may be even greater given the other gases emitted by planes flying at high altitudes, and given the contrail clouds formed by aviation pollution.[9]

Second, under even the most conservative scenarios, emissions from the aviation sector are likely to grow substantially, by some estimates quadrupling by 2050.[10] Between expected gains in efficiency from other areas of the transport sector and expected growth in international aviation, some experts expect emissions from this sector could grow as high as 10% of anthropogenic emissions or more. And capital stock turnover in the aviation sector

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7 Commission of the European Communities. Summary of the Impact Assessment: Inclusion of Aviation in the EU Greenhouse gas Emissions Trading Scheme (EU ETS). 2006.
8 http://www.delta.com/traveling_checkin/inflight_services/economy_class/dining.jsp
9 See Meeting the UK Aviation target – options for reducing emissions to 2050 (UK Committee on Climate Change, December 2009), http://www.theccc.org.uk/reports/aviation-report.
10 See, e.g., Aviation and the Global Atmosphere, J.E.Penner, D.H.Lister, D.J.Griggs, D.J.Dokken, M.McFarland (Eds.), Intergovernmental Panel on Climate Change (Prepared in collaboration with the Scientific Assessment Panel to the Montreal Protocol on Substances that Deplete the Ozone Layer),
Cambridge University Press, 1999; and see Commission of the European Communities. Summary of the Impact Assessment: Inclusion of Aviation in the EU Greenhouse gas Emissions Trading Scheme (EU ETS). 2006.

is slow, entailing several decades to design, test, and put into production new airframes, engines, air traffic control systems and the like. Since climate change is a problem of accumulating atmospheric concentrations of long-lived pollutants, sectors whose emissions are expected to grow substantially and whose capital stock turnover is slow draw particular attention from policy-makers bound by the objective of the UNFCCC to stabilise atmospheric concentrations of greenhouse gases at a level, and in a time frame, that will avert dangerous anthropogenic interference in the climate system.[11]

Third, the aviation sector is a cornucopia of technology innovation. From air frame technologies to navigational tools, from lightweighting of materials to the extremely sophisticated device that is a modern jet engine, the manufacturing side of the industry has consistently demonstrated its capacity, when challenged, to develop new technologies that not only improve aviation, but that also can be transferred to other industry sectors. The industry response to the fuel price shocks of the 1980s is legendary in terms of flight efficiencies. Aviation sector innovations allow natural gas fired thermal power plants to generate electricity more efficiently. They permit large truck fleets to achieve substantial fuel savings across warehouse, inventory and delivery chains. The list goes on and on. So the potential for the sector to meet an emissions cap and in so doing, spin off technology innovations that help other sectors meet their targets, is formidable.

B. How has international aviation managed to escape regulation so far?

The accounting issue. For years at the global climate treaty talks, various industries effectively jostled with one another competing to show that each was more special than the next - and that because of this specialness, the industry should be exempt from greenhouse gas emissions regulation. By far the industry most adept at this was the aviation industry (in the talks, the maritime industry rode aviation's coattails). The aviation industry capitalised on the fact that in the early days of the 1992 United Nations Framework Convention on Climate Change (UNFCCC) and the UNFCCC talks leading to the 1997 Kyoto Protocol on Climate Change, governments couldn't figure out how to account for the emissions of vessels (aviation and maritime) traveling between and among nations. Should these emissions be counted in the national totals of the country of origin of the travel? In the national totals of the countries of the citizenship of the passengers or freight? In the totals of the nations of registry of the vessels? In the totals of the nations whose sovereign airspace (or waters) the vessels transited? Where the fuel was uplifted?

The UNFCCC. Way back in 1996, the UNFCCC's Subsidiary Body on Scientific and Technological Advice (SBSTA) formulated eight different options for accounting for these emissions in national totals. The Conference of the Parties (COP) to the UNFCCC proved unable to choose a methodology. That inability to reach agreement served the industry well in its quest to evade regulation, for as long as the UNFCCC couldn't agree on how to account for its emissions, the likelihood that the UNFCCC would regulate it remained vanishingly small. On one point, however, the UNFCCC Parties agreed: emissions should *not* be accounted for based on a "sovereignty" approach. Accounting for emissions based on the airspace (or waters) where the emissions occurred, the Parties agreed, would lead to perverse results: the emissions of a vessel would "belong" to a nation simply because the vessel had transited that nation's airspace or sea, even though the vessel had never landed in the country, and pollution from flights passing over the high seas would be "orphaned," outside any sovereign's responsibility.

The shift to ICAO. At the behest of the aviation industry, in 1997 the COP adopted a decision directing UNFCCC Parties to pursue limitation of international aviation emissions in ICAO (and maritime emissions in IMO). The aviation industry had for years exerted

11 See UN Framework Convention on Climate Change (Rio de Janeiro, 1992), at Article 2.

substantial direct and indirect influence in ICAO, which it regarded as a forum friendlier to it than the relatively unfamiliar (to the industry) terrain of the UNFCCC. ICAO made several runs at tackling the issue, but never reached agreement on a new framework. By 2004, ICAO's Committee on Aviation & Environmental Protection (CAEP) announced that an aviation-specific emissions trading system based on a new legal instrument under ICAO auspices seemed "sufficiently unattractive" that it should not be pursued further. Having rejected an ICAO-wide approach, ICAO's Executive Committee then asked ICAO to provide, "consistent with the UNFCCC process," guidance to Contracting States on incorporating international aviation emissions into their national emissions trading programs. ICAO General Assembly Resolution A35-5 endorsed this kind of bottom-up approach, and after protracted negotiations, in 2010 ICAO's General Assembly adopted a further resolution providing limited guidance to nations for including international aviation emissions in national programs. (Some 40 nations filed reservations on the 2010 decision document.)

Ping pong. In the years since 1997, the UNFCCC revisited the issue periodically, including most recently at the 2011 COP meeting in Durban, South Africa - but with no results. Having ICAO and the UNFCCC vie with each other over who could dither longer only served the airlines' goal of postponing the regulatory reckoning as long as possible.

The EU. In 2008, having seen the issue kicked back and forth between ICAO and UNFCCC with no concrete results, the European Parliament and member states adopted a law placing the emissions of flights landing at and taking off from EU airports under caps as part of the EU Emissions Trading System. Some individual U.S. carriers, having basked in ICAO's inability to agree on a global approach, and having pressed hard to ensure that they would be exempt from any climate legislation that might pass the U.S. Congress, scrambled to postpone as long as possible the date of any effective regulation. With the support of their trade association and the Canadian carriers, they raced to court to try to block the very sort of national approach that ICAO had recommended back in 2004. In their court brief, US carriers had the hubris to argue that the EU system breached the Kyoto Protocol's directive that nations "pursue" the issue in ICAO, and that the only way to address the issue was through the kind of global agreement under ICAO auspices that the airlines had sought to escape back in 2005. (The court understandably took a different view on both points.) And they reached out to carriers from China to Russia to India to urge them to bid their governments to adopt a declaration in Delhi in October 2011 decrying the EU law. Those nations presented the declaration to the ICAO Council, which adopted it as a resolution in November 2011, with EU member states registering reservations. Of course, as Prof. Havel notes, "ICAO resolutions are hortatory and aspirational; they are not the equivalent of transnational legislation or a legally binding treaty. At best, the resolution amounts to a political commitment which can easily be derailed by State interests."[12]

C. New possibilities under ICAO auspices

Unquestionably, the rise of the EU ETS for aviation has put increased pressure on ICAO to try afresh to reach a global agreement on a framework for limiting and reducing greenhouse gas pollution from aviation. Many ICAO Council members recognise this pressure. It was a topic of intensive discussion at the November 2011 ICAO Council meeting. When the sharply divided Council adopted its non-binding resolution, many Council members on both sides of the divide welcomed a proposal put forward by Australia and supported by Canada to convene a rapid set of workshops to try to develop a new global framework for consideration by ICAO at its 38th Assembly in 2013.

12 ICAO Resolution on Aviation Emissions, Aviation Law Prof Blog (Oct. 11, 2010), http://lawprofessors.typepad.com/aviation/2010/10/icao-resolution-on-aviation-emissions.html. See also ICAO climate change agreement, Airspacelaw.org (Oct. 16, 2010), http://www.airspacelaw.org/2010/10/icao-climate-change-consensus/.

On 17 January 2012 in Washington, DC, ICAO Secretary-General Raymond Benjamin publicly pledged to put a proposal for addressing aviation global emissions on the table by the end of 2012, and ICAO has launched an ambitious roadmap aimed at doing just that. Among the core issues that ICAO will need to deal with are:

- whether the agreement would utilize market-based mechanisms, and if so, what would be the nature and characteristics of the mechanisms;
- whether a new agreement would include some kind of differentiation among nations; and
- what might convince ICAO members to adopt a new agreement after so many years of inaction.

The long road to redu
emissions from

1994 — Publication of "Aviation and Global Warming" begins public debate on aviation and climate change.

1995 — First Conference of the Parties to the UNFCCC. SBSTA initiates discussion on aviation & marine "bunker fuels."

1996 — UNFCCC SBSTA considers accounting methods for emissions of flights traveling between different countries. SBSTA explicitly rejects accounting on the basis of the sovereign airspace where the emissions occurred, because doing so would yield "orphan emissions" and perverse results.

1997 — Kyoto Protocol Article 2.2 states that Parties included in Annex I of the UNFCCC "shall pursue limitation or reduction of emissions…from aviation and marine bunker fuels, working through ICAO and IMO, respectively."

1998 — UNFCCC COP endorses SBSTA's accounting decision, rejecting the airspace-based methodology for accounting for emissions from aviation.

2002 — After five years of pursuit in ICAO, European Parliament and Council direct European Commission to propose aviation emission reductions if ICAO does not act.

2003-2004 — European Council repeats its directive to European Commission. ICAO does not act.

2004 — CAEP announces that an aviation-specific emissions trading system based on a new legal instrument under ICAO auspices seems sufficiently unattractive that it should not be pursued further. ICAO Executive Committee asks ICAO to provide, "consistent with the UNFCCC process," guidance to Contracting States on incorporating international aviation emissions into national emissions trading programs. ICAO General Assembly Resolution A35-5 endorses this approach.

2005 — European Council concludes that including aviation in EU emissions trading system seems best way forward. EU launches stakeholder dialogue.

200

cing greenhouse gas global aviation

07

EU places formal reservation on Appendix L to ICAO Resolution A36-22 which urges Contracting States not to implement an emissions trading system on other Contracting States' aircraft operators except on the basis of mutual agreement between those States. EU member states reserve right under Chicago Convention to enact and apply market-based measures on a non-discriminatory basis to all aircraft operators providing services to, from or within their territories.

2009

After four years of stakeholder dialogue and 11 years of ICAO inaction, EU adopts Aviation Emissions Trading Directive in February. The Directive's pollution cuts will take effect from January 1, 2012. US airlines file suit in UK High Court to try to block the EU aviation directive.

2010

With many reservations, ICAO adopts guidance for international aviation in Contracting States' emissions trading system. The UK High Court refers the airlines' case to the European Court of Justice.

2011 June

U.S./EU Open Skies Joint Committee meeting discusses EU aviation directive.

2011 July

Oral hearing of case in ECJ. U.S. House introduces bill to prohibit US airlines from complying with EU aviation directive.

2011 October

Advocate General in ECJ issues a preliminary, non-binding opinion on the ECJ case upholding the EU aviation directive and comprehensively refuting the litigants' claims. Airlines receive free allowance allocations from EU.

2011 November

ICAO Council passes by majority a non-binding, political declaration voicing opposition to the EU aviation directive.

2011 December

The 13 judge panel of the ECJ finds the EU aviation directive to be fully compatible with international law and treaties.

2012 January

Airlines using EU airports are accountable for their emissions.

2.2 The EU-ETS

Author: Jenny Cooper, Environmental Defense Fund

Aviation now accounts for roughly as much global warming pollution as the entire annual emissions of the country of the United Kingdom or the State of Texas - and could quadruple from 2005 levels by 2050.[13]

Emissions from global aviation have been rising, unregulated, for nearly two decades while the imperative to avoid dangerous climate change becomes ever stronger. To address a portion of aviation's growing GHG emissions, and given the absence of action by the International Civil Aviation Organization, on January 1, 2012 the European Union began holding *aircraft operators* accountable for CO_2 emissions by establishing a special EU Emissions Trading System for aviation (sometimes referred to as the EU Aviation Directive).

The EU Emissions Trading System for aviation is a regional regulatory program enacted in 2008 with built-in provisions that enable and encourage non-EU countries to link into the EU carbon market. This linkage can spur job creation and economic development, generate a reliable source of finance in countries outside the EU, achieve additional GHG emissions reductions, and help advance global efforts to combat carbon pollution.

How will the EU aviation program limit GHG emissions?

A cap on emissions from flights using EU airports will create a powerful incentive for aircraft operators to find the cheapest possible ways to reduce emissions. The cap establishes a limit on total emissions.

Regulations for reporting CO_2 emissions from aviation under the EU ETS went into effect January 1, 2010. All "aircraft operators" (passenger airlines, freight airlines, and business and corporate jets) are required to report their CO_2 emissions, based on fuel consumption, for each flight that lands in or takes off from the EU. The emissions limit--*the cap*--took effect January 1, 2012. Emissions from the entire duration of any non-military flight departing from or arriving at an EU airport will be covered under the regulations.

Emissions limits are phased in to give airlines time to plan: for 2012, the cap is set at 97% of the average annual aviation emissions from 2004-2006; for the years 2013-2020, the cap will be 95% of the 2004-2006 average. These caps are projected to result in emissions reductions on the order of 183 million tons of CO_2 per year by 2020.[14] That's roughly equivalent to taking 30 million cars off the road each year.

The EU is assigning "emissions allowances," with each allowance representing a ton of CO_2 emissions, so the total number of allowances is equal to the cap. At the end of each year, each airline must turn in (to their administering state in the EU) enough allowances to cover its actual emissions. So, if an airline reduces emissions below its cap, every ton of pollution that is not emitted is worth real dollars in the form of unused allowances that can be sold in the carbon market.

13 International Civil Aviation Organization. ICAO Environmental Report: Aviation's Contribution to Climate Change. 2010.
14 Commission of the European Communities. Summary of the Impact Assessment: Inclusion of Aviation in the EU Greenhouse Gas Emissions Trading Scheme (EU ETS). 2006.

How are EU aviation emissions allowances allocated?

Eighty-two percent of EU aviation allowances (EUAAs) will be distributed to the airlines free of charge. The EU will offer 15% of the allowances for sale. To receive free emissions allowances, an aircraft operator must report the weight of passengers and cargo and the distance traveled during the year 2010. This ton-kilometer (distance times payload) data is used to calculate how many allowances each airline will receive for free. The program encourages aircraft operators to operate more efficiently, because those who do will get a greater share of the free allowances. To date, virtually all airlines flying in and out of EU airports have applied for free allowances.

The EU will set aside 3% of aviation emissions allowances for new airlines, airlines with new and additional flights to Europe, and airlines whose average annual growth in ton-kilometers to/from EU airports increases by more than 18%.

How do aircraft operators comply with the EU Aviation Directive?

The program affords broad flexibility to airlines in determining how to meet their compliance obligations, **and encourages airlines to compete to find better, cheaper ways of cutting pollution.** To comply with the EU ETS, an airline can reduce emissions, buy allowances at auction, buy allowances from another airline that reduces its emissions below the level of the allowances it holds, use allowances saved from earlier years of the program, or (within quality and quantity limitations) use emission reduction credits from the global carbon market.

How much will it cost?

EU-ETS cost per ticket – Brussels-New York flight	*= $ 3.00*
Cost of a beer, US domestic flight (Delta)	*= $ 6.00*
US international arrival fee – Brussels-New York flight	*= $16.30*

A one-way ticket between Brussels and New York generates around 400 kg of CO_2. Using the current CO_2 futures price for December 2012 ($17 per metric ton), and factoring in that 85% of all aviation allowances will be given to airlines free of charge, the cost of a one-way ticket from New York to Brussels will likely increase by less than $3 in 2012. The corresponding increase for a flight from San Francisco to Brussels would be under $4 in 2012. Both are dwarfed by general ticket price volatility and the existing fees levied by regulators and airlines themselves, including the US-imposed $16.30 fee for each international arrival or departure, and up to $70 for a second piece of baggage.

The EU's allocation formula changes after 2012. From 2013 to 2020, 82% of allowances will be freely allocated, and the cap tightens slightly (to 95% of the 2004-2006 baseline level). In addition, emissions are projected to increase by around two-thirds by 2020 over the historic 2004-2006 baseline due to growth in air travel. Putting the two together, one can estimate that the number of free allowances would decrease from 62% in 2012 to around 45% in 2020. This would result in additional costs for a Brussels-New York flight of around $6 by 2020.

While some in the industry argue that compliance costs will be steep, evidence from the EU ETS and from the U.S. sulfur dioxide program (which provided a design model for the EU ETS) indicates that a competitive environmental market is a powerful tool for lowering compliance costs to a fraction of what an industry estimates in advance of compliance. Furthermore, airlines, concerned about fuel price rises, are looking for ways to improve efficiency and cut fuel consumption. For airlines that pursue efficiency aggressively, compliance could become a revenue source.

Within days of the carbon pollution limit taking effect on January 1, 2012, many airlines publicly announced their compliance plans. American air carriers stated that they would levy a $3 fee on trans-Atlantic flights, with Delta Airlines led the way, and United, US Airways, and others following suit. Singapore Airlines announced that it planned to reduce emissions and improve efficiency to comply with the EU Aviation Directive, while other airlines said they were still contemplating what their strategy would be.

How does the EU Aviation Directive affect national sovereignty?

Despite claims to the contrary, taking into account the total global warming pollution emitted by flights between third countries and the EU, including pollution emitted in non-EU airspace, is neither an invasion of sovereignty nor illegal under Article 1 of the Chicago Convention and customary international law. The EU Aviation Directive does not mandate any specific action outside of the EU; rather, it simply holds airlines that fly to/from the EU accountable for their total emissions of pollution that affects the territory of European countries. The EU law is thus similar to laws in many countries that set requirements for aircraft and ships coming into, and departing from, their territories.

Four examples:

- Legislation enacted by the United States Congress after the Exxon Valdez oil spill requires all oil tankers in U.S. waters to have double hulls. The effect of the law is to require the ships to have double hulls when they depart from their ports of origin.

- The U.S. charges every air traveler $16.30 tax each time the traveler departs from, or arrives in, the U.S.[15]

- The U.S. Department of Transportation requires all flights departing from and landing in the United States to comply with security regulations, even though the effect of these regulations is to require specific actions – including expensive and burdensome actions - at the airports of origin of the flights, in foreign territory.

- The Foreign Account Tax Compliance Act, which enters into force in 2013, requires foreign banks to report their American clients to the Internal Revenue Service. Foreign banks protest that this amounts to conscripting them in the service of the U.S. tax authorities, a claim similar in tenor to the claims of the U.S. airlines. The European tax commissioner is now seeking meetings with US counterparts to "find [equivalent] alternatives."[16]

Moreover, the idea that aviation pollution be regulated on an "airspace" basis (i.e., emissions would be regulated by the country over which they occurred) has *already been rejected* by UN bodies including ICAO. Specifically, in 2004, the ICAO Assembly directed the ICAO Council to provide guidance on incorporating emissions from international aviation into the member states' emissions trading programs, stating specifically that such guidance should

15 "US International Departure Tax - $16.30 – This tax applies to any transportation beginning in the US (including Alaska or Hawaii) and ending outside the US, with the exception of transportation from the US to a port or station within the Buffer Zone. The US International Departure Tax also applies to passengers who stop over in the US for more than 12 hours while traveling to an international destination….US International Arrival Tax - $16.30 – This tax applies to any transportation beginning outside the US and ending in the US (including Alaska or Hawaii), with the exception of transportation from a port or station within the Buffer Zone to the US. The US International Arrival Tax also applies to passengers who stop over in the US for more than 12 hours while traveling from an international destination. Any such passenger is treated as having traveled to such Stopover port or station and begun a new trip from such Stopover port or station." Airline Industry Agents' Handbook Section 7.0 (2007).
16 "Banks in desperate battle over US tax law," Financial Times, Monday June 13, 2011, page 1.

be “consistent with the UNFCCC process.”[17] That process had long since rejected the airspace methodology: in 1998, the Conference of the Parties to the UN Framework Convention on Climate Change had endorsed a decision of the Framework’s Subsidiary Body for Scientific and Technological Advice (SBSTA) to drop from consideration the airspace approach as a possible methodology for accounting for international aviation emissions.[18] SBSTA formally dropped the airspace approach because it “would lead to incomplete coverage at the global level, since emissions over international territories would not be allocated.”[19]

How does the program avoid redundant regulation?

The EU law provides that flights into the EU can be exempted from the ETS if the country of origin implements a measure with an environmental effect that is “at least equivalent” to that of the EU's. This serves the dual purpose of avoiding redundant regulation and ensuring a level playing field for all aircraft operators. The exemption is quite broad, and in no way dictates any specific steps countries would need to take in order to achieve equivalent outcomes. In other words, if a country established its own equivalent program to reduce global warming pollution from aviation, flights from that country to the EU would be exempt from the EU program.

17 ICAO Assembly Resolution A35-5, Appendix I 2(c)(2), www.icao.int/icao/en/assembl/a35/wp/wp352_en.pdf at page 15-30.
18 See FCCC/SBSTA/1996/9/Add.1, paras. 27-30. http://unfccc.int/resource/docs/1996/sbsta/09a01.htm
19 Id.

Part 3
A new flightpath: getting climate measures off the ground

3.1 A global market-based measure

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Would a new agreement under ICAO auspices utilize market-based mechanisms, specifically, emissions trading?

It seems highly likely that if a new agreement were to be developed under ICAO auspices, it would be essential to incorporate into it market mechanisms. The most efficient mechanism would be for ICAO to agree a global target of total emissions for aviation over a time horizon consonant with the long capital stock lifetime of the industry (e.g., to 2030), and then *to allocate to airlines* a set of emissions allowances for multi-year emissions budgets within that time horizon. ICAO would then assist the airlines in establishing allowance registries to enable allowance trading and "banking" (airlines could save unused emissions allowances from one budget period to the next). The banking element is crucial for sectors like aviation with slow capital stock turnover. Additionally, from a business point of view, the aviation industry is highly cyclical; air travel fluctuates significantly year-to-year and even within years; and airlines face tremendous competitive and financial pressures. Multiyear emissions budgets with banking and trading offer the industry crucial advantages over other regulatory approaches, in that they provide airlines great geographic and temporal flexibility in determining how best to meet emissions constraints. The airlines have, in principle, already recognised the importance of these types of flexibility mechanisms. Back in 2007, even though the EU ETS was still in its pilot phase, the International Air Transport Association (IATA) prepared its own analysis discussing the advantages of these tools.[20]

Seen from today's vantage point, with substantially more experience through the EU Emissions Trading System, it has become increasingly clear that well designed open emissions trading systems offer unparalleled flexibility for innovative compliance approaches, including "packaging" in-sector reductions and out-of-sector allowances or credits. Such systems could foster the diffusion of technologies not only within the aviation sector, but also in other sectors, creating broader and deeper markets for the new technologies, and thereby helping the technologies overcome high hurdle rates for return on capital. And because they promote price discovery and stimulate competition to grind down the costs of compliance, such systems offer the most cost-effective means of achieving the kinds of emission reductions that will be needed from the aviation sector.

Other regulatory tools may also be important. While the advantages and disadvantages of these are discussed in other chapters, here we examine how two of these might interact with market-based measures, so as to harvest synergies and avoid clashes between and among these policy instruments.

a. CO_2 emissions standards for new aircraft. ICAO has a work programme underway to develop such a standard, as discussed elsewhere in this volume. In addition, U.S. states and non-governmental organisations have petitioned the U.S. Environmental Protection Agency to set mandatory standards for limiting carbon dioxide pollution from aircraft engines, and in response to that challenge, preliminary court rulings have directed the EPA to begin the regulatory process to do so.

20 Financial Impact of Extending the EU ETS to Airlines, IATA 2007.

Standard-setting by both ICAO and EPA that applies to new aircraft or engines could be extremely important in spurring the development of better, higher-efficiency models, particularly if paired with fleet-wide standards and a fleet-wide banking and trading program of the kind that proved successful in implementing heavy diesel engine standards in the U.S. Such flexibility is important to mitigate the risk that such a standard could inadvertently discourage fleet turnover by creating perverse incentives to keep less efficient aircraft flying longer. And, as has been the experience with automobile fleet efficiency standards in various nations, because a carbon dioxide standard likely would apply only to the sector's emissions output or intensity, and not total emissions, the application of a CO_2 standard only, without a cap on total emissions, could allow total emissions to continue to climb even though all manufacturers were meeting the standard on a per-aircraft or per-fleet basis.

Moreover, if the history of ICAO efforts to develop a standard for engine emissions of nitrogen oxides is any guide, the effort to develop a single CO_2 standard that covers the various airframe and engine combinations may encounter trade and competitiveness issues as the relatively few manufacturers in these fields seek to protect their market shares and their historical investments in technology and capital. Participants in the standard setting process face the risk that these cross-currents could drag the standard down to a least-common-denominator ambition level, effectively codifying (and therefore freezing) what is currently available as best technology, and reducing incentives for future innovation, unless ICAO could be counted upon to continually revise the standard in order to drive further innovation.[21] While these challenges are significant, a carbon dioxide standard for aircraft emissions has significant potential for achieving environmental improvements and can play an important role in driving technology development. Civil society is directly involved in these efforts to secure a meaningful outcome.

b. Voluntary emissions limits. While some have proposed voluntary carbon dioxide limits as the sole policy instrument for the aviation sector, the history of voluntary emissions limits for greenhouse gases is not a positive one. A crucial lesson the world has learned over the past twenty years of international climate regulation is that approaches that do not place legally binding limits on emissions (e.g., those in the 1990 Framework Convention on Climate Change) simply are not effective. Furthermore, the recent history of market-based mechanisms indicates that the key starting point for successful deployment of such mechanisms generally is a legally binding absolute cap on emissions.

While some have proposed bringing into ICAO market-based mechanisms that do not entail absolute emissions caps, e.g., so-called "baseline and credit" trading systems, the history of those systems - in the United States and in the Kyoto Protocol's Clean Development Mechanism - is not positive. Such systems entail high transaction costs, including baseline development, verification, ensuring credits are truly "additional" to what would have otherwise occurred, independent verification of emissions credits obtained, and measurement of "leakage" (in which emissions are reduced at one location but inadvertently increased in another). Practical experience indicates that attempts to apply such systems at sectoral level yield relatively few emission reductions. They present a significant risk of conflict of interest in the determination of baselines and the verification of credits. And as the debate over aviation emissions scenarios in the context of the IPCC Special Report revealed, the entire process of projecting future aviation emission baselines is highly contentious. The baselines themselves, once adopted, must be continually revised. For airlines concerned about compliance costs, baseline-and-credit systems represent a generally inefficient policy instrument.

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21 See, e.g., Bruce A. Ackerman & Richard B. Stewart, Reforming Environmental Law:
The Democratic Case for Market Incentives, 13 B. Col. J. Envtl. L. 171, 183 (1988); Richard B. Stewart, Controlling Environmental Risks Through Economic Incentives,13 Colum. J. Envtl. L. 153, 160 (1988).

One of the few places where baseline-and-credit systems might prove a useful adjunct to an aviation-based cap and trade system would be in considering how to construct an "open" emissions trading system for airlines, a point emphasized in IATA's 2007 analysis. In an "open" emissions trading system, airlines covered by a cap on total emissions could undertake emissions trading with other sectors, allowing airlines to harvest emission reduction opportunities that yield multiple benefits. For example, many airports are large consumers of fossil fuel-generated electricity and of liquid fossil fuels for within-airport transport. An "open" emissions trading system could incentivize joint work by airlines and airports on strategies that not only reduce greenhouse gas emissions, but also reduce other harmful pollutants like nitrogen oxides, sulfur dioxide, and volatile organic compounds, while improving the efficiency of airport operation and reducing costs. If an airport is not already covered by an emissions cap and trade system, the baseline-and-credit approach could be a useful tool in unlocking emissions reduction opportunities within the airport envelope (with all the caveats about the general difficulty of determining baselines, verifying credits, and addressing leakage). A legally binding cap that obtains on aviation emissions in at least some portion of the world would be needed to drive demand for credible credits.

2. Would a new agreement include differentiation among nations?

In some respects this question addresses the core problem of reaching agreement in ICAO (or in the UNFCCC for that matter) on a new instrument to address greenhouse gas emissions. For nearly seventy years, the Chicago Convention Parties have proceeded on the basis that ICAO obligations bind all members equally, with no distinction between industrialised and developing nations. By contrast, for twenty years, talks under the auspices of the UNFCCC have proceeded with the express recognition of the principle of "common but differentiated responsibilities" (CBDR), enshrined most prominently in the UNFCCC.

In 2010, the ICAO General Assembly considered and adopted - with more than 40 reservations - a resolution providing guidance to members that wished to include international aviation in domestic emissions trading systems. In paragraph (m) of the Annex to this resolution, A37-WP/402, member states agreed that market-based measures (MBMs) should "include de minimis provisions". A distinction or differentiation based on whether a nation is a "de minimis" emitter is unprecedented in ICAO and in the UNFCCC. It offers an important conceptual breakthrough that could serve as one possible footing for a new agreement - potentially achievable at ICAO's 38th Assembly in 2013 - that could enable member states not only to overcome the historical obstacles that have hampered discussions on global MBMs in ICAO, but that could also provide a bold and powerful example for the larger talks on a new international climate framework. These talks, launched under UNFCCC auspices at Durban in December, are slated to be concluded by 2015.

Important issues remain to be considered in defining "de minimis" in a way that respects, as much as possible, the Chicago Convention's requirements regarding non-discrimination. ICAO, at its 37th Assembly, adopted a resolution for

"...a *de minimis* threshold of international aviation activity, consistent with the guiding principles in the Annex, of 1 per cent of total revenue ton kilometres to MBMs as follows:
a) commercial aircraft operators of States below the threshold should qualify for exemption for application of MBMs that are established on national, regional and global levels; and
b) States and regions implementing MBMs may wish to also consider an exemption for other small aircraft operators."

De minimis: Operator-Based or State-Based? The ICAO Council has recently begun to consider whether the "de minimis" threshold might be premised on the revenue ton kilometres (RTKs) of individual operators, or on the RTKs of states. Each, however, carries risks that in practice will prove discriminatory. For example, an operator-based definition of "de minimis" could result in discrimination between carriers flying the same route, if the route is flown by one carrier that qualifies as de minimis, and another that does not.

A new approach to determining "de minimis": city-pairs. To avoid many of the problems of discrimination inherent in the operator-based or state-based definition of de minimis, ICAO could base the "de minimis" distinction on city-pair routes. Under this approach, ICAO would rank the emissions data (or revenue ton kilometre data if the emissions data are not available) for international aviation based on city-pairs. ICAO would determine a threshold for "de minimis" city-pair routings so as to ensure that the global system covers 85% (or more) of global international aviation emissions in a historical base year or years. The emissions of carriers flying between covered city-pairs would be capped, and the carriers would receive emissions allowances. City-pairs that en bloc constitute less than, say, 15% of global aviation emissions would not be subject to the cap.

Such a system would capture the lion's share of aviation emissions without discriminating between and among carriers flying the same routes. It would naturally focus effort where it is most needed, namely on city-pairs with the heaviest traffic and the least efficient routings. It would reduce focus on the “rarer” city-pairs which, to some extent, correspond to geographic areas of greatest economic vulnerability. Some adjustments might be needed - as for example if the ranking of city-pairs happened to exclude as de minimis flights between cities already covered by an existing market-based measure, those city-pairs could be included in the 80% coverage. Or, for example, if a city-pair happened to be excluded as de minimis simply because a new airport had opened to handle traffic from a nearby highly congested city-pair's airport. Traffic flows between such city-pairs via intermediate points would also need to be considered.

The data from city-pair routes would need to be reviewed on a regular basis (e.g. biennially) to determine whether any individual city-pair's total emissions had increased so as to bump it up out of the de minimis category, or whether the collective emissions of the de minimis city-pair bloc exceeded the 20% threshold. Of course, any grouping of carriers flying a de minimis route that wished to participate in the system could apply for a cap and allowance allocation, potentially giving them access to new sources of capital which could be used for fleet modernisation and expansion.

3. Why might ICAO members adopt a global MBM after so many years of inaction?

Launching a global MBM for international aviation, under ICAO auspices, with emissions trading based on legally binding total emissions limits for individual airlines, and with an exemption for de minimis flights on a city-pair basis, offers distinct environmental, economic, and political benefits that could enable the ICAO member states actually to achieve consensus on it. First, environmentally, by capturing the largest proportion of aviation emissions, the city-pair based de minimis distinction offers the potential to tackle the problem of aviation global warming pollution effectively, without requiring the smallest and those with the least capacity to participate. Second, economically, the airlines with the largest fleets typically cover the high-traffic city-pairs and have greater economies of scale open to them to enable them to achieve the biggest "bang for the buck" - that is, the most efficient emission reduction opportunities per unit of investment.

Third, a city-pair-based de minimis distinction could garner support from the nations that are most vulnerable to climate change impacts. Such an approach, when incorporated into an emissions cap and trade framework, could also help bridge the differences in ICAO between the United States and the EU, as well as between those nations (which have strenuously opposed importing CBDR into ICAO) and other nations that do seek some differentiation in ICAO. For example, most analyses indicate that an MBM that entails a substantial free allocation of allowances could actually serve as a revenue-raiser for airlines.[22] Moreover, at Durban, the world's largest emitting nations, both industrialized and developing, signaled their potential openness to future emissions limits provided certain conditions were met, recognising the great progress that they will need to make in monitoring and other institutional capacities. Applying MBMs first in the aviation sector, where modern airlines in non-Annex I nations already have institutional capacities comparable to their competitors in Annex I nations, offers a path forward for such nations to gain experience at scale with a sectoral MBM while continuing to build broader domestic capacity. So because it offers the possibility of support from a broad array of nations, solving the de minimus issue has the potential to unblock the logjam in ICAO.

Conclusion: The announcement by ICAO Secretary-General Benjamin that ICAO will put on the table by the end of 2012 proposals for market-based measures to limit global warming pollution from aviation offers important opportunities. Whether ICAO will be able to achieve agreement on MBMs that will be environmentally effective - and cost-effective - remains to be seen. Airline-based emissions cap and trade, matching mandatory caps on total emissions with the broad flexibility of open emissions trading and banking, and a distinction for de minimis city-pairs, offers a potential path forward that could mesh well with emissions standards.

3.2 Aviation as a source of climate finance

Author: Bill Hemmings, Transport & Environment, Brussels

Any global market based measure to reduce aviation GHG will entail incidence on developing countries while at the same time generating substantial revenues. The UN Secretary-General's Advisory Group on Climate Finance (AGF) considered these issues during 2010 in the context of its work to identify ways to mobilize $100 billion per year in climate financing. The AGF concluded that a carbon-related instrument on international aviation, assuming a carbon price of US$25/t, could generate some $6 billion p.a. of which 25 to 50% of these revenues could be earmarked for climate finance. The IMF/World Bank October 2011 paper to the G20 identified either emissions (fuel) charges or emissions trading for international aviation as possible options for such a measure, noting that the aviation sector is relatively lightly taxed from an environmental perspective and also receives favourable treatment from the broader fiscal system.

This G20 report suggested higher levels of revenue were possible; at $25/t some $12 billion annually could be raised in 2020 while at the same time reducing aviation emissions by perhaps 5% mainly by reducing forecast demand (ie. aviation demand would continue to grow but at a slightly slower rate) . Compensating developing countries for the economic harm they might suffer from such charges – ensuring that they bear no net incidence – was recognised as critical to the acceptability of such a measure. And it seemed unlikely that such compensation would require more than 40% of global revenues. The report went on to argue that the principles of a good MBM for aviation were the same as in any other sector; for emission charges this means minimizing exemptions and targeting environmental charges on fuels rather than on passenger tickets or on arrivals and departures. For emissions trading it means auctioning allowances to provide a valuable source of public revenue, including provisions to limit price volatility, and developing institutions to facilitate trading markets.

22 See, e.g., "Including Aviation in the EU ETS: The Burning Question," Bloomberg New Energy Finance, 25 October 2011; and see R. Malina et al., "The Impact of the EU ETS on U.S. Aviation," Journal of Air Transport Management 19 (2012), 36-41.

ICAO has yet to look seriously at the details of in constructing a global MBM including the question of incidence on developing countries. Possible exemptions from MBMs was discussed at the 37th ICAO Assembly in September 2010: based on a proposal from the EU which had originated with Nigeria, Resolution A19 introduces a global aviation activity de minimis threshold of 1% of total global RTKs, below which States are not required to submit action plans on how they will contribute to ICAO goals; similarly, A19 states that all commercial operators of States below the threshold would be exempt from any MBM. But a large number of reservations were entered by Parties on this point including in the end from the EU which had made the proposal only in the context of a global MBM with ambitious reduction targets. One purpose of the de minimis proposal appears to have been to distinguish between those states (and carriers) who might legitimately need compensation from the effects of a global MBM and those developing countries who are host to some of the largest and most successful airlines – Singapore, China (Hong Kong), UAE etc.

In mid 2011 the ICAO Secretariat wrote to the Transitional Committee of the Green Climate Fund which COP 16 in Cancun had agreed to establish, pointing out that the 37th Assembly had agreed on guiding principles for a global MBM and that ICAO had decided to explore a global scheme for international aviation. The ICAO note went on to express concern at the AGF's option to consider the potential generation of revenues through the application of MBMs to international aviation asserting that if aviation was singled out as a source of revenues this was likely to result in a shortage of resources for mitigation activities in the sector. "In addition it would lead to a disproportionate contribution from the (aviation) sector compared to other sectors" considering that aviation accounts for about 2% of global CO_2 emissions and of which about 60% (1.2%) is from international aviation. The Secretariat went on to recall that Resolution A37 had resolved that where revenues are generated from MBMs it was strongly recommended that they be applied in the first instance to mitigating emissions in sector. The Secretariat paper omitted to mention that Resolution A-19 went on to say that revenues from MBMs should also be applied to mitigation and adaptation as well as assistance to and support for developing countries. The paper further suggested that the differentiated application of MBMs as proposed by the AGF might have implications for the allocation of emissions. ICAO called on the Transitional Committee to defer to ICAO on such issues when discussing MBMs.

3.3 Taxes

Author: Bill Hemmings, Transport & Environment

The airline industry today faces thousands of taxes and fees on its operations and services, including taxes on income, property, fuel, equipment and taxes for social and economic purposes such as development aid, the environment and tourism expansion.
IATA website

On pure tax grounds, the case for increased indirect taxes (or equivalent charges) on international aviation is strong.
Michael Keen & Jon Strand "Indirect Taxes on International Aviation" IMF 2007

Aviation is subject to a wide range of fees and charges. Many of these such as airport landing charges, passenger security charges and en routes navigation charges are essentially user fees for services with the proceeds earmarked for aviation-related services.

Taxes are different and are used to raise revenue for governments to be put to the general use. As regards aviation and indirect taxes (i.e. taxes other than corporate taxes) aviation occupies a privileged position vis a vis other sectors in the economy. The aviation sector for example is almost entirely exempt from fuel tax. Internationally, a web of bilateral agreements exempt from taxation virtually all fuel used for international aviation.

Article 14 of the EU's Energy Tax Directive (ETD) forbids member states from taxing aviation kerosene used on international flights from and to the EU as well as fuel used for maritime transport and fisheries. There is no justification for this ban, neither policy-wise nor legally. There is no international legislation forcing the EU to ban fuel taxation in these sectors. For aviation, the oft-mentioned Chicago convention does not prohibit fuel taxation; it only prohibits taxing fuel on board on arrival. In addition, if it did indeed outlaw international fuel taxation, the current ETD would also be illegal as it allows member states to tax fuel used for intra-EU flights.

Deleting the ban from EU legislation would not in itself make kerosene taxation possible because of the many bilateral air service agreements with third countries still ban it. But if kerosene taxation is ever to be an option in Europe, the ETD which is currently under review is the place to start as it would no longer impede EU efforts to renegotiate its bilateral commitments.

The ECJ in its recent ruling on the EU-ETS said: "the European Union is not bound by the Chicago Convention because it is not a party to that convention and also has not hitherto assumed all the powers falling within the field of the convention." Article 11(2)(c) of the Open Skies Agreement provides – put simply – for exemption from the taxes, levies, duties, fees and charges on fuel, lubricants and consumable technical supplies for the Parties' aircraft. This provision is indeed sufficiently precise to be directly applied, since it specifically states which items are to be afforded exemption and from what they are to be exempt. The provision is not unconditional, however, as it grants exemption only 'on the basis of reciprocity'. [1] Whether an airline can rely on this exemption at a particular point in time vis-à-vis a specific Party to the Open Skies Agreement therefore depends upon the conduct of that other Party at that time. A US airline can claim the exemption provided for in the Open

Skies Agreement vis-à-vis European authorities only if and to the extent to which the authorities in its own State of registration at the same time grant corresponding exemptions to European airlines. In view of this condition the requirements for direct application of Article 11(2)(c) of the Open Skies Agreement are not fulfilled

Value added tax is another area of taxation in Europe where aviation is special. There is no VAT on any aspect of air travel; not on airline tickets, nor on purchase of aircraft, nor on their servicing or leasing, nor on their fuel, nor on air traffic control, nor on baggage handling, nor on aircraft meals. Everything to do with air travel after passport control is zero rated. The VAT exemptions for aviation, which also include travel by ship, date back prior to the EU's formation and then lived on as derogations to the EC's original Sixth (VAT) Directive. They were supposed to be transitional but new joining member states demanded equal treatment and have now acquired a life of their own.

"International air transport is a service provided to the end consumer outside any taxing jurisdiction."
IATA website

3.4 CO_2 / Fuel efficiency standards

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There was considerable debate in ICAO after Kyoto concerning the need to develop a fuel efficiency standard for new aircraft. However after CAEP found in 2001 that market forces alone were sufficient to drive new aircraft efficiency and therefore that a CO_2 standard was unnecessary[23], the aviation industry experienced a "lost decade" in aircraft efficiency during which the fuel efficiency of new aircraft stagnated[1]. Manufacturers now estimate that the fuel efficiency of new aircraft will improve approximately 1% annually[24]. Returning the rate of fuel burn reduction for new aircraft back to the historical average of 1.5% per year through 2030, which an ICAO expert panel has found could be achieved with moderate regulatory pressure, would reduce CO_2 emissions by a projected 440 MMT annually below the IPCC 1999 baseline trend in 2050[25], or about three-quarters of the 2005 global inventory.

The question of a CO_2 standard was revisited in ICAO in the runup to the Copenhagen Climate Conference and ICAO's Committee on Aviation Environmental Protection (CAEP) finally agreed a 3 year workplan starting in 2009 to develop a CO_2 standard for new aircraft by 2013. The work was assigned to a CO_2 task group comprising representatives and experts from governments, industry (aircraft manufacturers, airlines, and engine manufacturers). Civil society was represented by its observer to ICAO, ICSA, the International Coalition for Sustainable Aviation.

A number of criteria for the work were specified including that:

- The certification standard should not compromise safety
- Efficiency improvements due to the certification requirement should correlate with emissions reductions observable in day-to-day operations at the aeroplane level
- The standard should be robust, be fair across manufacturers, not be administratively burdensome and explainable to the public

Major points of contention during development of the work have included; whether a standard should cover all new production aircraft or only new aircraft types (new aircraft types will be considered first); and what the objective of a standard should be; merely to ensure the best and latest technology was used on new aircraft (industry preference) or whether the standard should serve to reduce emissions below a business-as-usual trend. It was finally decided by the CAEP Steering Group in September 2011 in Beijing that the purpose of a standard is to reduce emissions beyond business as usual.

Work is significantly behind schedule and a decision is yet to be taken on the metric (or test cycle) to be used to measure emissions. Industry and some governments favour a Specific Air Range (SAR) -based metric which would measure emissions at a single point within the flight cruise phase to be nominated by the manufacturer. Others, including civil society, favour a mission-fuel metric that measures emissions over a significant proportion of the flight or at several points in the climb/cruise/descent phases of flight. A number of variants of these options remain under close study. Although some debate still exists as to the full coverage, currently it has been agreed that the same standard will cover all aircraft types including regional jets and business jets.

Additionally, within a given aircraft type, aircraft are rarely operated at maximum capabilities of range and payload. Figure 1 illustrates the frequency of flights for various stage length as

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23 CAEP5-WP23
24 CAEP8-WG3-05- LTTG-WP5
25 CAEPSG.20101.WP.023

reported in the US Bureau of Transportation statistics for the Boeing 777 for 2009.[26] As shown, a significant majority of flights are operated at more than 30% below the maximum capabilities of the aircraft. This "one sizes fits all" design mentality arrests efficiency from technologies implemented and can be a source for gaining systemic efficiency in the near to mid-term by considering the reduction of capabilities in future designs. The Boeing 787 is the latest and most technologically advanced commercial aircraft in-production by its manufacturer. In its current design, it can fly passengers to most destinations globally from JFK airport (Figure 2) with the exception of the continent of Australia and surrounding region.[27] If this maximum range were to be reduced by 30% (modified capabilities in Figure 2), ICSA projects that fuel burn could be reduced by at least 6% for a common mission at 80% passenger payload factor and 8000 km.[28] Thus changes in range capability can be an important determinant of fuel efficiency.

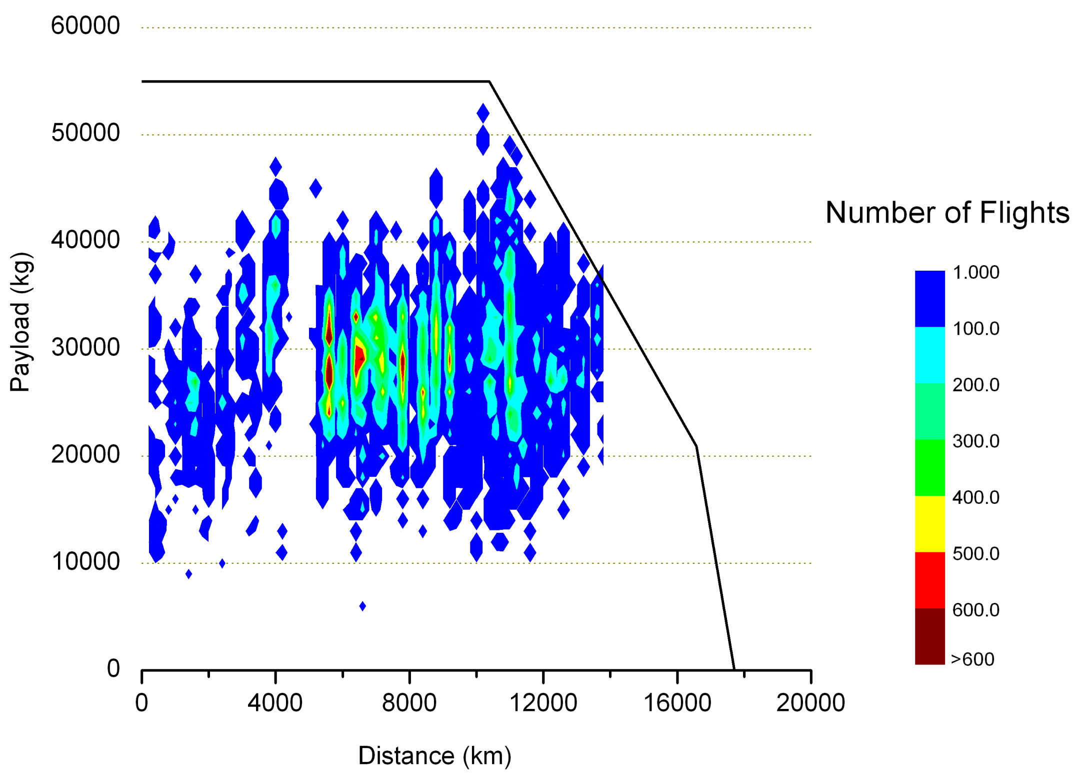

Figure 1 Average operational norms for Boeing 777-200 aircraft as reported in BTS form 41 data (code 627). The black boundary line represents the payload-range capabilities for B777-200ER as quantified in Piano 5.

26 This finding is consistent with global operations as determined by MDG using the Common Operations database.
27 "Unmodified Capabilities" - maximum of 15200 km as reported Boeing (http://www.boeing.com/commercial/787family/787-8prod.html)
28 Using Piano 5 and its 2011 aircraft database. Aircraft was resized to reduce design range by 30% while maintaining wing loading and thrust to weight of original aircraft to climb and field capabilities.

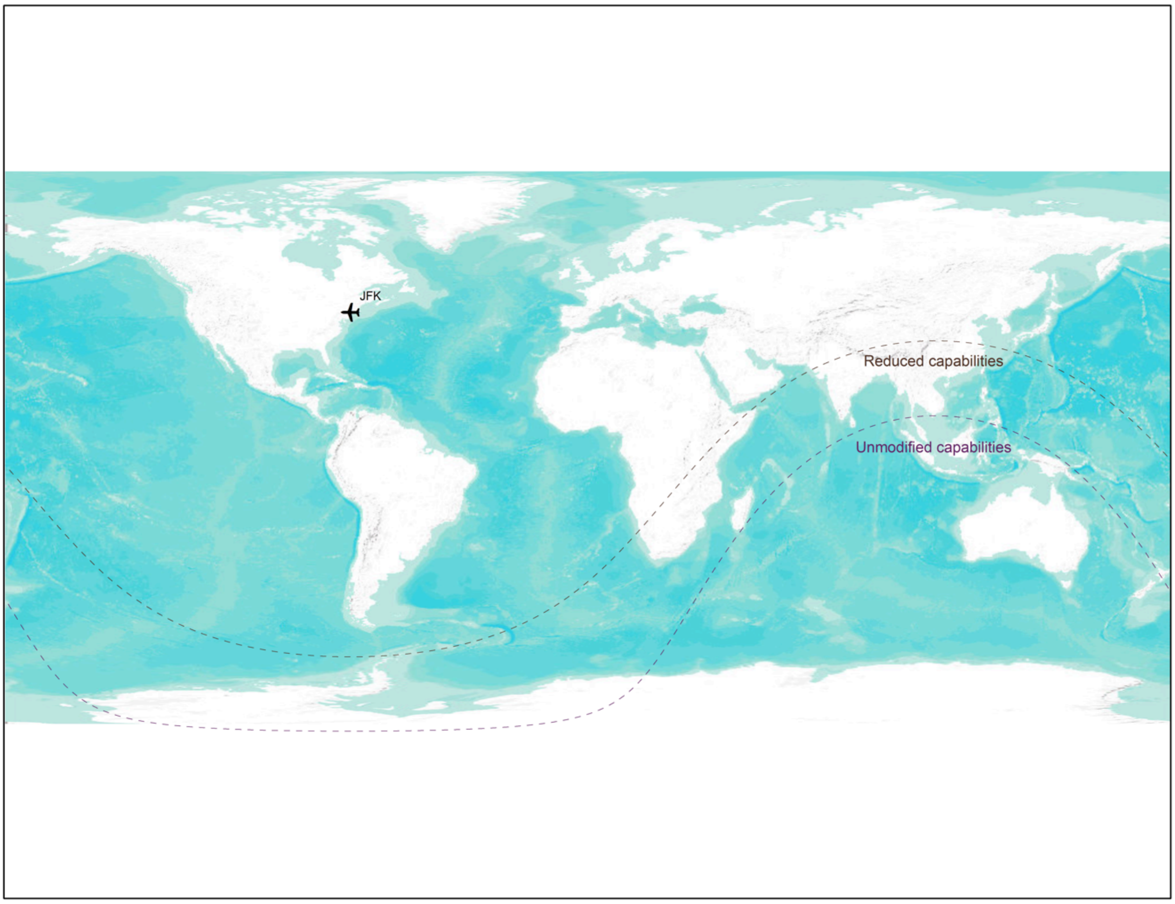

Figure 2 Design range for the Boeing 787-8. Unmodified boundary as reported by Boeing. Reduced Capabilities is a 30% reduction in design range as modelled in Piano 5.

ICAO 2% efficiency goal

ICAO has set a goal to achieve an annual 2% fleetwide efficiency improvement target through the year 2050. Figure 3 from the ICAO Sustainable Alternative Fuels Workshop held in Montréal in October 2011 illustrates the goal. However when reconciling the 2% goal with ICAO's Modelling and Database Group (MDG) Environmental Goals Scenarios (Figure 4), it basically follows a Scenario which corresponds to a 1.16% per annum fuel burn improvement for all aircraft together with improvements associated with migration to the NextGen and SESAR future air traffic management systems. Considering the aspirational goal in this light and in ICSA's view, the 2% goal is really an accounting exercise rather than a commitment to fully meeting a true 2% goal. In addition, analysis of the scenarios suggests that in achieving this goal, credit for efficiency improvements would also be given for such events as an economic downturn ie activity reduction would be part of meeting efficiency goals.

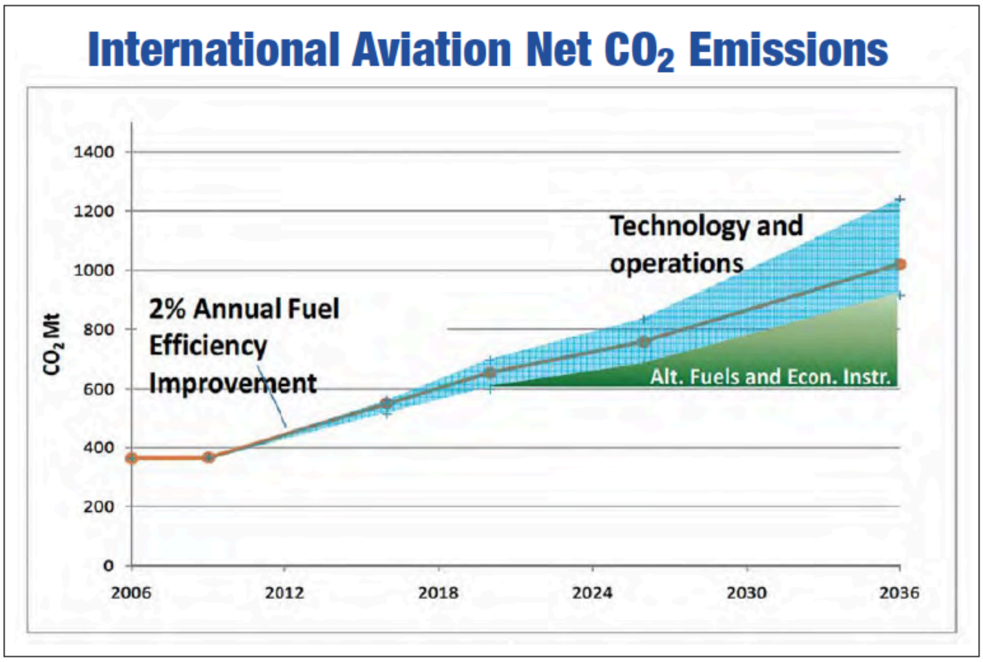

Figure 3 This figure is from "ICAO Review: Sustainable Alternative Fuels for Aviation" . http://legacy.icao.int/SUSTAF/

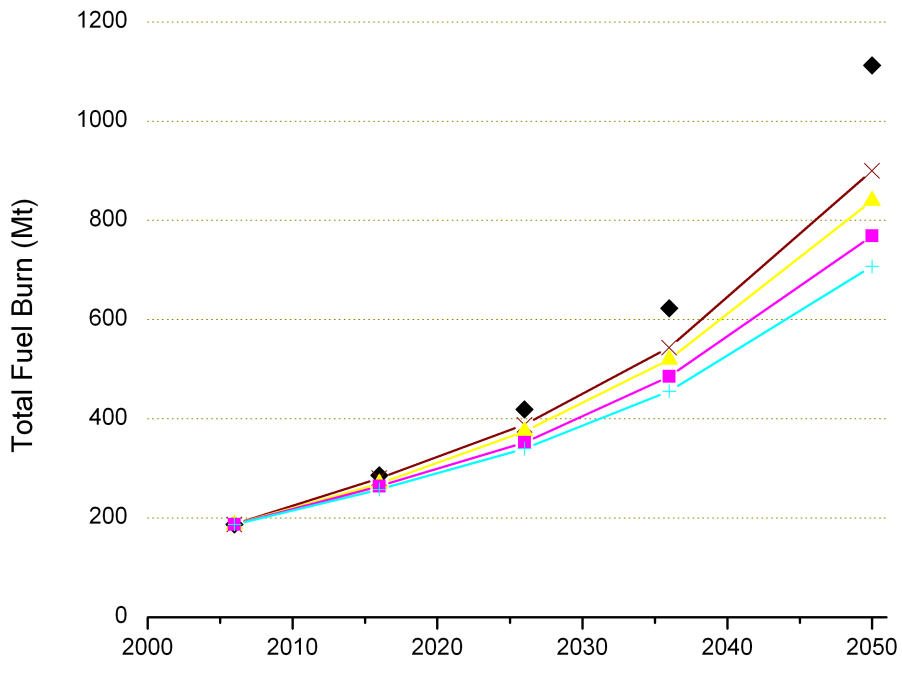

Figure 4 MDG CAEP Environmental Goals Scenarios. Data from ICAO Environmental Report 2010:Aviation Outlook.

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