Cranfield UNIVERSITY

Air Transport Management Course: Universidade Lusofona

Aviation and the environment

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Aviation and the environment: outline

- **Aircraft noise**
- **Aircraft engine emissions**

  Local air quality

  Greenhouse gases and climate change
- Airline, airport and manufacturer impacts

Aircraft noise

- **ICAO Chapter 2, 3 and 4 (from January 2006): standards for new aircraft certification**

  Take-off and approach

  Sideline
- **EU rules and procedures for airport noise (2002/30/EC)**
- **Local airport night curfews and operational restrictions**
- **Aircraft landing fee surcharges (and reductions?)**
- **Fines for aircraft going off-track**
- **Re-investment in noise schemes**
- **Compensation for affected installations**

Climate change: the background

- Need to halt or slow climate change
- Carbon dioxide has largest impact (NOx, contrails etc also important, especially for aviation)
- Emissions trading most cost-effective way of reducing emissions without controls or taxes (and easier to introduce in compliance with international aviation treaties)
- Kyoto Protocol (December 1999) included only domestic aviation: international aviation agreed to be discussed in ICAO:

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ICAO and emissions

- **ICAO Annex 16: Environmental Protection,**

  Vol.II – Aircraft engine emissions

- **New aircraft required to meet improved emissions standards**

  Only NOx, CO and HC for reference LTO cycle below 915m

- ***Considerable discussion and analysis in ICAO's CAEP: encourages regional emissions trading initiatives, but nothing likely on global scale***

Voluntary schemes and targets

- IATA: 26% improvement in fuel efficiency between 1990 and 2012 (1% pa)
- British Airways: 30% improvement in fuel efficiency between 1990 and 2010 or 1.3% pa (20% already achieved by 2000)
- ATAG and others: average annual reduction of 1.9% between 2002 and 2008 (vs past trend of just over 1%)
- ICAO: 8% reduction (one-off) in fuel efficiency from ATC and other operational improvements
- ACARE: 50% reduction in CO_2 emissions per tonne-km for an aircraft entering service in 2020 versus 2000 equivalent
- Green et al: laminar flying wing estimated to give 70% reduction in fuel burn per tonne-km vs existing aircraft

Existing EU Emissions Trading Scheme (ETS)

- Cap and Trade system for CO_2 only, started in January 2005 for initial three year period
- Limited to power and heat generators, and some energy intensive industries such as cement and paper (emitters included account for around 45% of total EU CO_2 emissions)
- Emissions allowances allocated free of charge to countries, and countries decide allocation for each installation
- Surplus allowances can be sold on open market, and shortfalls purchased (€10 billion tonnes traded last year)
- Criticised as being too short-term: investment in emissions reduction technology a long-term decision
- Criticised as being too generous in handing out free allowances (based on average of past years' emissions)
- Measuring and monitoring?

Aviation to be included in EU scheme from 2011:

British Airways' CEO Willie Walsh:

' ….. the initial carbon allocations to airlines should be based on their emissions performance, as in other industries, rather than an expensive auction.'

In address to Ireland's National Management Conference in County Wicklow, Ireland, 6 April 2006

EU Aviation ETS Regulation

- To cover all flights between EU airports from 2011, with all arriving/departing flights at EU airports from 2012
- Excludes aircraft of MTOW less than 5.7t, VFR flights and others
- Harmonisation of allocation method across EU
- Allowances allocated by reference to aviation emissions in the years 2004-2006
- Allocation likely to be based on benchmark, with free allowance combined with auctioning of up to 40%
- Aircraft operators allowed to buy allowances from other sectors in EU scheme
- Revenues from auction invested in emissions reducing projects

European Parliament's views

The EU proposals for an aviation ETS were debated on 12 November 2007. The Liese Report was adopted by a large majority with amendments.

Supports European Commission proposal with following changes:

100% cap on baseline reduced to 90%

All flights included from 2011 (not just intra-EU)

25% of permits auctioned (no firm proposal from Commission)

MEP for East Midlands opposed to bringing aviation into the existing ETS ('this failing system'); Caroline Lucas (Green Party MEP) wanted 100% auctioning

Council of EU Environmental Ministers meet on 20 December 2007

Other industry reactions

- **ACI Europe**

  Broadly supports proposed EU scheme; worried about competitive position of EU hub airports

- **AEA/ERA**

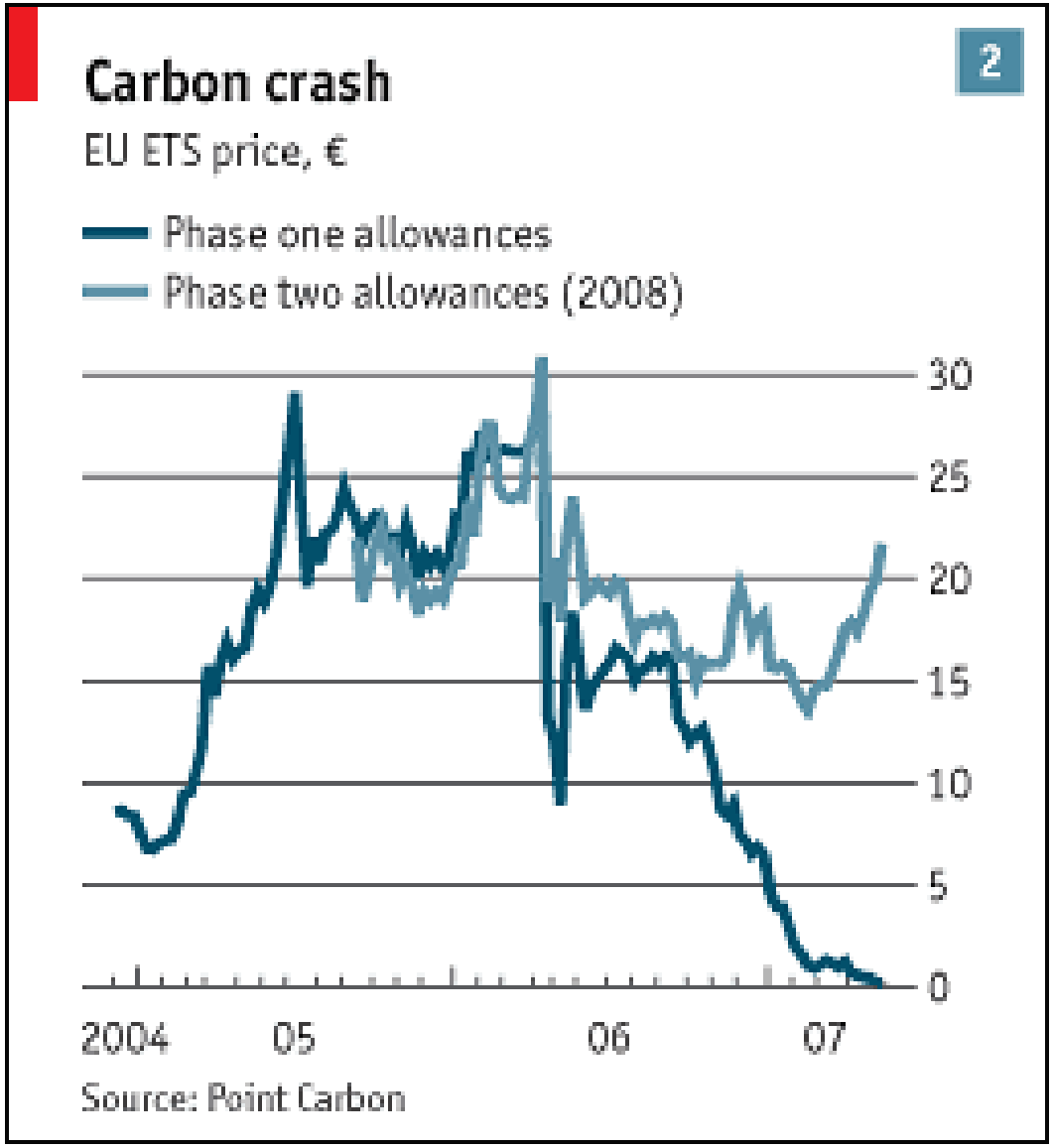
  Supports well-designed Emissions Trading Scheme, but proposes changes to existing proposal (baseline 3 years later, 110% cap, single 2012 start date); also opposes mandatory auctioning at punitive level

- **IATA**

  Backs emissions trading but prefers to wait for a global emissions trading scheme that is 'fair, voluntary and effective'

- **US Government (DOT)**

  EU aviation ETS breaches the 1947 Chicago Convention on international air travel, and would fail any legal challenge



Graph from 'Economist'
31 May 2007
(Trading thin air)

2006 fall due to France and Spain announcing lower emissions than expected.

Potential for airline emissions reductions

- ETS provides financial incentives for airlines to apply new technologies and ideas
- Limited degree to which airlines can invest themselves to reduce emissions and thus need to buy permits
- Aviation a growth industry and thus need to buy extra permits to emit
- Airlines likely to buy permits from other sectors (if allowed)
- Other sectors can obtain reductions in emissions more cost effectively
- Airlines must buy permits at market price of carbon: uncertainty but so is the market price of jet kerosene
- ETS does not provide clear long-term price signal (fleet planning based on longer term assumptions)

Past trends in airline fuel efficiency

Period:	Average annual improvement (RTKs/litre)
1965 to 1975	+ 2.1%
1975 to 1985	+ 4.3%
1985 to 1995	+ 1.3%
1995 to 2002	+ 1.4%
1965 to 2002	+ 2.3%

Source: ICAO

Future trends in airline fuel efficiency

Period:	Metric	Average annual improvement
IPCC (1999)	1992 to 2020 (per ASK)	+ 1.0%
QinetiQ (2006)	2002 to 2030 (per ASK)	+ 0.5 to 1.8%
Lee et al, 2001	Next 25 years (per ASK)	+ 1.3 to + 2.5%
Dings et al (Delft) 1997	1992 to 2015	+ 2.6% (worldwide) + 1.3% (to/from/within EU)
Most air traffic forecasts higher: continued increase in aviation emissions		

Fewer engines, more cabin?

Fuel efficiency per unit of traffic carried

- Should focus on emissions per unit of traffic, especially when including long-haul
- Traffic = Passenger-kms (in tonne-kms) and cargo tonne-kms, or RTKs
- Greater efficiency from higher load factors
- Greater efficiency from higher seat density

  easyJet get 118 pax-kms per US gallon (2004)

  British Airways short/medium-haul fleet: 77 pax-kms/gallon (2004)
- **But not the same quality of service**
- Piston-engined aircraft were very fuel efficient but much slower!

Selected airlines: fuel efficiency in 2004

Domestic and intra-EU routes

	RPKs/US gallon	% industry	ASKs/US gallon	% industry
British Airways	76.8	91	118.1	91
easyJet	117.5	140	138.3	107
Britannia/Thomsonfly	147.6	176	164.0	127
Industry (IATA)	84.0	100	129.2	100

Marked advantage from higher seat density (LCCs and leisure) and larger aircraft (leisure)

Airline operational measures

1. Flying the most fuel efficient aircraft for the sector
2. Taxiing via the most efficient route
3. Flying the most efficient routing
4. Operating at the most fuel efficient speed
5. Operating at the most fuel efficient altitude
6. Maximising the aircraft's load factor
7. Minimum fuel to safely complete the flight
8. Minimising non-revenue flights
9. Maintaining clean and efficient airframes and engines

Source: IATA Environmental Review, 2004

How many of the above have already been exploited to maximum?

AEA say that 1 to 3 above would reduce fuel burn by 18%

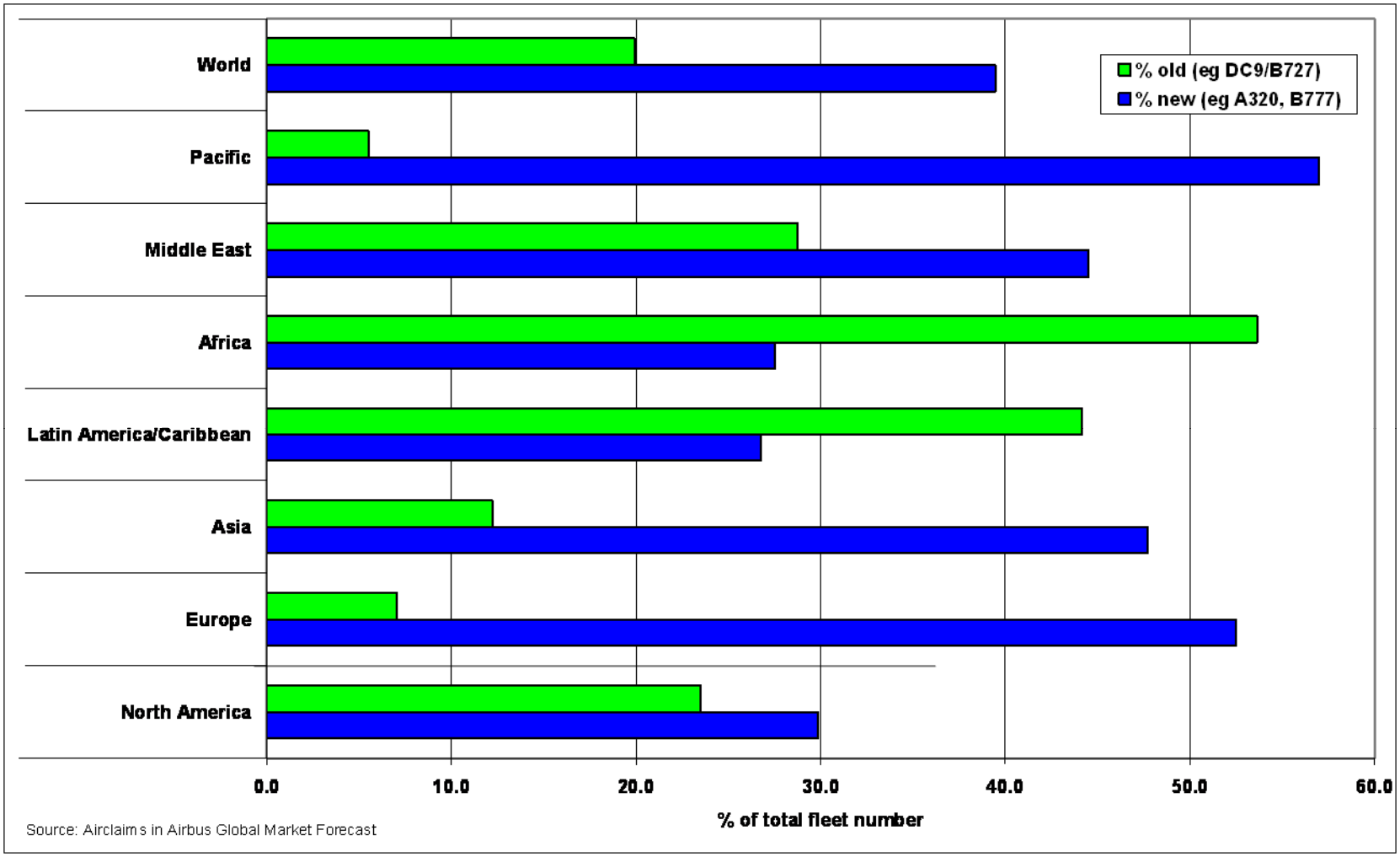
Fleet modernisation and investment

- **Worldwide airline fleet averaged 11 years old at end 2005 (12 years at end 1998)**
- **Leading airlines keep aircraft in fleet for 20-25 years: reducing this to 15-20 years would not make a huge difference**
- **Noise regulations have forced retirement of older aircraft**
- **Aircraft life often extended to 25-30 years through cargo conversion**
- **Fuel efficiency deterioration over time can be minimised**
- **New aircraft should give at least 25% reduction in fuel efficiency versus aircraft it replaces (for 1% pa improvement):**

  A319/B717 are 25% + more fuel efficient than B737-200

  B787 should be 25% more fuel efficient versus B767-300
- **Retrofit sometimes possible for incremental improvements in fuel efficiency (eg winglets)**

Fleet age by region (2004)



Future aviation emissions?

- Difficult to conclude that aviation can get greater fuel/emissions improvements than 2% a year for foreseeable future
- Any growth in traffic above 2% pa will increase emissions
- High end of fuel efficiency improvement estimates associated with higher traffic growth rates
- At 5% pa traffic growth, air transport emissions in 2025 might be 85% higher than 2005 levels (with 2% pa efficiency gains)
- Zero emissions growth achieved with only 1% pa traffic growth (with 2% pa efficiency gains)
- Reduction clearly needed but to what level, and would high fuel prices bring this about without any measures?
- How to deal with NOx, contrails and cirrus cloud formation?

Impact of aviation on society

- 80% of aviation emissions come from trips of over 1,500km
- Trend towards longer-haul leisure holiday destinations
- Conferences more attractive in exotic locations (eg Brussels!)
- Potential for tele-/video-conferencing, especially using Skype PC link-ups, replacing business trips
- Moving towards polluter pays principle, with air transport users paying the full cost of environmental damage = somewhat lower growth in traffic
- Consumers choosing more environmentally acceptable airlines?
- Air travel becoming less socially acceptable = lower growth in traffic?? **Or 'sinful' according to Bishop of London!**

Final thoughts

- Air passengers and shippers should be charged for environmental damage caused
- UK APD to be replaced by aviation tax in 2009
- No need to single out aviation: all sectors should be included, even rail
- Properly run ETS the most efficient way of doing this
- Cap/trade schemes and offsets raise the problem of channelling the funds to new emissions reductions investments
- Environmental taxes tend to disappear in government coffers (no ring-fencing)
- What about issuing emissions permits to consumers?