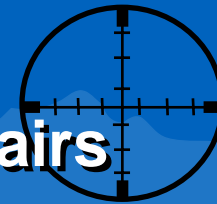




Airlines in the Crosshairs



*The implications of impending
environmental regulation*

Green Aviation Madrid 2008

SH&E and ICF offer aviation and climate change expertise to help clients manage the industry's growing global carbon constraint

SH&E

- ◆ **Founded in 1963, SH&E is the world's largest consulting firm specialising in commercial aviation**
- ◆ **Located in the US and the UK, its 100+ staff have provided consulting, strategic planning and technical services across the aviation industry, including:**
 - Airlines
 - Airports
 - Financial Institutions / Investors
 - Government agencies
 - Airframe and engine manufacturers
- ◆ **In 2007, SH&E joined ICF**

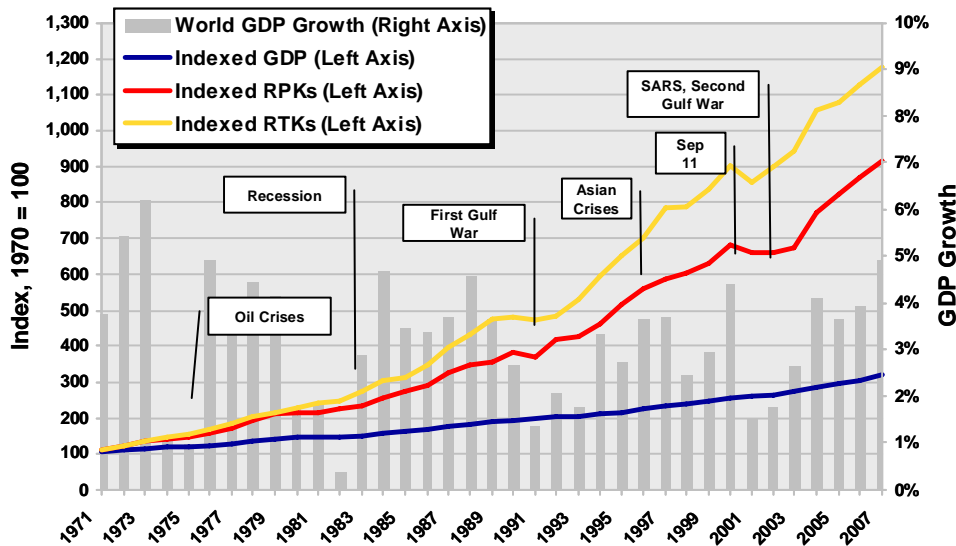
ICF INTERNATIONAL

- ◆ **ICF is a leading international management, technology, and policy consulting firm**
- ◆ **Climate change has been a core competence since the mid-1980s**
 - ICF's climate change team is composed of more than 250 experts
 - Clients include several national governments, international agencies, and more than 60 FT500 companies
- ◆ **ICF has extensive experience providing climate strategy services to the Air Transport sector**

Global air travel growth is stable and generally positive, but airlines struggle to earn positive profit margins

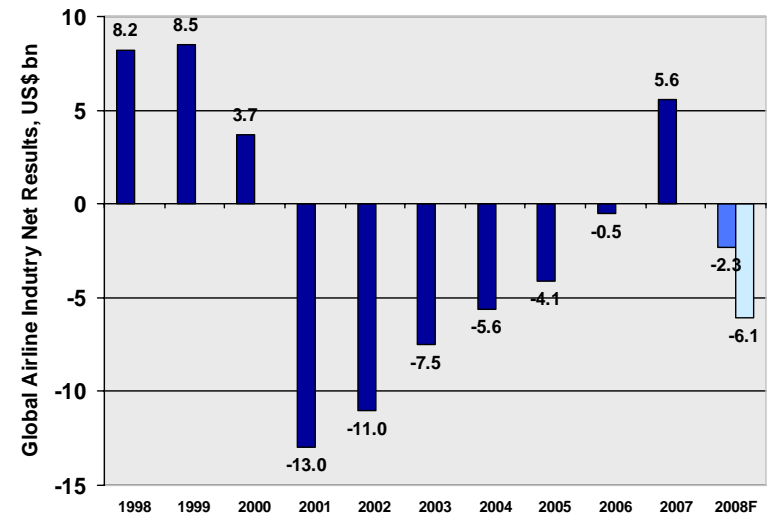
Airlines already burdened with high sensitivity of traffic to GDP growth, competitive markets, exposure to oil prices, taxation, high levels of financial leverage and insufficient airport and ATM infrastructure....

Global GDP and Air Traffic Growth, 1971-2007



source: IMF, Airline Boeing, SH&E

Global Airline Profitability, 1998-2008F



source: IATA

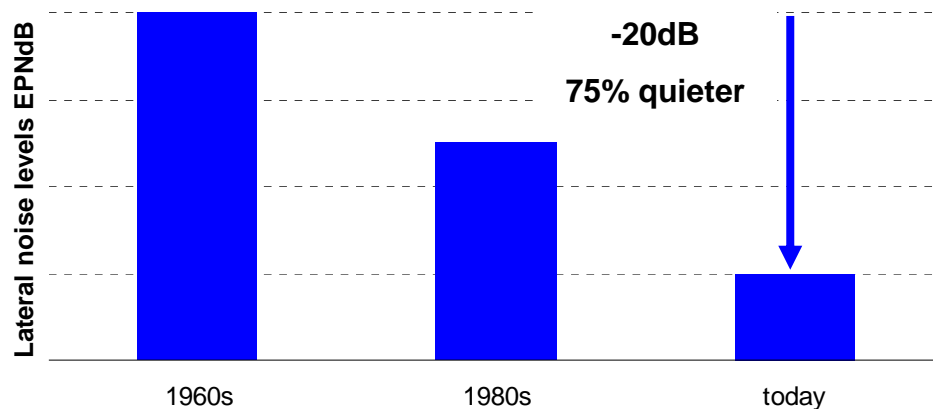
...can they cope with impending environmental regulations?

Technological innovation and cooperation in the aviation industry have enabled dramatic progress in environmental performance

Noise & Local Air Quality

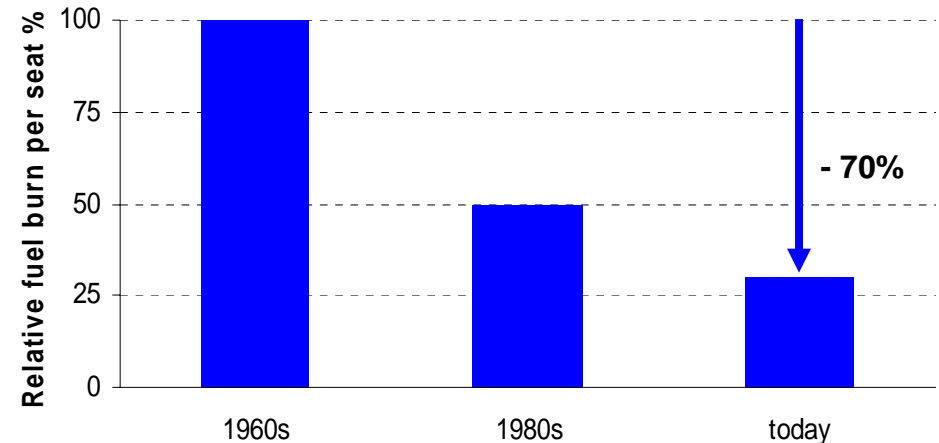
- ◆ The aviation industry has come a long way in reducing its local environmental impact

- E.g., the issue of noise once threatened to become a major inhibiting factor to air travel
- Considerable progress achieved through a global industry response involving airlines, manufacturers, airports and air traffic
- Carbon monoxide have come down by 50% and unburned hydrocarbons by around 90%



Fuel Efficiency / CO2

- ◆ Fuel efficiency has improved 70% over the last 50 years

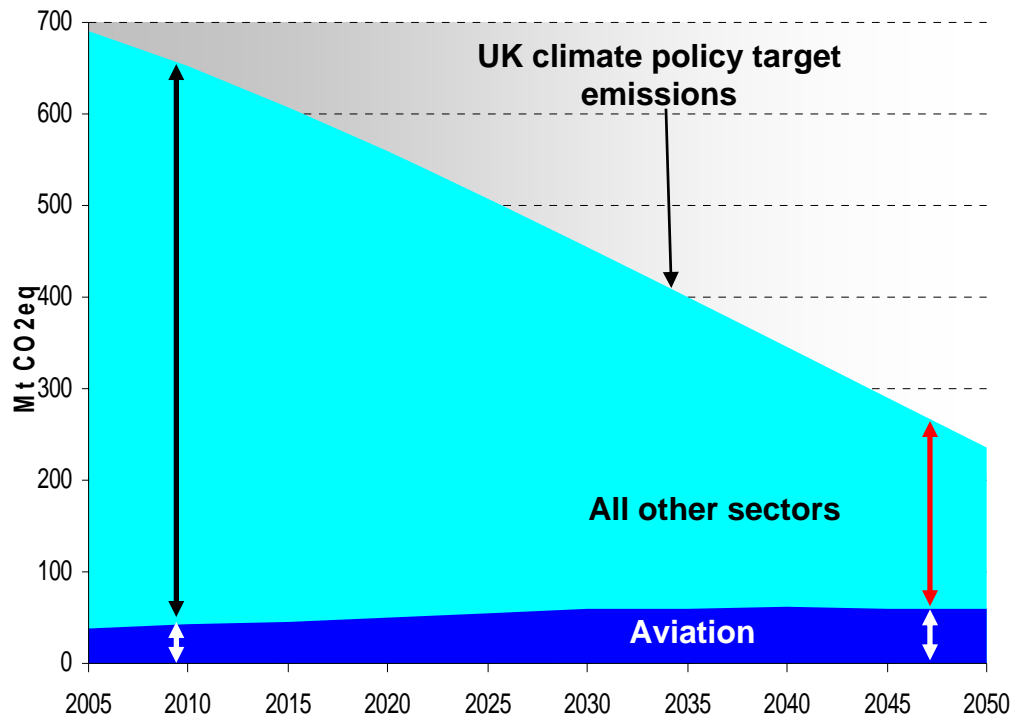


source: Airbus

Despite this progress in fuel efficiency, the aviation industry must make considerable efforts to reduce absolute CO₂ emissions

- ◆ Climate change often quoted as “the greatest challenge facing humanity”... what about the greatest challenge facing aviation?

Example: UK national emissions targets and projected aviation emissions



- Challenges the principle of **aviation growth** itself
- Challenge to reach **consensus** between different regions / industry participants / business models
- Challenge to achievements on **other environmental issues** (e.g., trade-off between fuel efficiency and noise)

The historical policy context provides clues as to the future development of aviation climate change regulation

◆ International policy context

- The **Kyoto protocol** to the UNFCCC, which set national targets for emission reductions, excluded international aviation due to the difficulty of allocating emissions to a given country
- ➔ Tasked **ICAO** with developing a framework for developed countries to pursue the limitation or reduction of GHG emissions from international aviation.
- ICAO left it to its member states to act ➔ Europe decided to move forward

◆ European policy context

- EU climate change targets:
 - *between -20% and -30% compared to 1990 levels by 2020*
 - *Aspirational target of between -60% and -80% by 2050*
- Principle: aviation must pay for its environmental externalities, in particular carbon emissions
- Few options within the sector to reduce emissions significantly in the near term
 - ➔ aviation to contribute to efforts to reduce emissions outside the industry through emissions trading in the **EU Emissions Trading System**

The form of the EU ETS for aviation has gained clarity... at least for 2012

◆ Scope

- All EU arriving/departing flights from 2012

◆ Allowance Cap

- 2013 onwards: 95% of average 2004-2006

◆ Auctioning

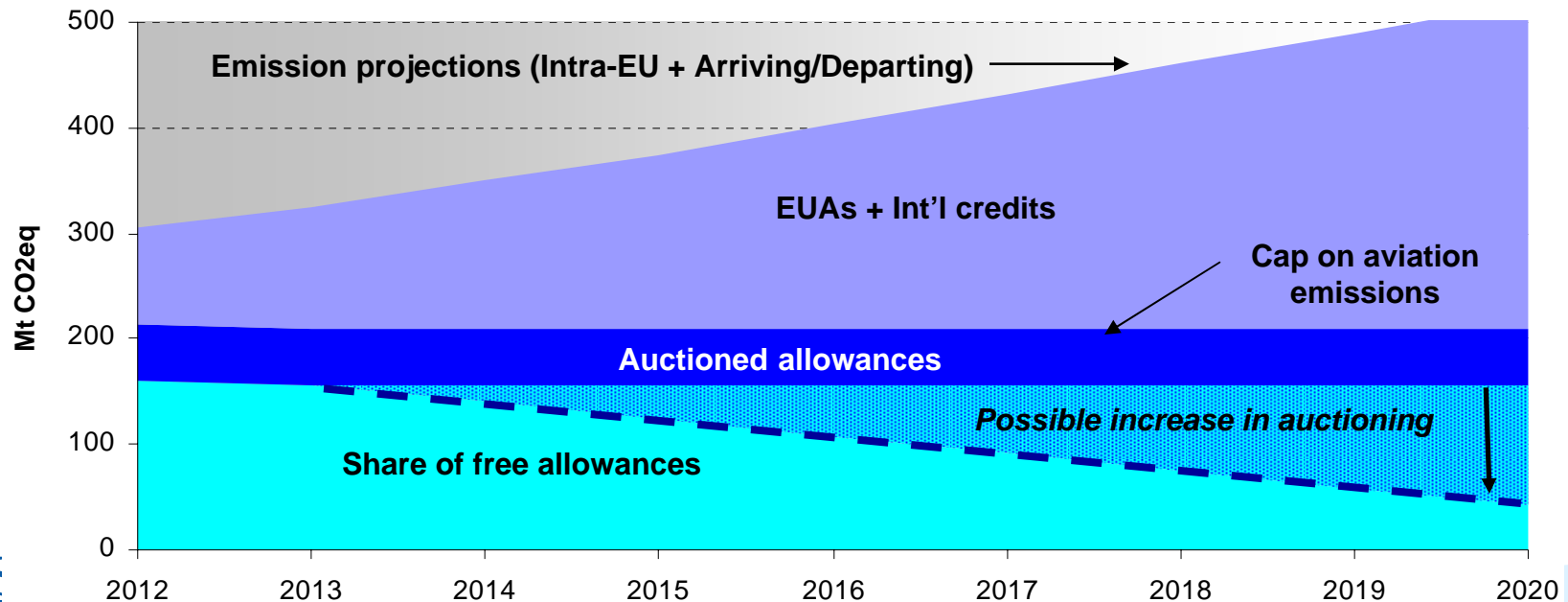
- 15% of allowances to be auctioned

◆ International carbon credits

- Up to 15% can be used to cover emissions

◆ Possible revisions

- Cap, auctioning level, earmarking of auction revenues, limit on credit use... starting 2013



Global airlines already face significant pressure to reduce emissions due to high jet fuel prices, but what costs will ETS add?

Incremental cost of CO₂ relative to fuel

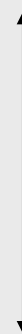
Carbon price (\$/tCO ₂)	Jet fuel price (\$/metric t)		
	750	1000	1250
25	11%	8%	6%
50	21%	16%	13%
75	32%	24%	19%

- ◆ EU ETS implications & high fuel cost implications largely similar
- ◆ Main dissimilarities:
 - Compliance Requirement
 - Asymmetric impact
 - Dependent on level of auctioning

Potential Implications for Airlines

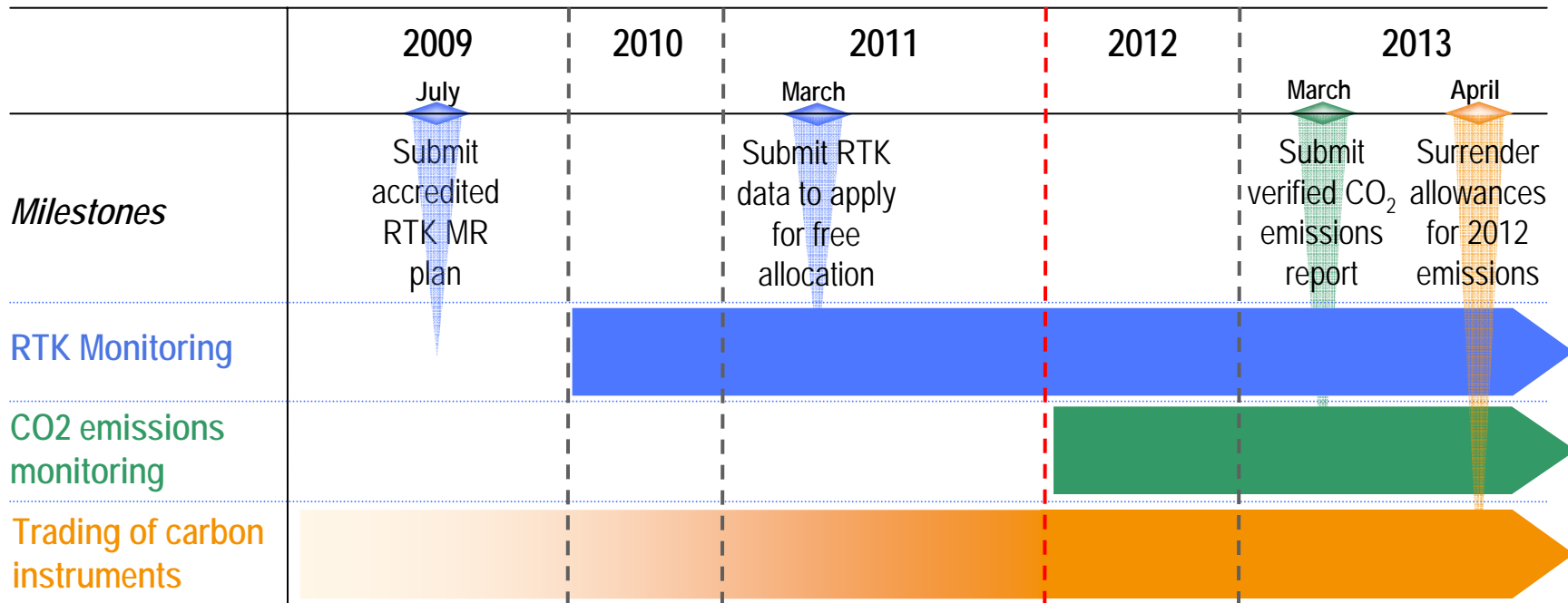
- ◆ EU ETS compliance and monitoring requirements
- ◆ Operational considerations
- ◆ Allowance auction/purchase/sale strategies
- ◆ Competitive and strategic implications relevant to business model, market segments, etc
- ◆ Fleet management / renewal planning / financing strategies

Near Term



Long Term

All airlines with plans to fly to and from the EU should begin planning for how to comply with the EU ETS scheme today



✓ A lot is at stake in RTK monitoring

- ✓ Meet the deadline
- ✓ Maximise free allocations
 - ✓ *Select the most appropriate methodology*
- ✓ Apply for free allocations from new entrants and fast-growing airlines reserve

✓ Trading strategy with efficient use of international credits options

- ✓ Minimise compliance costs
- ✓ Hedge risks from carbon markets volatility
- ➔ Early moves will lower costs and facilitate onward sale of any excess carbon credits

Airlines can undertake operational planning review in order to mitigate future exposure to carbon costs while reducing fuel costs

◆ **Schedule Planning**

- Slot/gate management
- Flight times, seasonal adjustments, right sized aircraft, minimise positioning flights, etc

◆ **Flight Operations Practices**

- Pilot training initiatives/incentives
- Mission Planning guidelines/evaluation (pre-flight; in-flight procedures; communication with ANSPs, etc)
- Weight management
- Tankering/Fuel Procurement Processes
- Ground Support Procedures

◆ **Green Maintenance practices**

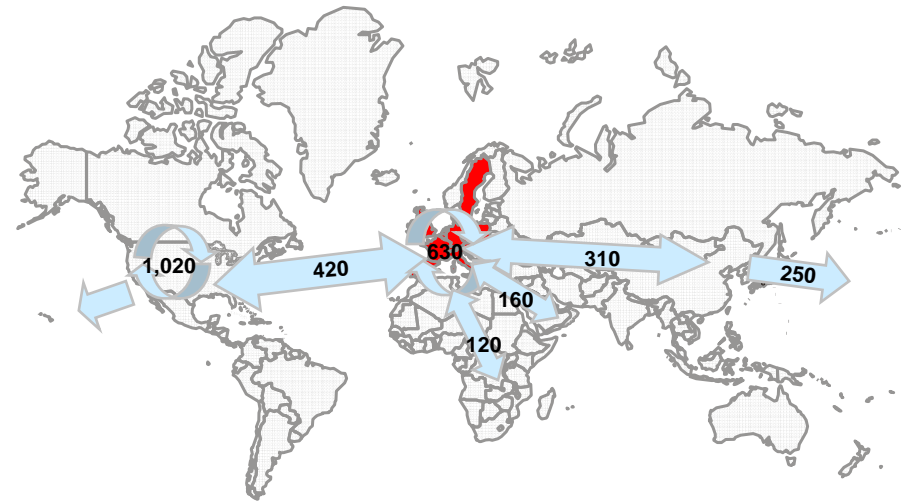
- Supply chain management
- Engine washing, weight saving practices, etc

Leading airlines already have programmes underway, but there is significant room for near term improvement for airlines across the globe

Will aviation's inclusion in the EU ETS bring significant changes to the competitive environment or other strategic implications?

The additional cost burden from EU ETS will only be imposed on airlines based in or operating to the EU

- ◆ **Different business models and traffic mixes will be affected in different ways**
 - Pass on to consumers?
 - Impact bottom line?
 - Complex demand profile places reality somewhere in between
- ◆ **Airline growth profiles will need to be reassessed**
- ◆ **Supply chain relationships may change (e.g. Airports, MRO, other service providers)**
- ◆ **Network Planning / Fleet Planning implications should be reviewed**
- ◆ **Longer term: European hubs may increasingly be by-passed by passengers connecting through other global airports, primarily in the Middle East (“carbon leakage”)**



Arrows show RPKs (bn) in 2007 on major passenger flows

Source: Boeing 2008

ETS and other potential similar carbon trading schemes will add to the imperative to renew fleets and develop technology

Airlines are already highly incentivised to minimise the fuel consumptions of their aircraft due to the significant cost burden imposed by record oil prices

- ◆ Fuel prices have led to the development of substantial efficiency improvements for existing types
 - Retrofits such as winglets
 - OEM continuous improvements (e.g. weight reduction, improved aerodynamics, engine upgrades, etc)
- ◆ New leaps in airframe and engine technology are under development
 - Entry-into-Service expected to be 2015-2022



Longer Term Engine Competition Landscape

Target EIS	Program / Engine	SFC Reduc Range	Stage 4 Noise Reduc	Thrust (lb st)	Engine Architecture
2013	PW1000G	12.5%-17.5%	20dB	10-25	Geared Turbofan
2015	RB282	12.5%-17.5%	20dB	20-30	Two Spool Turbofan
2015	RB285	12.5%-17.5%	20dB	20-45	Three Spool Turbofan
2015	NG34	16,5%-19.5	15dB	10-20	Two Spool Turbofan
2016	LEAP-X ATF	14.5%-17.5	18dB	20-40	Two Spool Turbofan
2018	PW1000G2	17.5%-22.5%	20dB	15-35	Geared Turbofan
2018	RB282	17.5%-22.5%	20dB	20-30	Two Spool Turbofan
2018	RB285	17.5%-22.5%	20dB	20-45	Three Spool Turbofan
2018	RB2011 OR	26.5-30.5%	10dB	20-45	Open Rotor
2018	LEAP-X OR	26.5-30.5%	8dB	20-40	Open Rotor

While technological step changes are on the horizon, it will take time to form a substantial part of the global fleet

◆ Global Fleet Development

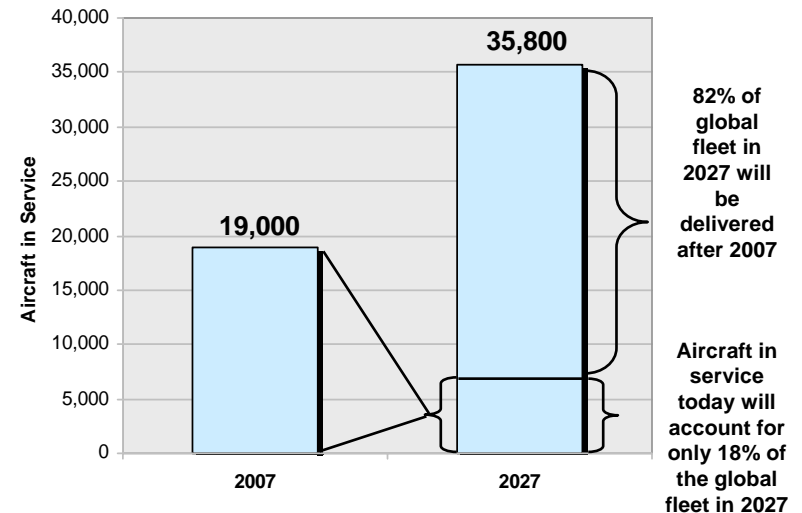
Improving Emissions Profile:

- Accelerated renewal of older generation aircraft currently in service is already occurring and will lead to an overall improvement in efficiency
- Boeing predicts that 18% of the current jet fleet will remain in service in 20 years
- New generation large regional jets/small single-aisle aircraft are hoped to begin service entry in 2013

Challenges in Technological Diffusion:

- The next generation of larger single-aisle types may not enter service in 2020
- Given the economic lives of these aircraft, long-term profile is one of relatively slow integration into the global fleet
- At such point the 737NG and A320 family fleets could easily exceed 13,000 units and any replacement would take substantial time to transition through the fleet

Worldwide aircraft fleet, 2007 and 2027



Source: Boeing 2008

Development of Alternative Fuels remains vital, but how quickly can they become a substantial source of energy for aviation?

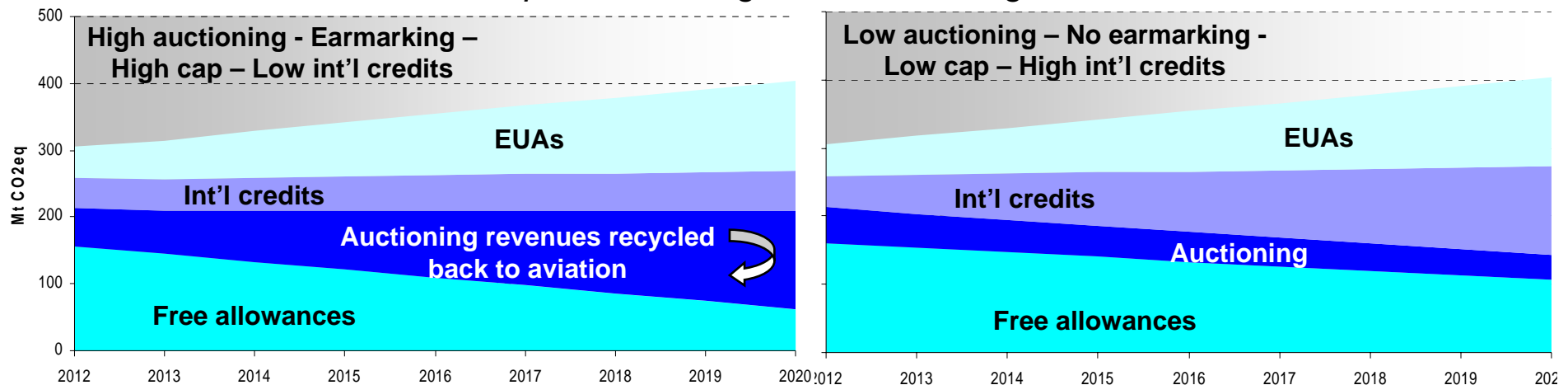
Imposing a heavy EU ETS financial burden solely on airlines will not yield the most effective environmental results

◆ Spreading the signal beyond airlines

- Airports and Air Traffic Management have control over part of the emissions
 - E.g., Single European Sky could achieve 12% reduction in emissions
- ➔ Need incentives to reduce emissions under their control

◆ Review of EU ETS Phase III under way

2 possible configurations...among others



- ◆ **Use of int'l credits:** little opportunities for abatement within the industry and inherently international nature
 - ➔ airlines should be entitled to use more int'l credits than other EU ETS participants
- ◆ **Earmarking:** auctioning revenues should be recycled back to the industry to promote fleet renewal and fund R&D for new generation of fuels and aircrafts

While ETS will be a regional reality, it is imperative that global action is taken to establish a coordinated aviation scheme

◆ Risks of current situation:

- Patchwork of heterogeneous policies in various regions
 - *E.g., proposal in the US to impose a carbon constraint on fuel*
- “**Carbon leakage**”: increase in emissions in other regions of the world as a result of emission reductions in Europe

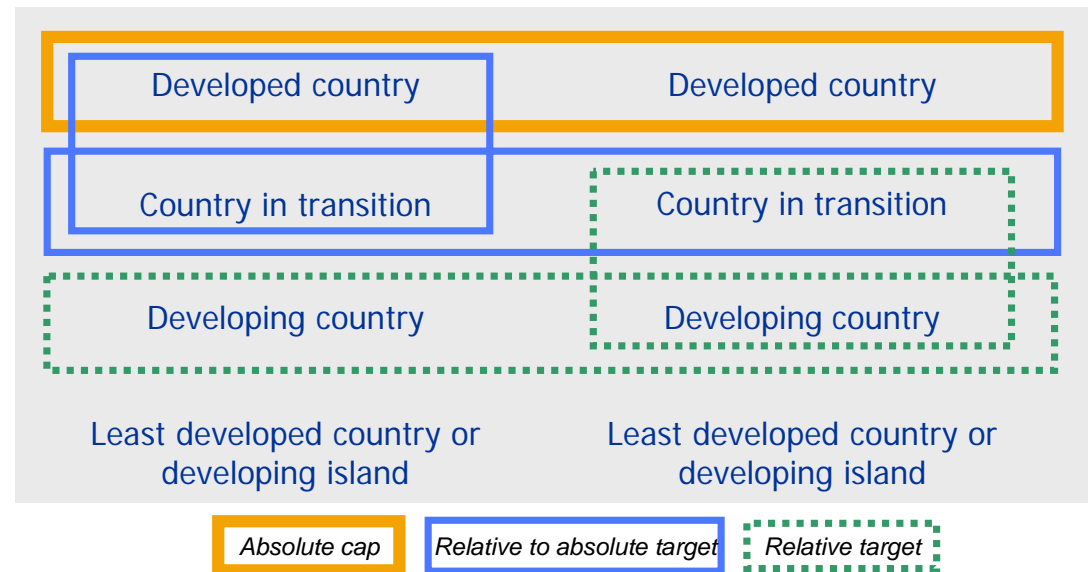
◆ Industry stakeholders must continue dialogue with policy makers as clear priorities will need to be established

- Airport Noise/Local Air Quality considerations require trade-off with emissions
- Preference for CO₂ reduction will likely increase opposition to runway expansion

◆ Ultimate goal: global aviation emissions trading scheme

- Based on a classification of countries, air routes, in accordance with “differentiated but common responsibilities”
- Multiple stage flights considered throughout to origin and destination of flight to minimise rerouting

Possible international policy framework



Conclusions

- ◆ **New environmental regulations will have a transformative effect on aviation, though the near term impacts remain debatable**
 - Likely to slow growth relative to prior expectations, particularly if fuel prices remain high
 - Marginal hubs are likely to become less viable, particularly if the share of ETS auctioning increases over time
 - Likely to bring about more rapid reduction of existing fuel efficient aircraft in current fleet
 - Ongoing consequences such as consolidation, less competitive industry, shift of transport to trains or other modes

- ◆ **Airlines can work to mitigate these impacts through near term operational improvements and ETS preparation and longer term strategic planning**
 - It is essential for policy makers to establish clarity regarding the long-term framework for ETS
 - Technological development making great strides but takes time to infiltrate

- ◆ **The airlines have a lot at stake in the evolution of environmental regulations and are also directly affected by major issues they do not control**
 - ATM inefficiencies, taxation regimes, airport congestion, etc
 - Collaborative decision making is vital

Thank you for listening

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