AIRPORTS COUNCIL INTERNATIONAL

The voice of the world's airports

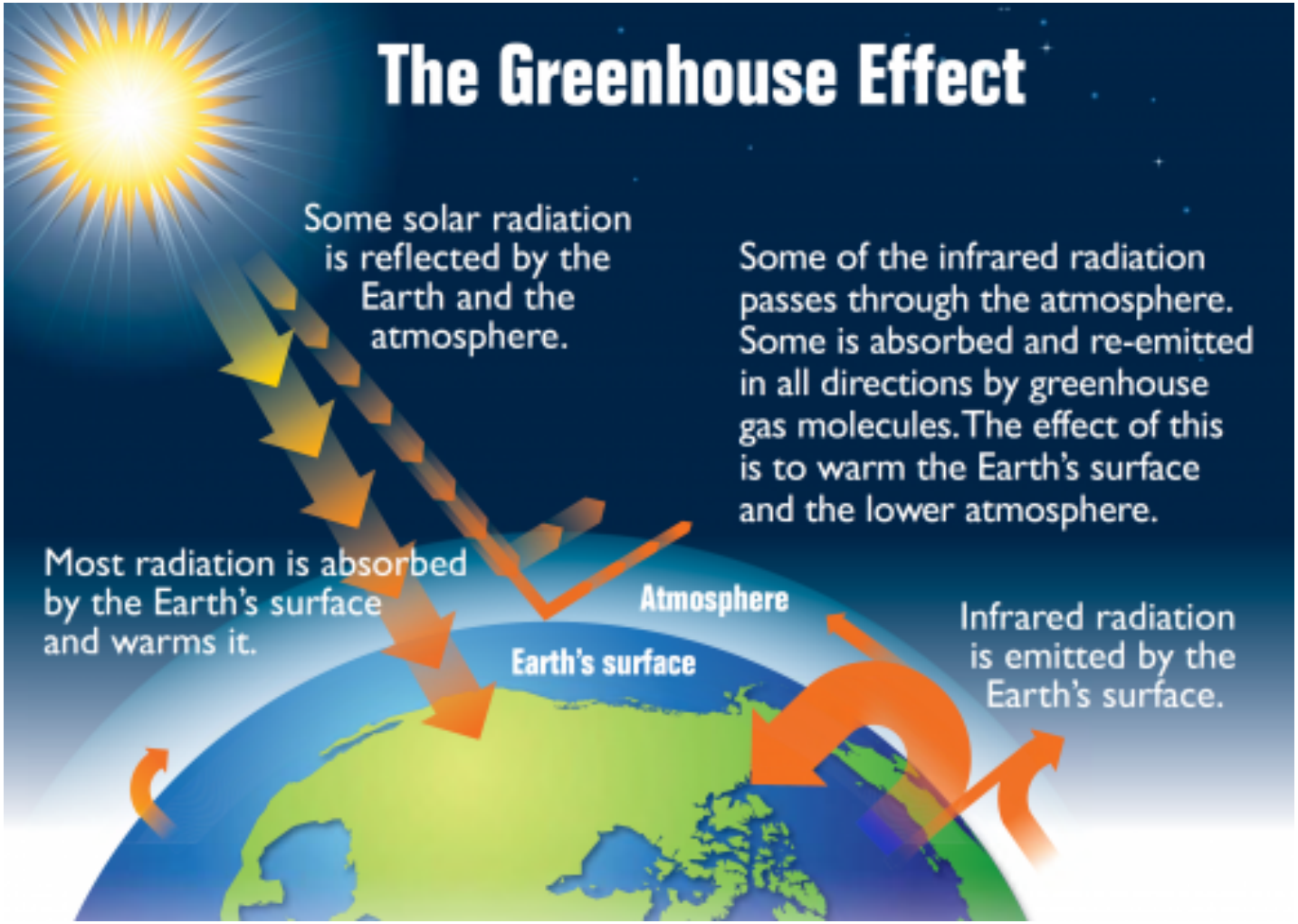
AIRPORT ENVIRONMENTAL MANAGEMENT

04-08 October 2015 | **Abu Dhabi, UAE**

Module 12: Climate Change and the Commercial Imperative

Module objectives

- To review the scientific evidence for human-induced climate change
- To highlight international and national commitments to reduce climate change emissions
- To explain the financial implications arising from increasing carbon liabilities



Source: Phys.org, 2013

The latest climate science

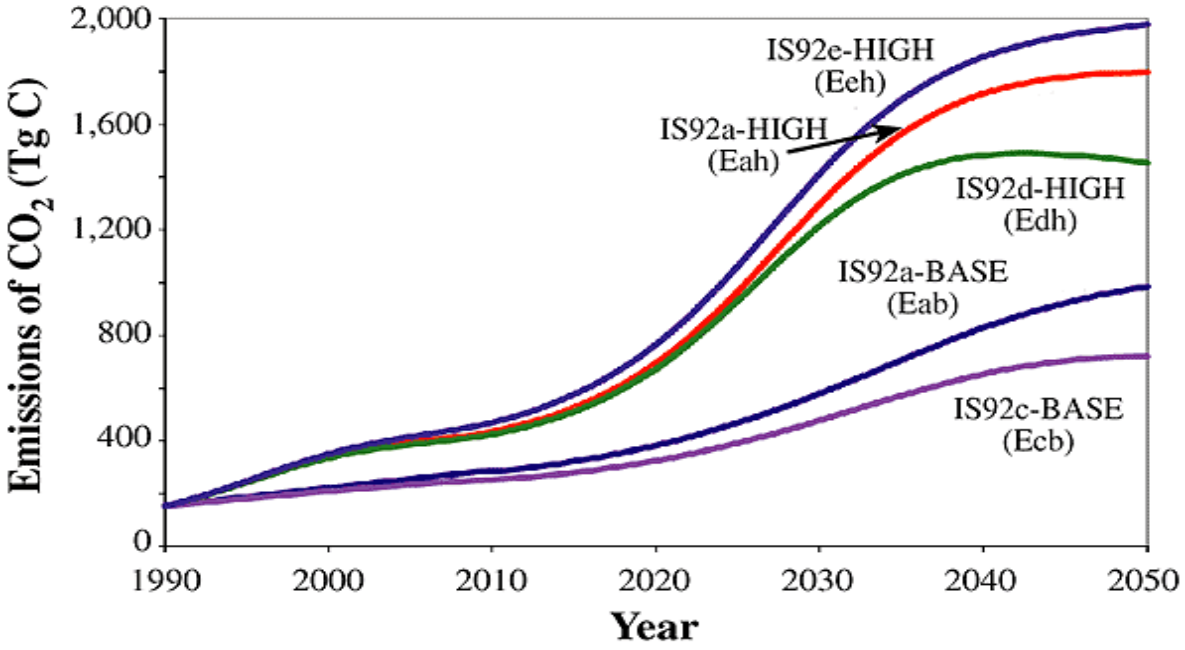
- The Climate Change debate is over
- Temperature rise between 0.3°C and 4.8°C by 2100 (1985-2003)
- Limit to +2˚C (EU)

Atmospheric CO_2 equivalent parts per million	% likelihood of eventual warming exceeding 2˚C
430	63
450	77
550	99

(Hadley Centre, 2007)

- 399 ppm (August 2015) http://co2now.org/

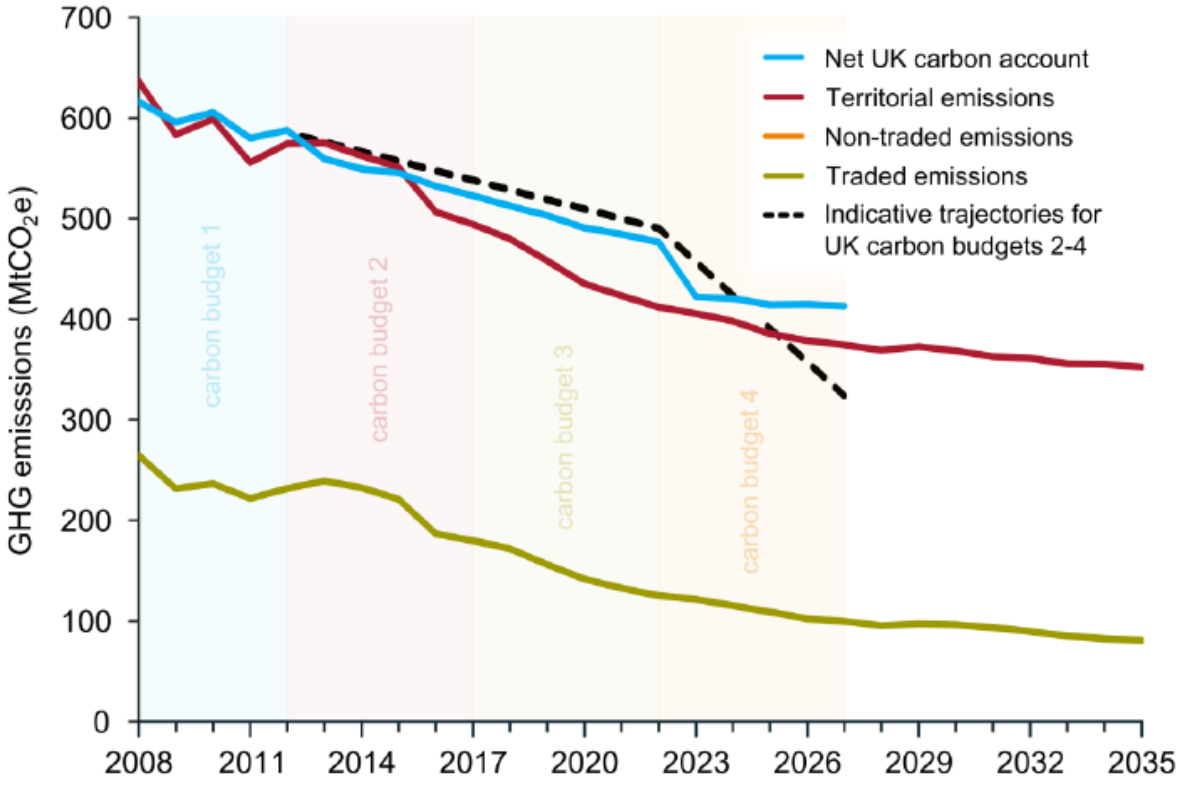
Global aviation emissions forecast to 2050



Low growth = +467%
High growth = +1,282%

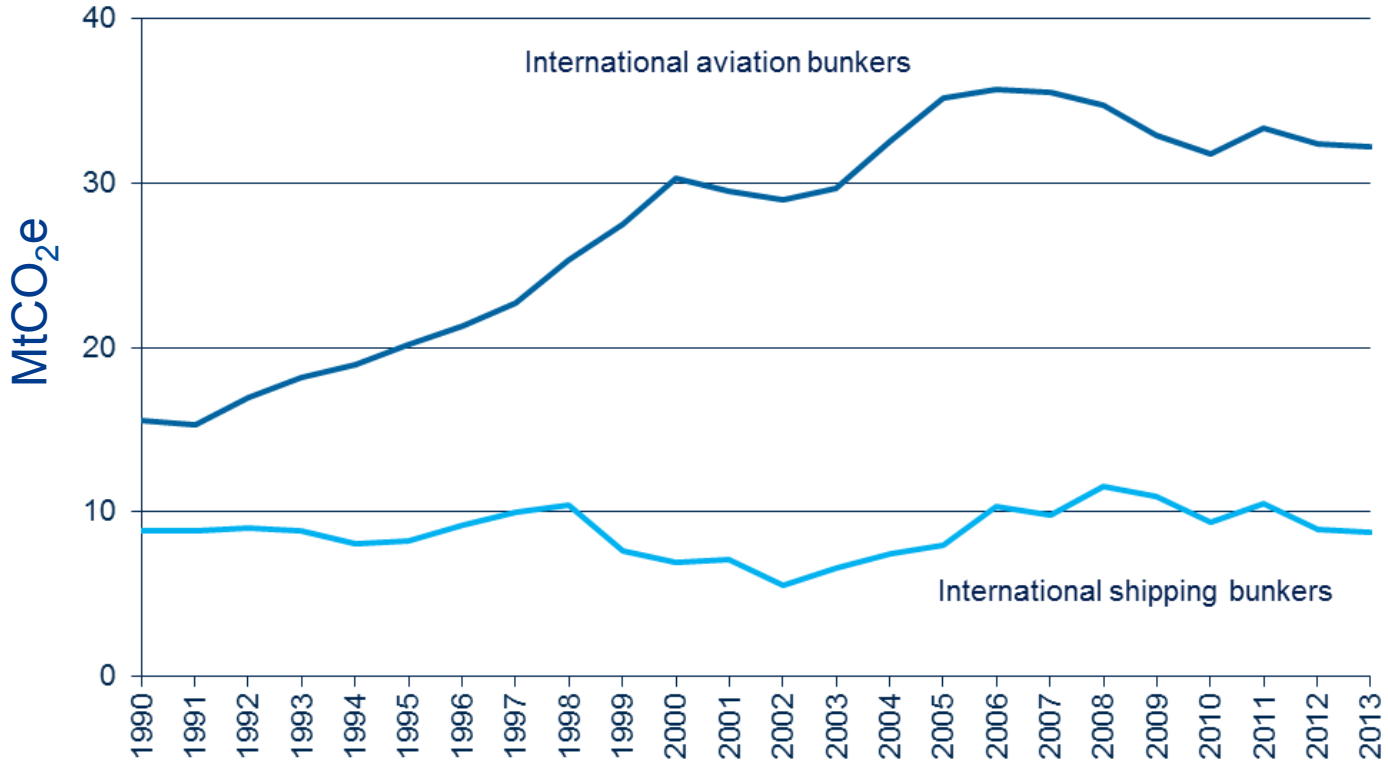
UK emissions performance and projections

Figure i: Projected UK emissions of greenhouse gases against targets



Source: UK Department for Energy & Climate Change

UK international aviation emissions



Greenhouse gas emissions from UK-based international aviation, 1990-2013 ($MtCO_2e$), https://www.gov.uk/government/publications/final-uk-emissions-estimates

The magnitude and speed of change

- Dramatic CO_2 reductions to prevent 'dangerous climate change'.
- But aviation CO_2 emissions growing and there is no technological solution on the horizon.
- System and technology change will have to be fast and far reaching.

- *Aviation will remain in the political spotlight.*

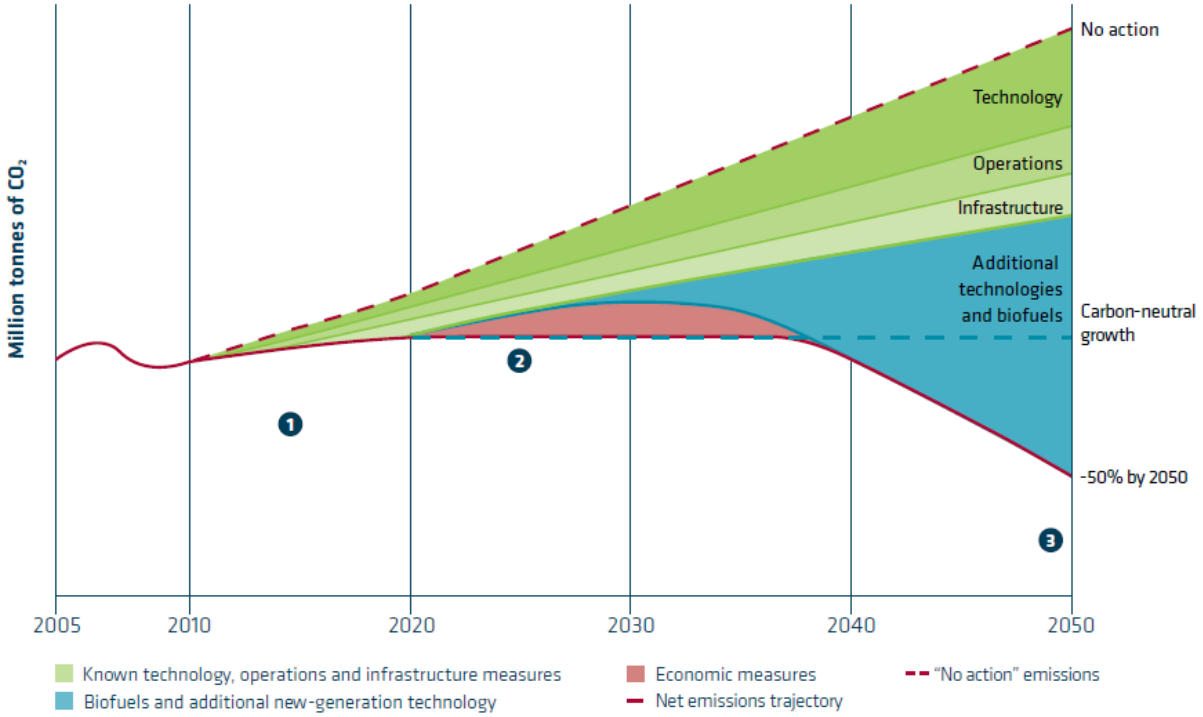
Industry roadmap to reduce CO_2 emissions

MAPPING OUT THE INDUSTRY COMMITMENTS

❶ improve fleet fuel efficiency by 1.5% per year from now until 2020

❷ cap net emissions from 2020 through carbon neutral growth

❸ by 2050, net aviation carbon emissions will be half of what they were in 2005



(Schematic, indicative diagram only)

ATAG (2012) 'A Sustainable flightpath towards reducing emissions' Air Transport Action Group, Geneva, Switzerland.

Implications for aviation

- ***Carbon pricing*** impact upon the cost of air transport.

- ***Low Carbon Technology*** Step change airframe/engine design and alternative fuels. Rate of developing being outstripped by growth.

- ***Securing the engagement of individuals -*** could influence public attitudes to air transport.

Stern Review

Regulatory intervention growing

- 1997 International Aviation excluded from Kyoto Protocol
- 2008 National CO_2 targets - 80% includes international aviation?
- 2009 UK aviation emissions targets - 2050 CO_2 < 2005
- 2009 CAA commission on CO_2 limits for Heathrow
- 2009 UK presses for EU ETS at COP 15 in Copenhagen
- 2010 DEFRA Airports CC Adaptation Order
- 2012 Aviation enters EU ETS and 'stop the clock'
- 2013 ICAO 38th Assembly – MBM in 2016, start 2020

UK CCC report on aviation emissions (2009)

- 2008 report suggested that present aviation CC emissions would account for 25% of all emissions by 2050 if UK achieved its 80% cut.
- Jan. 2009 UK Government commits to stabilising aviation emission to 2005 levels by 2050
- 60% growth in air services only by 2050 allowing for expected improvements in efficiencies – well below that which would occur (est. 200%) if demand is not constrained by carbon prices and airport capacity
- Global aviation emissions should be capped

ACARE Goals

- By 2020 (relative to 'typical' 2000 aircraft)
  - 50% reduction in perceived noise
  - 50% reduction in CO_2 emissions
  - 80% reduction in NOx emissions
- By 2050 (relative to 'typical' 2000 aircraft)
  - 65% reduction in perceived noise
  - 75% reduction in CO_2 emissions
  - 90% reduction in NOx emissions

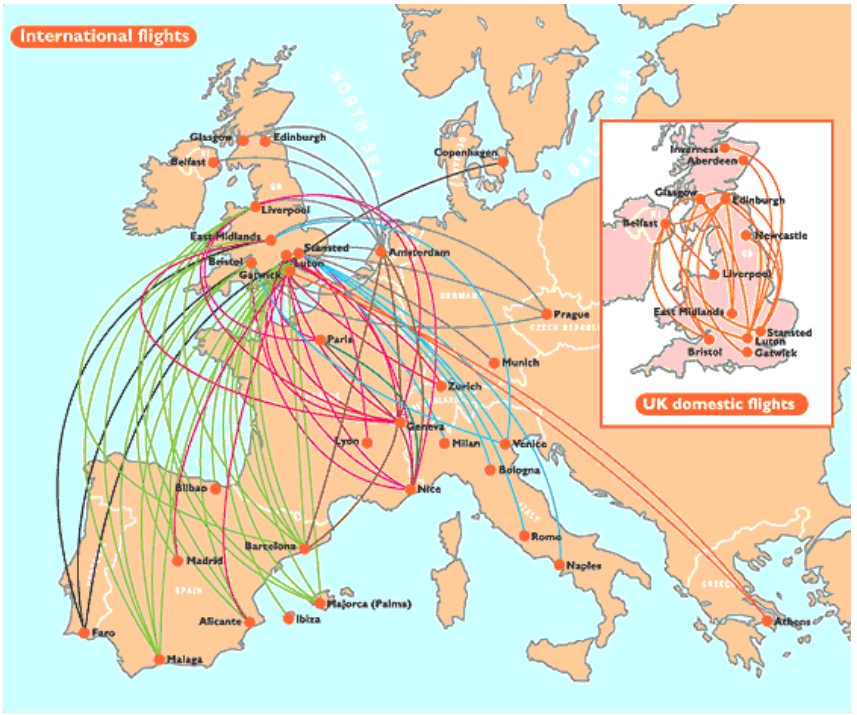
But what about growth?

Will CC restrict airport growth?

- Arguments being made to restrict further airport infrastructure growth
  - To prevent dangerous climate change
  - Because aviation will have limited role in low carbon economy

Could climate change affect air route networks?

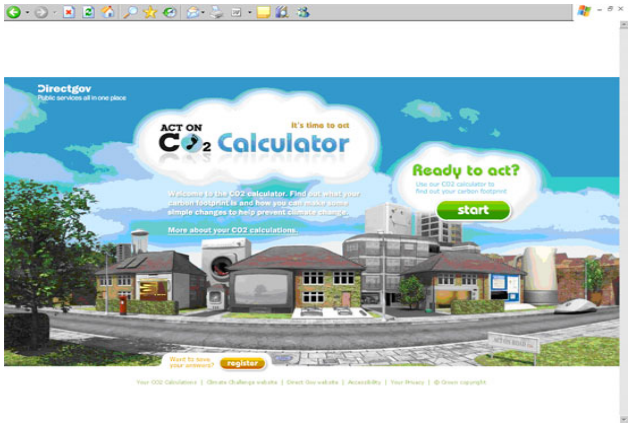
- Maximise load factors
- Service Frequency
- Hubbing v. point to point
- Dynamic Capacity Management



Changing Public Attitude

Public attitude to air travel

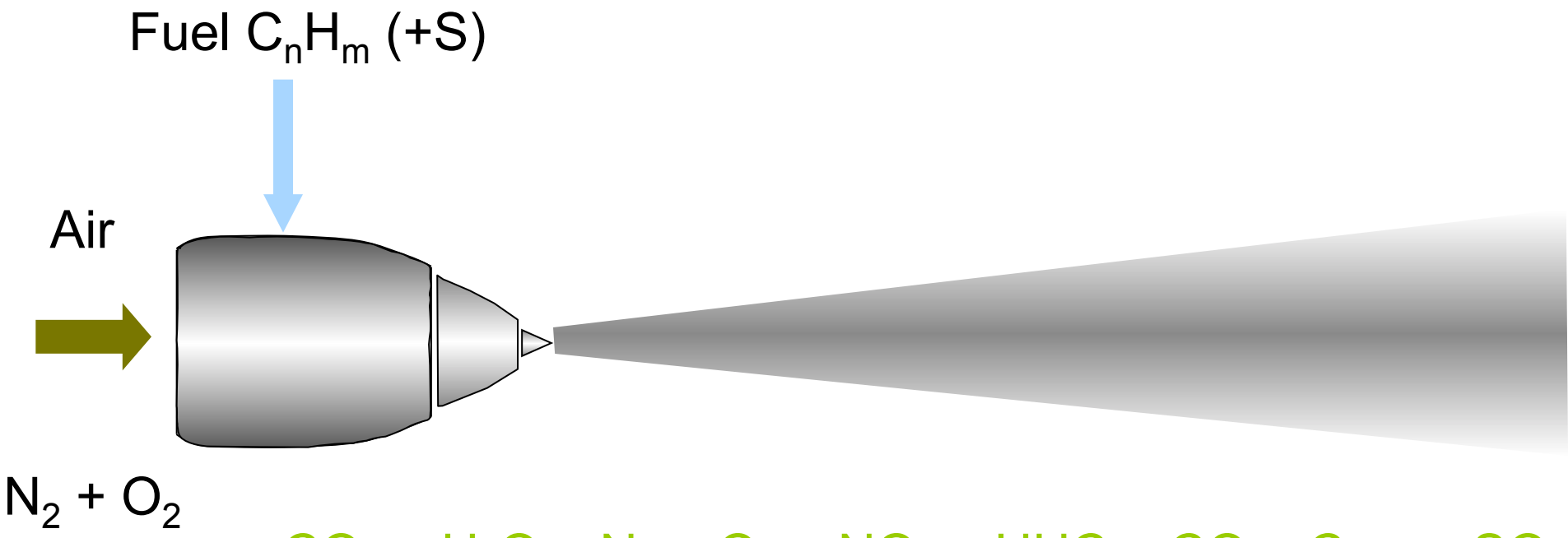
- Government targets for CO_2 reductions will not be achieved by industry alone.
- Public awareness to be raised about CC consequences of purchasing habits
- Globally aviation 2-3% of CO_2 from human activity
- For many UK households it could be 25%+ of their direct purchasing



Public attitude to aviation and climate change

- High awareness of climate change
- Low awareness of climate change and aviation
- Generally not willing to change flying habits
- Willing - to pay more to compensate /offset, change expectation of convenience and on board services (but will this translate to action?)
- Most believe government and industry responsible for resolving the problem
- Starting to affect demand at the margins, one survey suggested 10% planning to fly less (but was this a credit crunch impact?)

Non-CO_2 Climate Impacts of Aircraft



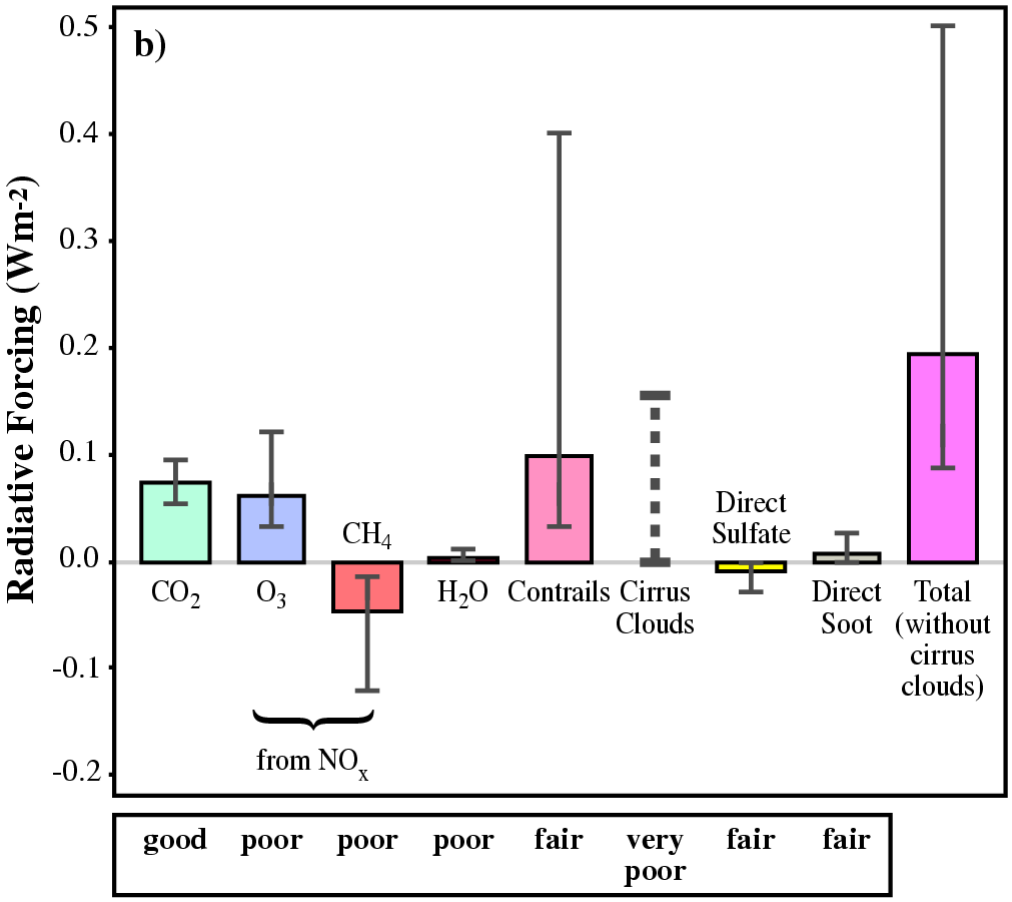
$CO_2 + H_2O + N_2 + O_2 + NO_x + UHC + CO + C_{soot} + SO_x$

\+ \+ \+ −

O_3 CH_4

\+ −

Aviation RF in 2050 (IPCC, 1999)



A radiative forcing of 0.19 W m^{-2} in 2050 for the reference scenario (Fa1)

About 5% of the total radiative forcing from all anthropogenic activities

IPCC, 1999

Peak Oil and Carbon Prices

The broader carbon challenge

- The debate is not simply about climate change - its mitigation and impact
- A second threat is the availability and price of carbon fuels
- After 200 years we are approaching the end of the Carbon age

Peak oil I

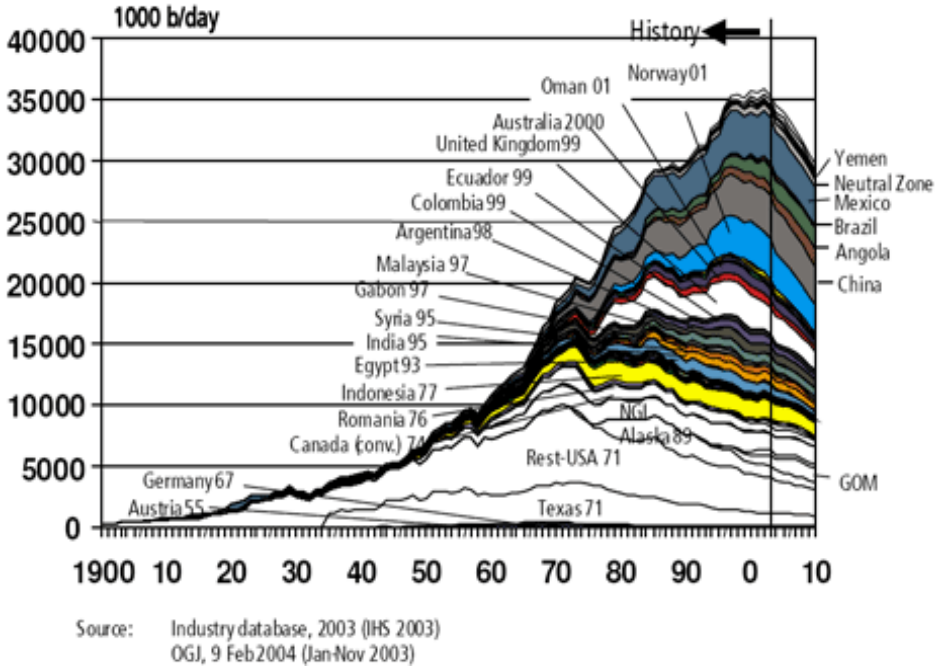
- Known reserves finite and declining
- Demand growing
- New finds (deep water and tar sands) environmentally & financially costly / risks to extract & refine

Alberta Tar Sands © Garth Lenz

Peak Oil II

- Aviation a legacy user of C fuels
- Can synthetic / biofuels fill the gap?
- The cost of flying will rise

<u>Does Sustainable Aviation = carbon free flight?</u>



Exercise: Drivers for carbon management

- Identify the key commercial, social and environmental drivers for carbon management at airports

- Which drivers have greatest influence at airports in your country?

Impacts of Climate Changes on Airports

2010 DEFRA airport CC order

- Requires 7 largest English (and Scottish) airports to:
  - assess the risk of CC for their 'statutory functions'.
  - bring forward adaptation proposals in 2011.

Climate change impacts on aviation

- At airports and *en route*
- Disruption, delays, diversions
  - rain, fog, winds, heat.
  - changes in jet stream
- Changing a/c performance
  - Runway length, airspace

Climate change and airport capacity

- Infrastructure design for future weather.
  - Construction materials
  - Capacity of drains etc.
  - Water / energy use
- Disruption and delays.
  - Rain, fog, winds, heat.

Sea level rise

- 2050 and beyond ?
- Low lying airports- coasts, river estuaries
- Airport infrastructure or approach roads
- Risks -sea level rises, storm surges, tidal lock
- Examples: EU, Norway, San Francisco
- London City ?

Climate change, levels and patterns of demand

- Destinations less attractive
- Seasons will change
- New markets emerge
- Sun and Ski
- Air freight patterns/food production

- NOT an Environmental issue
- Implications
- Timescales
- Magnitude
- Certainty

Risks and Control Measures

Heathrow
Making every journey better

R	Significant	Excessive	E	A	**Action** Defines actions that are known and required now to mitigate identified short-term climate related risks and/or longer-term risks if the solution requires action now
		Optimal	O	P	**Prepare** Defines tasks to improve understanding of the cause or solution to a significant or medium term risk. Tasks are therefore predominately research based
A	Moderate	Adequate	A	W	**Watching Brief** Watching brief to be maintained in the short term on the latest climate science developments, and the situation on the ground.
G	Low	Inadequate	I		

Risk ID	Risk	Climate Variable	Threshold	Confidence (climate projections and or consequence)	Risk Grading (no adaptation)		Existing Control Measures		Adaptation Response Needed		Business Unit owners	Director's Responsible
					Short Term (to 2020)	Medium / Long (2020 to 2050s)	Summary	Adequacy				
AIRSIDE												
1	**Flashpoint of aviation fuel exceeded on hot days** - potential fire hazard.	Temp	Aviation fuel flash point is 38°C. Temperatures during the summer of 2003 peaked at 37.5C	H	A	R	Spill reporting and defined clean up procedures.	A	P	**Prepare:** Research into spill clean up options currently used at airports in warmer climates to commence to develop policies robust to air temperatures exceeding 38°C.	Airside	Airside Director
2	**Increased incidence of fuel venting** from aircraft in warm weather.	Temp	Aviation fuel flash point is 38°C.	H	A	A	Spill reporting, clean up procedures, airport pollution control system	O	P	**Prepare:** Research into options currently used at airports in warmer climates for spill reporting and clean up procedures.	Airside	Airside Director
3	**Increased fire risk** due to hotter temperatures combined with increased lightning and drought potential.	Temp	Requires research	M	G	A	Onsite fire brigade, fire water supply and fire mains, regular drills, smoke and fire detection systems, vegetation management plans, PATS testing of electrical equipment.	O	P	**Prepare:** Ensure that the planned changes and development of the airport's fire main considers and addresses the potential for increased fire risk resulting from climate change.	Airside	Airside Director
4	**Change in distribution of pests and wildlife species.** Potential changes to bird migration patterns and bird strike risk.	Temp	Requires research	L	G	G	PPE, first aid for outdoor workers. Veterinary service, bird management controls.	O	W	**Watching Brief**	Airside	Airside Director
5	**Reduced lift** for departing aircraft due to 'thin air' and reduced engine efficiency in very hot weather.	Temp	Aircraft operate in multiple temp zones, unlikely to be breached	H	G	G	Potential to change load factors, ATM rates, if needed. Existing noise footprint monitoring and mitigation tools.	E	W	**Watching Brief**	Airside	Airside Director
6	**Torrential rain creates hazardous conditions for vehicles and planes** i.e. airside and landside road vehicles, and taxiing and landing aircraft.	Precip.	Defined in Strategic Flood Risk Assessment (SFRA)	H	G	A	Grooved runway, drainage system, ATC procedures i.e. increased separation distances, runway safety zones, operational guidance for pilots/airside staff, warning signs on motorway network to announce hazardous conditions.	O	W	**Watching Brief**	Airside	Airside Director
7	**Seasonal changes to fog related disruption** (increase in winter months, decrease for remainder of year).	Fog	Low Visibility Procedures when the Runway Visual Range (RVR) is < 600m and/or cloud ceiling is < 200 ft. Projections do not suggest any critical thresholds would be crossed	L	G	G	LVPs, operational guidance for pilots and airside vehicles, warning signs on nearby motorway network to alert drivers to hazardous conditions.	E	W	**Watching Brief**	Airside	Airside Director
8	**Increased risk of schedule interruption** from stormy conditions.	Storms	High wind procedures and cross wind procedures enacted at defined criteria (dependent on aircraft type).	L	G	A	ATC procedures i.e. separation distances, contingency plans for disruption.	O	W	**Watching Brief**	Airside	Airside Director
9	**Increased longevity of wing tip vortex effect** due to general becalming of surface wind speeds.	Wind	Wing tip vortex is particularly problematic for small planes taking off in quick succession after large aircraft.	L	G	G	Reparation programme to repair affected roofs, ATC procedures i.e. increased separation distances.	E	W	**Watching Brief**	Airside	Airside Director
10	**Change to prevailing wind direction affects runway utilisation** and schedules.	Wind speed/ direction	All commercial aircraft are tested to a "demonstrated" maximum crosswind as part of their certification. Large aircraft are better able to handle cross winds than light aircraft. Technology is improving all of the time.	L			Not able to be assessed due to lack of projection data.		W	**Watching Brief**	Airside	Airside Director
11	**Disruption to airfield operations from lightning** i.e. refuelling suspension, changes to flight routing.	Lighting	All commercial aircraft are tested for resilience to lightning strike as part of their certification. Planes can withstand lightning strike in the air but during take off and landing instrument loss would be critical hence the diversion of routes and stacks.	L	G	A	Suspension of refuelling, changes to stack locations and departure routes, diversions.	O	W	**Watching Brief**	Airside	Airside Director

Heathrow Airport Climate Change Adaptation Reporting Power Report, May 2011. Heathrow Airport Limited.
http://archive.defra.gov.uk/environment/climate/documents/adapt-reports/08aviation/heathrow-airport.pdf

Conclusions

- High degree of certainty that we are already dealing with 'Dangerous Climate Change'
- Policy is seeking to avoid 'Catastrophic Climate Change' and address adaptation requirements
- Policy requirements for mitigation and adaptation will add to the increasing price of carbon resulting from reducing oil reserves
- Aviation will be affected by climate change and has to play a full part in emissions reductions

Any questions?