The potential for cost-effective CO$_2$ abatement in commercial aviation

Brian Pearce

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To represent, lead and serve the airline industry
CO₂ projections have differed
IATA 2010-2030 forecasts lower than MODTF’s (low) scenario 6 for CAEP/8 but in line with FAA 2009 GIACC projections

Scenarios for CO₂ from commercial airline fuel burn

IATA scenario - frozen technology
IATA scenario - fleet renewal and higher load factors only
IATA scenario - full implementation of cost effective pillar 1-3 measures, including 12% biofuel by 2030

Source: IATA, ICAO, FAA
We are hopeful about biofuels in long-run
E4tech aviation biofuel report for UK Committee on Climate Change concluded that, if land use impacts are managed, there is a potential for very significant biofuel use especially by the 2035-2050 period

Figure I: Uptake of biofuels to 2050 under the five summary scenarios
Source: E4tech
Estimating current aviation CO₂ emissions
IEA data fuel consumption and IATA fuel efficiency survey used to extend model-based (FAST) CO2 projections

Million tonnes CO₂, unless otherwise specified

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<td>Scheduled, under ideal flight conditions</td>
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<td>Correction for flight conditions</td>
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<td>628</td>
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<td>679</td>
<td>689</td>
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<td>% change over year</td>
<td>4.1%</td>
<td>-2.8%</td>
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<td>6.4%</td>
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<td>% Total CO₂</td>
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<td>% IEA CO₂ from fossil fuel burn</td>
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<td>% Transport</td>
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<td>726</td>
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<td>744</td>
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<td>Total aviation fuel use-based emissions</td>
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<td>652</td>
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<td>726</td>
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<td>750</td>
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<td>% total CO₂</td>
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<td>% CO2 from Energy (inc bunker fuels)</td>
<td>2.8%</td>
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<td>% transport (inc bunker fuels)</td>
<td>12%</td>
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Source: IATA
Little difference on passenger outlook
CAEP/8 baseline growth rates spliced on IATA 2012-2015 world RPK forecasts. Following the recession IATA forecasts are 3% lower than CAEPs.
Higher load factors also in line with CAEP/8

With 85% load factors on some markets there is scope for a further rise in asset utilization, reducing the need for capacity, above the 81% LF assumed by 2030.

Source: ICAO, IATA
Similar fleet retirement profiles
IATA modelling of fleet used CAEP/8 survivor curves

CAEP/8 FESG Passenger Aircraft Retirement (Survivor) Curves

- **Narrow Body aircraft (2-man fit crew)**
- **Wide Body Aircraft (Less MD-11)**
- **B707 / B727**
- **MD-11**
- **Russian Built TP/Jet aircraft**

Source: P&W
Fleet changes and emissions modelled

IATA used survivor curves, traffic forecasts, flight stage lengths and emission factors to model fleet bottom-up. Delay in new model introduction has limited their share compared to earlier forecasts.

Source: IATA
Fuel efficiency 1.5% pa from fleet renewal

Fleet renewal and higher LFs alone reduce CO₂ growth from 4.7% to 3.2%, as a result of average fuel efficiency gains of 1.5% pa

Frozen technology and 'fleet renewal' CO₂ projections, m tonnes

- 'Frozen 2010 technology' 4.7% pa (2010-2030)
- Fleet renewal and LFs only 3.2% pa (2010-2030)

Source: IATA
As additional measures to fleet renewal (which includes new aircraft types and embodied technologies later in the forecast period) the following technology options were modelled:

- Wingtip devices
- Engine upgrades
- Re-engining
- Early retirement of aircraft
- Reduced speed with redesigned fleet
- Algae oil-based biofuel
These operations options were modelled

- Optimised flights using cost index
- Use of ground power
- Taxiing with some engines shut down
- Improved fuel management
- Cabin weight reductions
- Improved pilot technique
- Takeoff and landing procedures
- Centre of gravity measures
- No fuel tankering
- Reduced speed with existing fleet (no redesign)
These **infrastructure** options were modelled

- NextGen related ATM improvements
- European ATM improvements
- Flexible tracks North Pacific
- RVSM China (implemented 2007 but baseline emissions 2006)
- Pearl River Delta ATM improvements
- Chinese airspace redesign
- Flexible use of military airspace
- Gulf region airspace redesign
2020 potential for cost-effective CO₂ cuts
Bottom-up modelling suggests a further 92mT of CO₂ could be cut in 2020 with costs less than the cost of carbon

Source: IATA
2030 Potential for cost-effective CO₂ cuts
Bottom-up modelling suggests a further 215mT of CO₂ could be cut in 2030 with costs less than the cost of carbon

Source: IATA
Implementing cost effective CO\textsubscript{2} cuts

- MBMs set a price for CO\textsubscript{2} emissions and so a financial incentive to cut them.
- However, the 2020/2030 abatement cost curves show only biofuels may be incentivized. Some measures just too costly.
- All infrastructure measures are negative cost i.e. they should happen without an MBM. MBM will have no impact. Suggests other barriers requiring political action.
- Operational measures also negative cost. Again MBM will have no effect. Information instrument like IATA Fuel Teams required.
Potential to cut 2030 CO₂ to 1025mT

Implementation of all cost-effective ‘pillar 1-3’ measures could reduce average 2010-2030 CO₂ growth from 3.2% pa to 2.2% pa. Without biofuels CO₂ growth 2.8% i.e. 2% pa fuel efficiency gains are the maximum feasible

Source: IATA
Back up slides
OECD markets are approaching maturity

Ratio of air transport volume to GDP growth

Source: ICAO, IATA
But plenty of future demand from BRICs

Available aircraft seats per capita and population

Available seats per capita per year
(left scale)

Population
(right scale)

Providing 3.5 seats a year to BRIC population would mean additional 10 billion seats capacity
3x global capacity today

Source: Haver, IATA
Biofuels costly but may become economic

Jet fuel and carbon prices versus estimated costs of bio-jet

Source: IATA
Abatement potential over time was modelled

- Technology measures used detailed fleet forecasts to measure baseline emissions from targeted aircraft/engines
- Infrastructure measures used detail traffic flow forecasts to measure baseline emissions from movements in target regions/markets
- Operations measures used a combination of fleet and traffic flow forecasts to measure baseline emissions subject to these measures
- Together with data from the OEMs and industry experts on the improvements per aircraft/traffic movement from specific measures
Cost effectiveness of different emission reduction measures is a key output of the ACM, allowing a comparison against ETS allowance prices. Cost effectiveness is measured by ‘full’ net costs per tonne of CO$_2$ saved (or tonne jet kerosene saved). ‘Full’ costs means capital costs, amortised over the effective life of the measure using the average airline WACC, plus any operating costs. ‘Net’ costs means ‘full costs’ minus fuel and any other operating cost (e.g. maintenance or block hour-related) savings.
There are other ways of looking at the same data for different decisions

- **Pay-back period** - ‘will cash flows from this measure cover my initial investment quickly enough in this business environment?’

- **Net present value** – ‘if I discount future cash flows by my WACC will they exceed my initial investment and make this a financially effective use of funds?’

- **Internal Rate of Return** – ‘will future cash flows generate a return on my initial investment that exceeds my WACC or target rate of return?’

- **Cost effectiveness** – ‘will the full net cost of this measure at a particular future date be less than the cost of any alternative measure or the price of buying an emissions trading scheme allowance?’

We present data on **cost-effectiveness** for the purpose of this study, but can also show the payback period, PV and IRR.