

The role of aviation alternative fuels in climate change mitigation

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Overview

- Why the interest in alternative fuels?
- Three questions for 2009
- Hurdles to overcome for alternative fuels
- Other policy instruments to reconsider
- Conclusions

Biofuels in aviation: jumping the gun?

- Much action and interest
 - Numerous commercial trials attracting public attention
 - USAF seeking biofuels for blend certification by 2013

- But...
 - Compelling evidence that GHG emissions from today's biofuels higher than conventional petroleum fuels
 - Supply constraints severe:

Meeting USAF demand for 300,000 gallons (~0.00035% of annual commercial use) "tricky"¹

Carrier	Date	Biofuel blend
Virgin Atlantic	Feb 2008	20% (coconut and babassu)
Air New Zealand	Dec 2008	50% (jatropha)
Continental	Jan 2009	50% (algae and jatropha)
Japan Airlines	Jan 2009	50% (camelina, jatropha, algae < 1%)

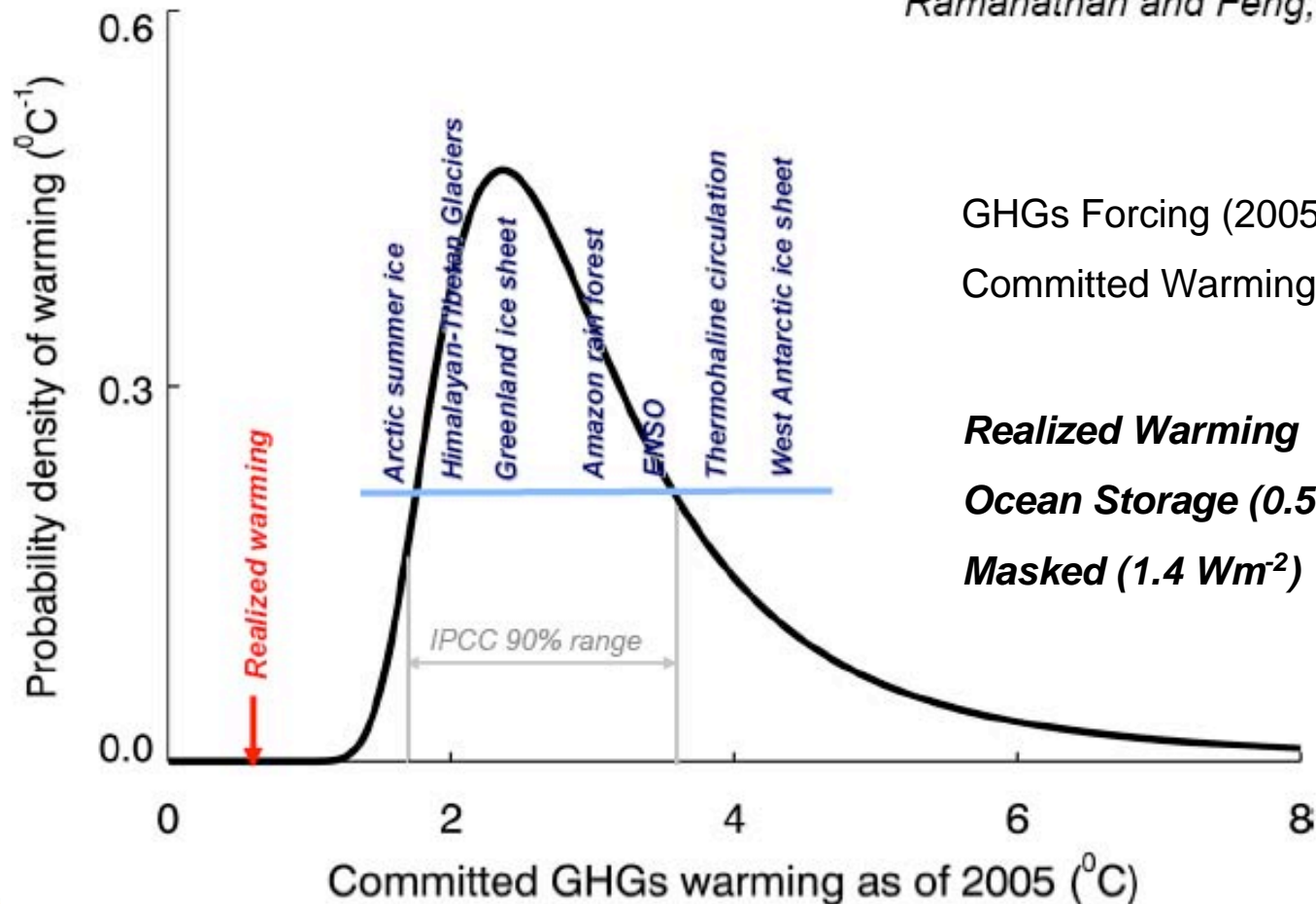
[1] Richard Altman, Aviation Week.com 01/29/2009

- Little reason to believe that biofuels will significantly reduce GHG emissions in the short to medium term --> need to think broadly about a range of mitigation options

Action needed today to avoid climate tipping points

Committed Warming as of 2005

Ramanathan and Feng, 2008



GHGs Forcing (2005) = 3 Wm^{-2}

Committed Warming = 2.4 C

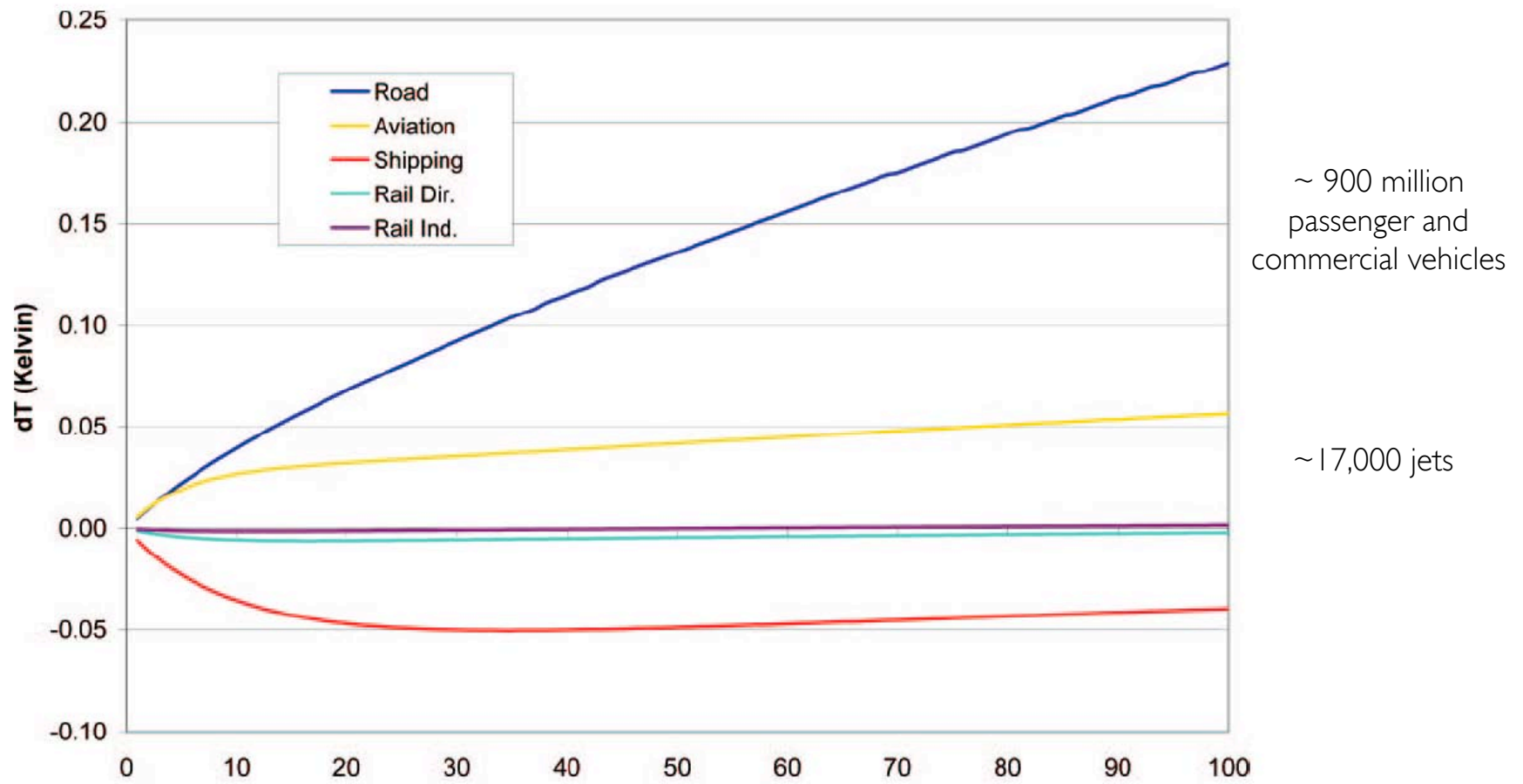
Realized Warming = 0.6 C

Ocean Storage (0.5 Wm^{-2}) = 0.5 C

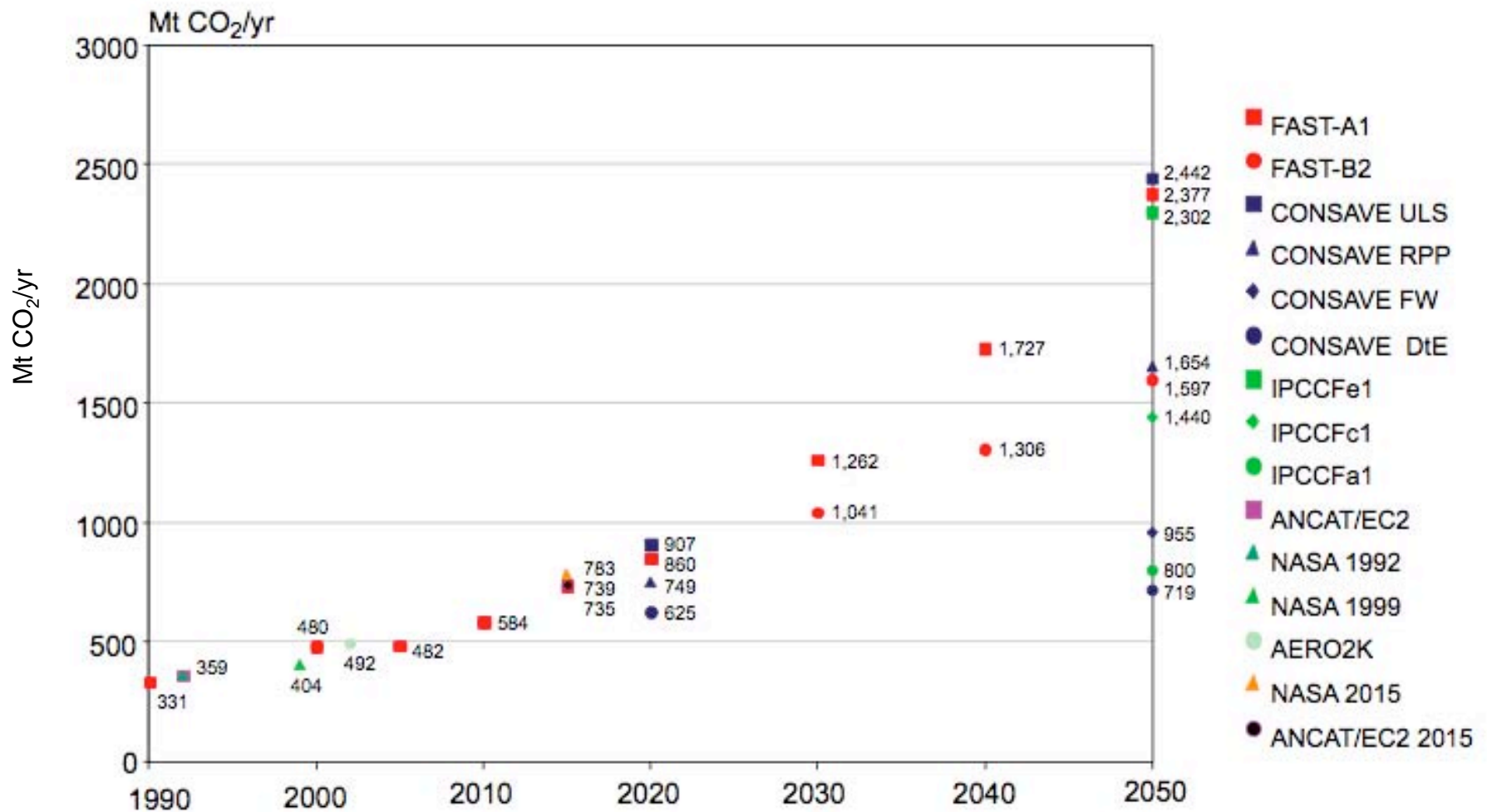
Masked (1.4 Wm^{-2}) = 1.2 C

Aviation is the second largest transport contributor to climate change

Future temperature change (K) due to transportation
with constant 2000 emissions



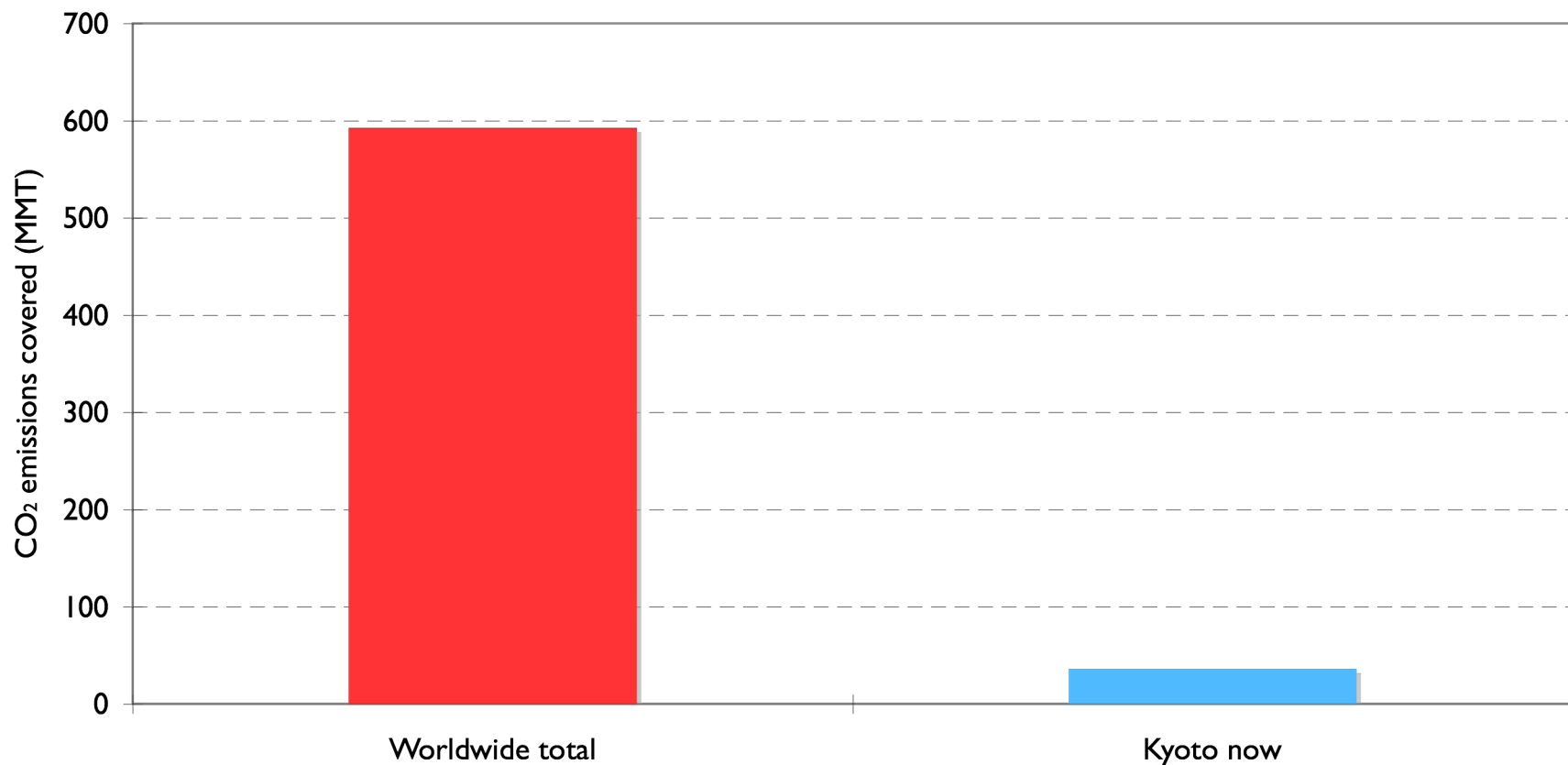
Anticipated two to fivefold increase in aviation CO₂ emissions by 2050



Source: IPCC Working Group III 4th Assessment Report, 2007.

Global aviation CO₂ essentially unregulated today

Kyoto protocol coverage of global aviation CO₂ emissions
assuming no post-2004 growth



ICAO Action to Date

Instrument	Action	Year
Fuel taxes	Reaffirms opposition	2001
GHG emission standard	Rules out	2001
Closed emissions trading	Opposes	2001
Global ETS	Dismisses in favor of existing schemes	2004
GHG emissions charges	Three year moratorium	2004
EU ETS	Attempts to block inclusion of foreign carriers	2007
Alternative fuels	TBD	2009

Three questions to address in 2009

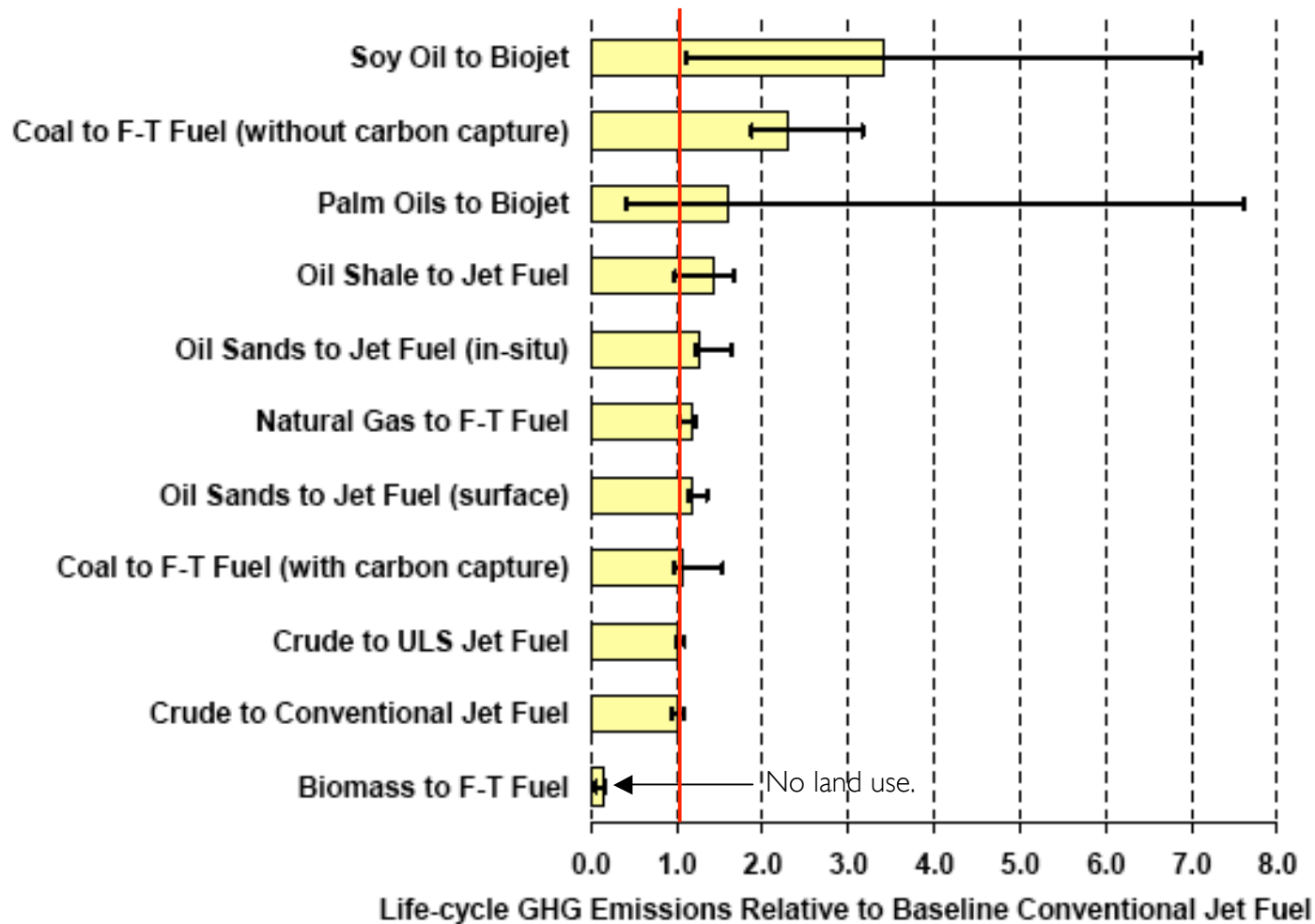
1. How can aviation's current and future climate impact be reconciled with the need for 60~80% reductions in GHG emissions from developed countries by mid-century?
2. What role can alternative fuels play in reducing emissions?
3. What other policy instruments need to be incorporated into a post-Kyoto agreement to bridge the gap?

Key hurdles to alternative fuel use

- Environmental
 - Should not compete with food production
 - Must provide significant, verifiable GHG emission reductions measured on a lifecycle basis
 - Consider opportunity costs (biomass for electricity generation)
- Economic
 - Supply (esp. competition with other transport modes)
 - Cost
- Operational
 - Energy density critical
 - Freeze point, engine restart, etc.
- Infrastructure/distribution
 - Separate infrastructure for fuel delivery?
 - International use feasible, or domestic only?

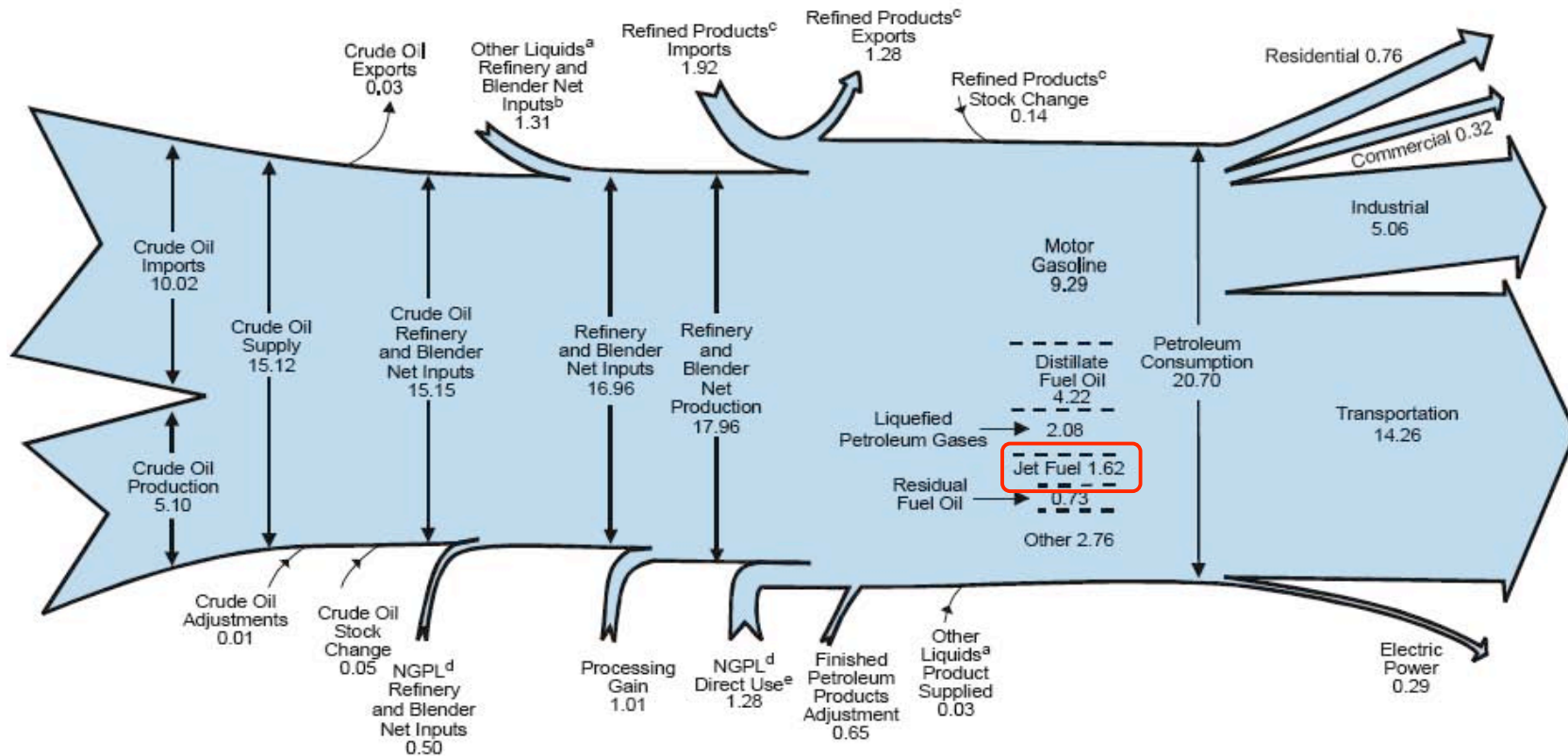
Many alternative jet fuels not likely to meet environmental criteria

Lifecycle GHG emissions relative to baseline conventional jet fuel



Aviation will compete with other modes and sectors for alternative fuels

US Petroleum Flows, 2007 (million barrels per day)



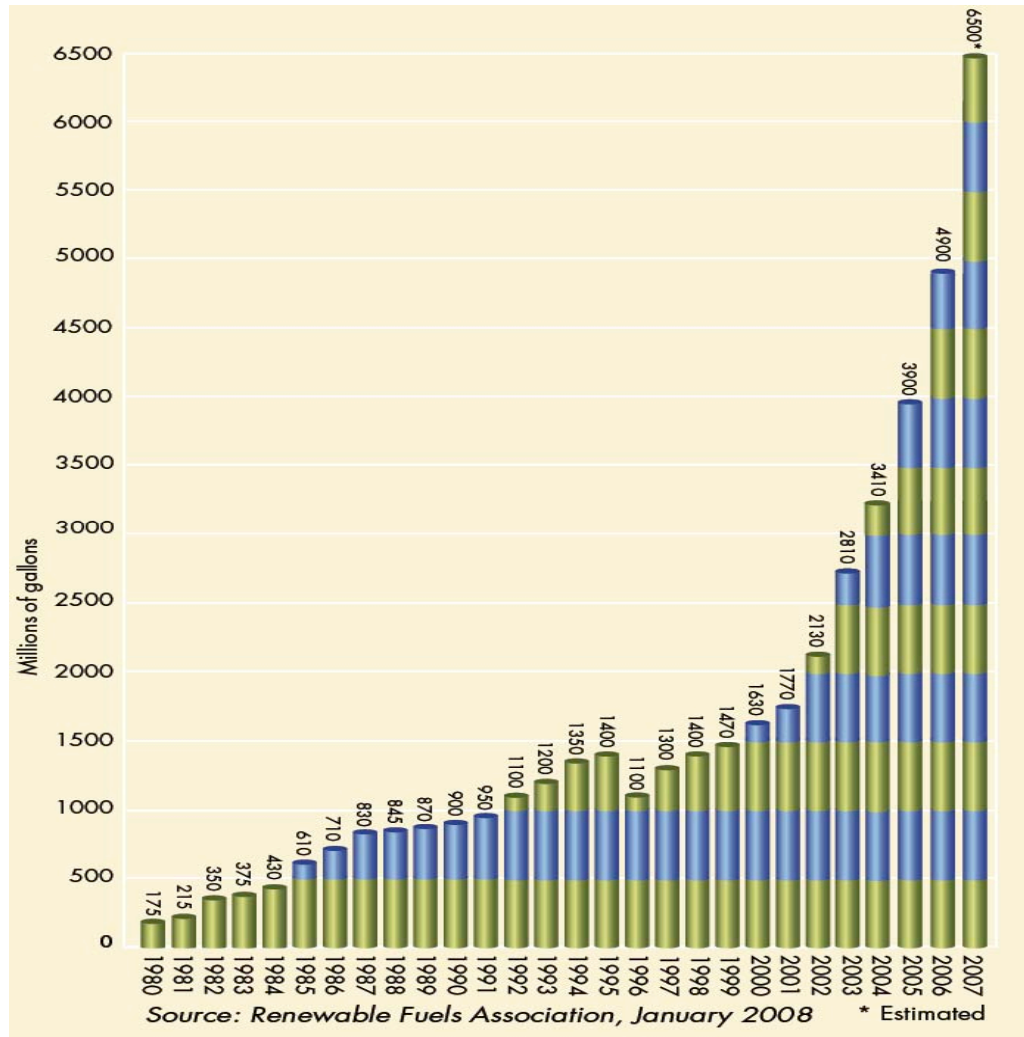
Source: EIA Annual Energy Review 2007.



Without regulatory requirements how will aviation compete for capital and low-carbon feedstocks with other transport modes and sectors?

What is a realistic outlook for the supply of renewable fuels for aviation?

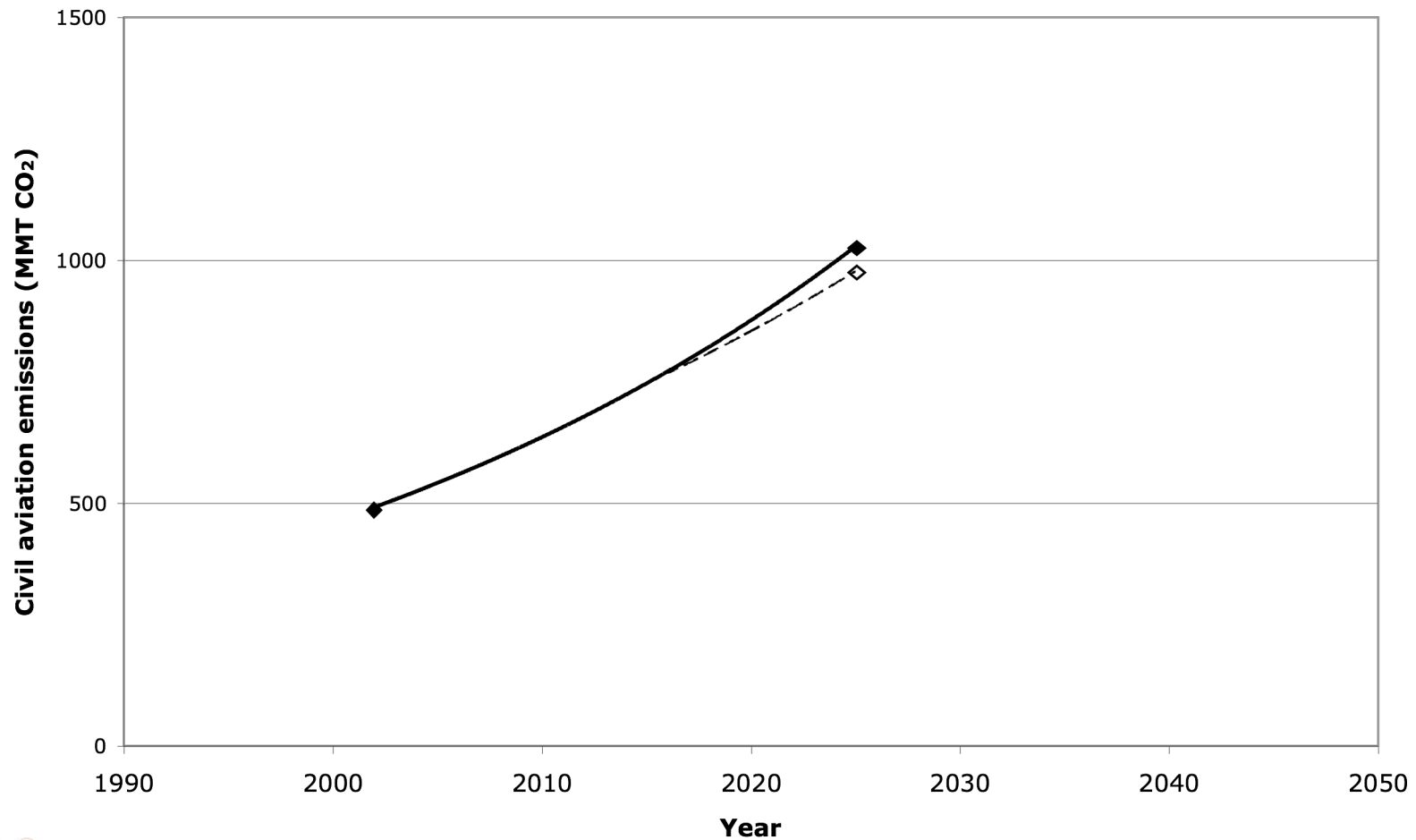
US Ethanol Production, 1980 to 2007



Annual Growth rates
1980 -- 2007: 14%
2000 -- 2007: 22%

Even optimistically, aviation unlikely to reduce emissions significantly in medium term through alternative fuels alone

Emissions reduction due to fleetwide 10% use of alternative fuels with half the lifecycle CO₂ emissions of petroleum jet fuel in 2025



ICAO needs to reconsider other policy measures

- GHG emission/efficiency standards:
 - LD vehicle efficiency widely regulated worldwide
 - HD: regulated today in Japan, action pending in US and China
 - IMO: efficiency standard under consideration in 2009
 - ICAO: ????
- Market-based measures
 - Global ETS under GIACC
 - International kerosene tax
 - En-route charges
- Flanking measures for NO_x, contrails/cirrus
 - Cruise NO_x emission standards
 - Emission-based landing/en route charges
 - Aircraft rerouting to reduce contrail formation?

Conclusions

- Caution needed, particularly for today's biofuels
- Undeniable need for GHG action from aviation this year
 - Large climate impact
 - Fast growth
 - Essentially unregulated by UNFCCC or ICAO
- Industry focus on sustainable fuels acknowledged, but substantial hurdles to overcome
- Alternative fuels alone not sufficient to contain growth in GHG emissions in the foreseeable future
- ICAO needs to reconsider other measures to meet climate protection goals