Greenhouse Gas Emissions from International Transport

A Window of Opportunity

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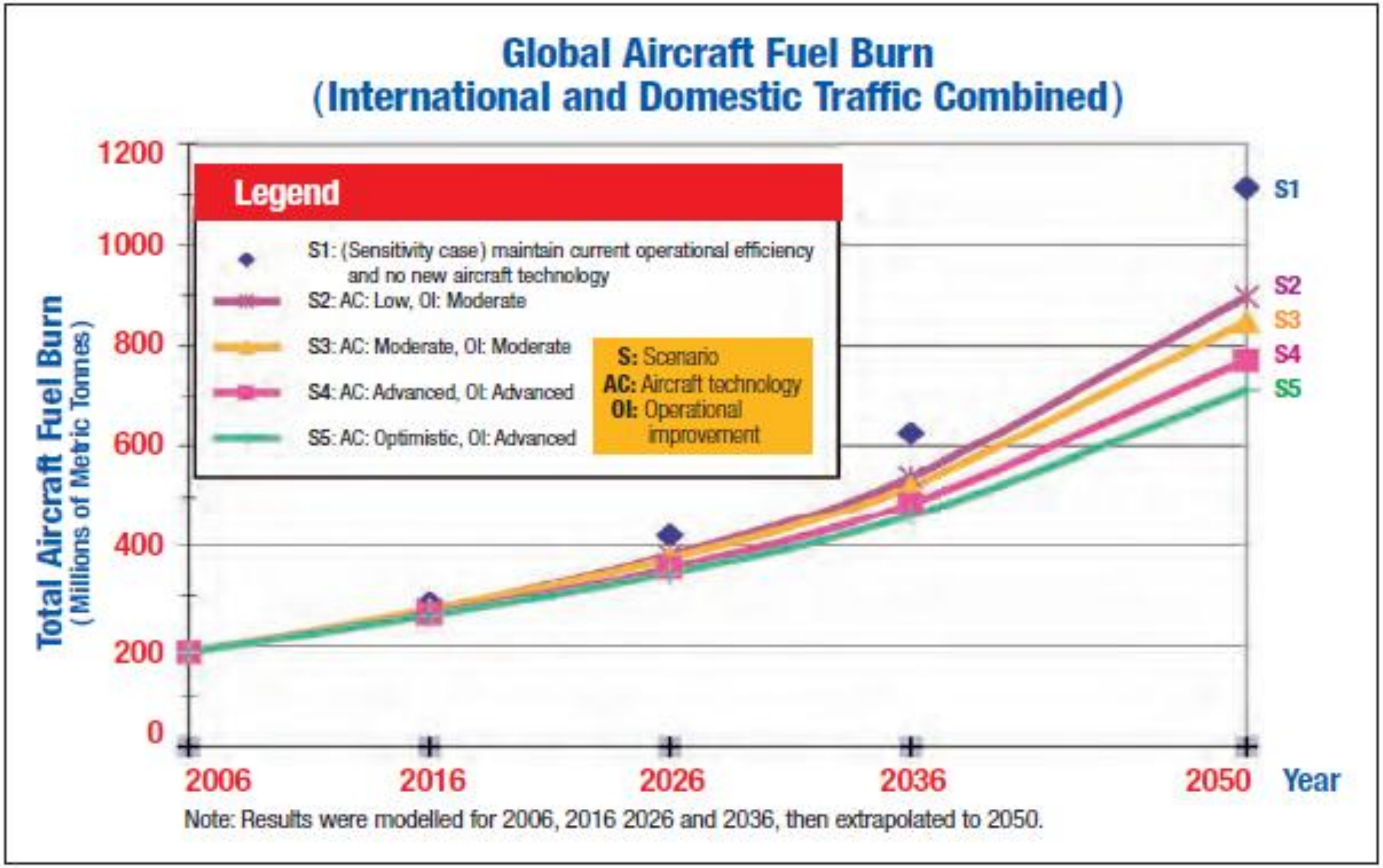
Aviation CO_2 emissions currently 2% of total…will grow rapidly



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ICAO. "Introduction: Aviation Outlook." In ICAO Environmental Report, 2010. http://www.icao.int/environmental-protection/Documents/EnvironmentReport-2010/ICAO_EnvReport10-Outlook_en.pdf.

…as will shipping emissions, which are currently 3% of total.

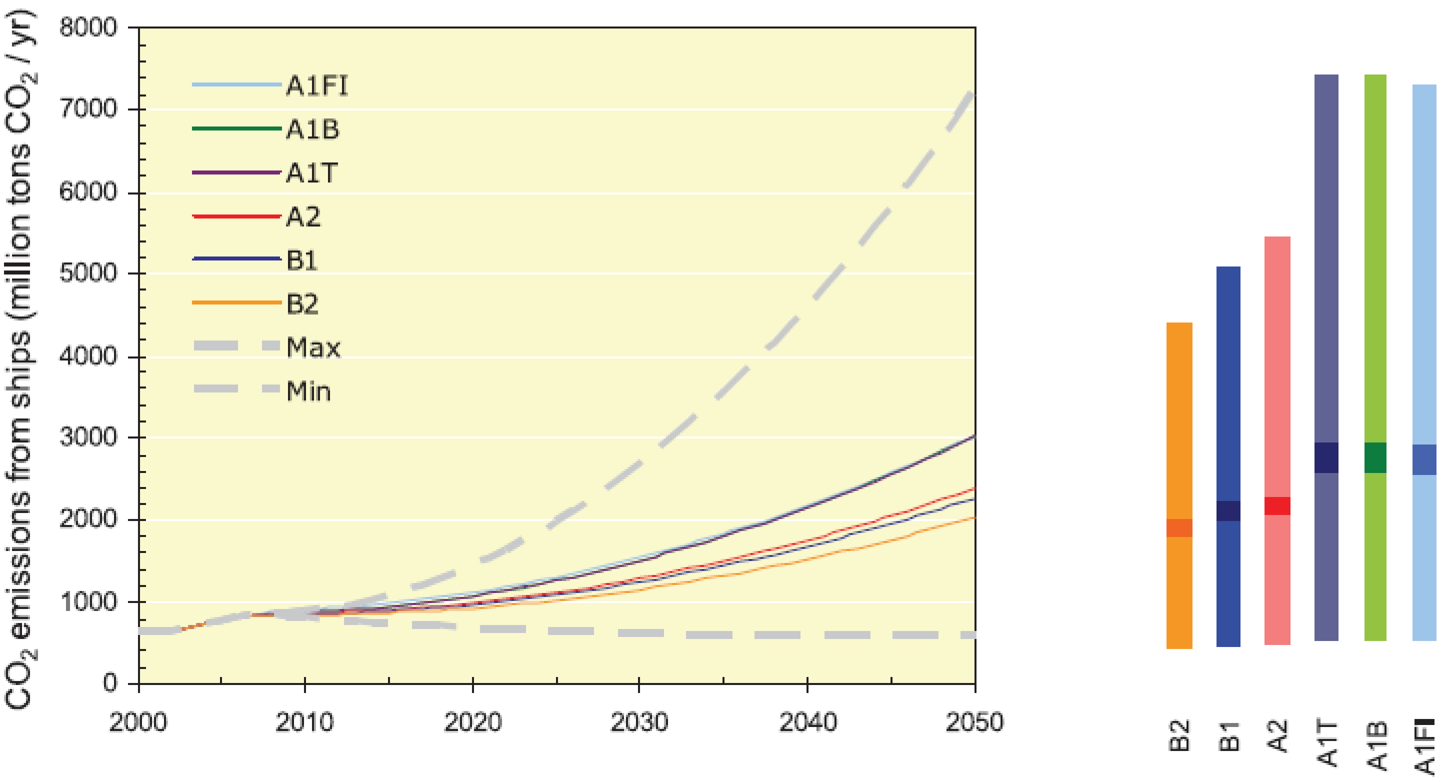

Figure 1.2 *Trajectories of the emissions from international shipping. Columns on the right-hand side indicate the range of results for the scenarios within individual families of scenario.*

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International Maritime Organization. *Second IMO GHG Study 2009*, 2009. http://www.imo.org/blast/blastDataHelper.asp?data_id=27795&filename=GHGStudyFINAL.pdf.

Progress in controlling emissions has been slow

- Under the Kyoto protocol, *international* shipping and aviation fell under the purview of the IMO and the ICAO, respectively
  - Due to the problem of allocation
- Both industries seen as small contributors
- Shipping is seen as clean
- Aviation is protected by treaties (e.g., on cross-border taxes on fuel)
- Common but differentiated vs. level playing field

IMO proposed efficiency standards in 2011

- Energy efficiency standard (in kg CO_2 per ton mile) for new ships
- Effective from 2013; tightened every 5 years; ships in 2025-30 will be 30% more efficient than reference.
- Mandated an energy management plan for existing ships. No hard targets.
- Is considering a market-based mechanism and technology standards

IMO standards *not* tech-forcing

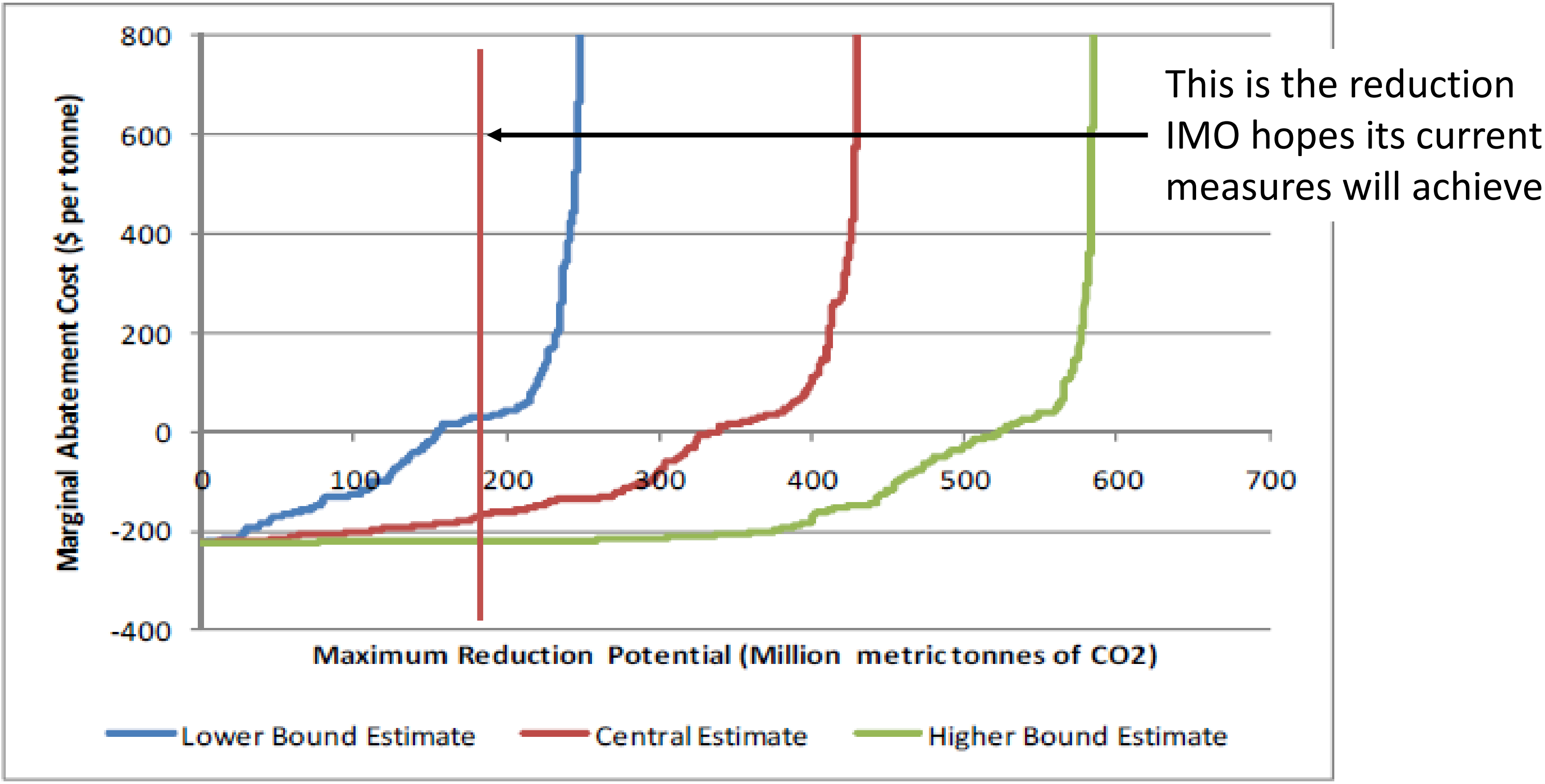

Figure 6-1: Aggregated MACC in 2020 with $700 per ton fuel price and 10% discount rate for all ship types.

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International Maritime Organization. *Second IMO GHG Study 2009*, 2009. http://www.imo.org/blast/blastDataHelper.asp?data_id=27795&filename=GHGStudyFINAL.pdf.

IMO. “Technical and Operational Measures,” 2011. http://tinyurl.com/pf4gfj4

ICAO has aspirations; no targets yet

- 2% per year improvement in efficiency until 2020, *aspirational* target for efficiency improvements of 2% per year until 2050
- defined an efficiency metric for aircraft
- said it will outline an MBM by 2016, for implementation in 2020

ICAO aspirations unrealistic

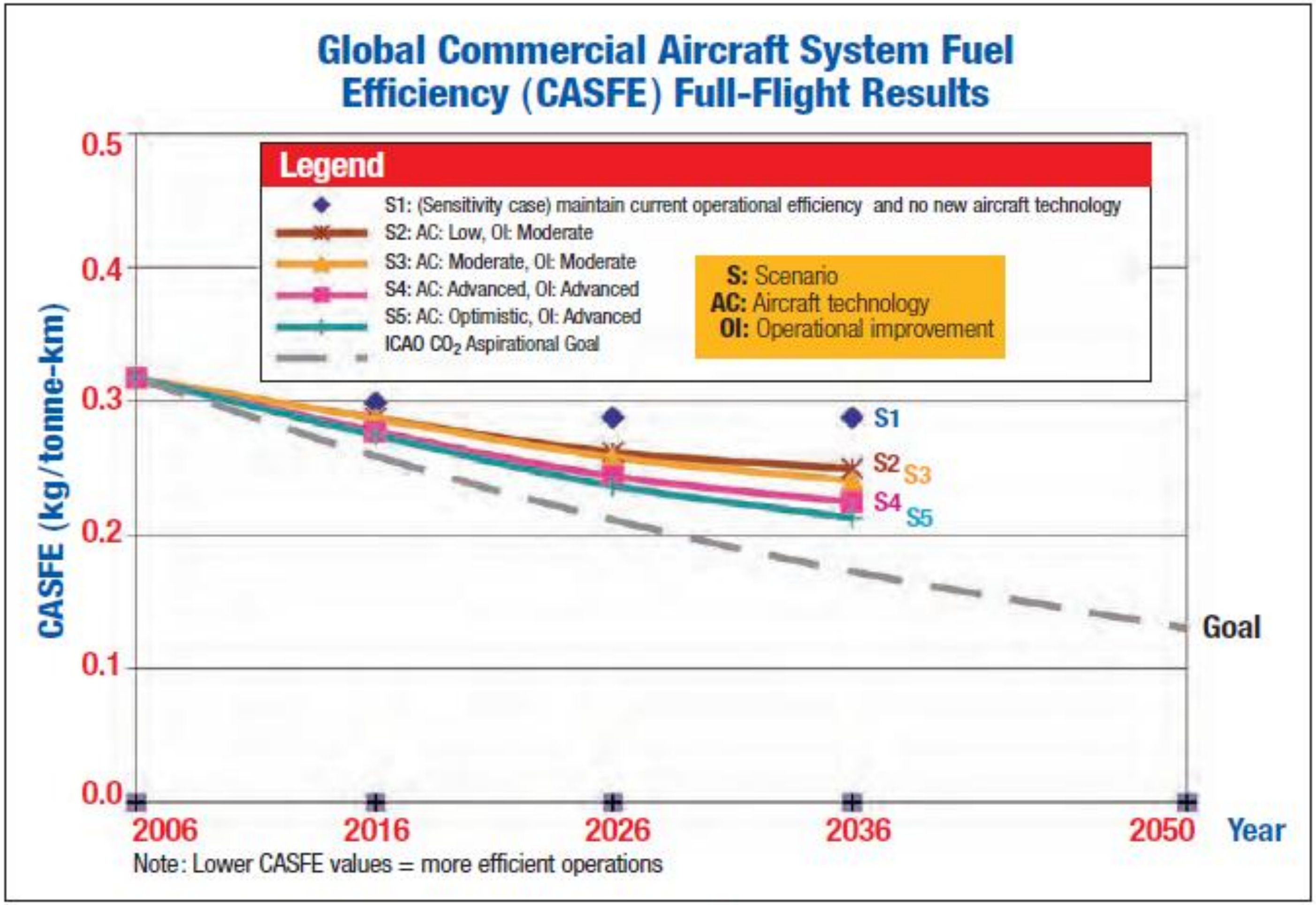
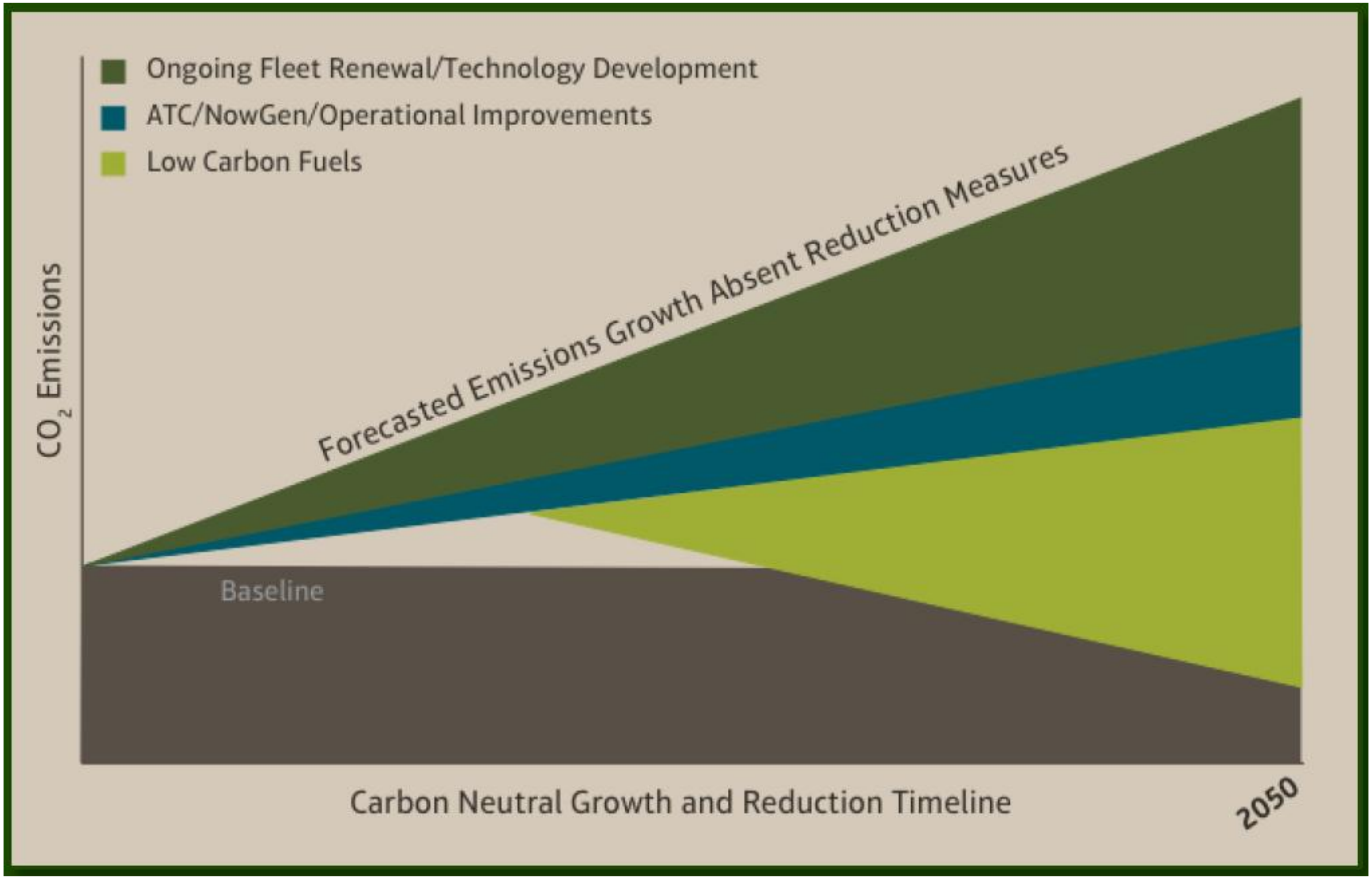


Figure 4: Commercial Aircraft System Fuel Efficiency (CASFE) Full-Flight Results.

ICAO. "Introduction: Aviation Outlook." In ICAO Environmental Report, 2010. http://www.icao.int/environmental-protection/Documents/EnvironmentReport-2010/ICAO_EnvReport10-Outlook_en.pdf.

US sees a big role for alternative fuels…



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Maurice, Lourdes, Juan Alonso, Karen Marais, and James Hileman. "Greening U.S. Aviation," December 2009. http://cop15.state.gov/documents/organization/133706.pdf.

…but not any time soon.

"Since the potential supplies of all of the alternative fuels…will be limited in the next decade, if not longer, forcing certain feedstocks and fuels into one or another application (e.g., aviation versus automotive) may result in diseconomies and reduce progress toward reducing overall GHG emissions and increasing energy security."

"Our findings on alternative fuels in the near term show that the opportunities that are available to reduce the life-cycle well-to-wake (WTW) GHG emissions from aviation operations are costly and could potentially be counterproductive…Rather than legislating or regulating the sector to which these feedstocks should be directed, we suggest broader-based mechanisms that place a price on GHG emissions and allow economically efficient choices to be made across multiple sectors."

Hileman, James I., David S. Oritz, James T. Bartis, Hsin Min Wong, Pearl E. Donohoo, Malcolm A. Weiss, and Ian A. Waitz. *Near-Term Feasibility of Alternative Jet Fuels*, 2009. http://web.mit.edu/aeroastro/partner/reports/proj17/altfuelfeasrpt.pdf.

There are several ideas for "broader-based mechanisms"

- Inclusion of aviation in the EU-ETS
  - Would have raised NYC-LON round-trip airfares by about $2 per ticket in 2012*
- The ICAO's ideas**: could require airlines to
  - purchase credits to offset emissions, or
  - purchase credits AND pay a tax on fuel, or
  - have a cap and trade system within aviation
- These ideas could also be applied to shipping

* Leggett, Jane A. *Update on Controlling Greenhouse Gases from International Aviation*. Congressional Research Service, November 19, 2012. http://www.fas.org/sgp/crs/misc/R42828.pdf.

** ICAO. Market-Based Measures. Council of ICAO, April 13, 2009. http://www.icao.int/Meetings/a38/Documents/WP/wp029_en.pdf.

A tax would not dramatically increase prices

- Cheapest way to achieve net reductions would be an open system
  - If a $30/tonne CO_2 tax were applied, within-sector emissions cuts in aviation would be about 2% *
- $45/tonne in shipping would have a small impact on commodity prices**
  - Price of jute shipped from Bangladesh to Europe would rise by 2%
  - Coffee prices would rise by 0.2%
  - Could raise $15-30 billion per year

* Anger, Annela, Jasper Faber, Marnix Koopman, Andre van Velzen, Katy Long, Hector Pollitt, Claudia Comberti, Terry Barker, Dora Fazekas, and Andrzej Błachowicz. "Research to Assess Impacts on Developing Countries of Measures to Address Emissions in the International Aviation and Shipping Sectors," February 6, 2013. http://www.climatestrategies.org/research/our-reports/category/69/376.html.

** AGF. *Paper on Potential Revenues from International Maritime and Aviation Sector Policy Measures*. Secretary-General's High-Level Group on Climate Change Financing, 2010. http://www.un.org/wcm/webdav/site/climatechange/shared/Documents/AGF_reports/Work_Stream_2_International_Transport.pdf.

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International transport as a test-bed for a broader mechanism

- ICAO and IMO could co-operate
  - e.g., as they do in search and rescue
- One of few activities that are naturally global
  - pooling of sovereignty essential for basic functioning
- Aviation / marine MBM would have to contain many of the “moving parts” of a wider mechanism
  - Monitor and verify emissions
  - Ensure near-universal participation
  - Compensating those hardest-hit
  - Deploying revenues

Focus of internship is supporting analysis for aviation MBM

In the context of a market-based mechanism for international aviation

- Is there a credits gap?
  - How could it be filled?
- What is the impact of *de minimis* exemptions?
- What is the legal basis for implementing such a scheme in developing countries?
  - The example of India
- What if people were opted into voluntary offsets?
  - The case of IndiGo

Thank you

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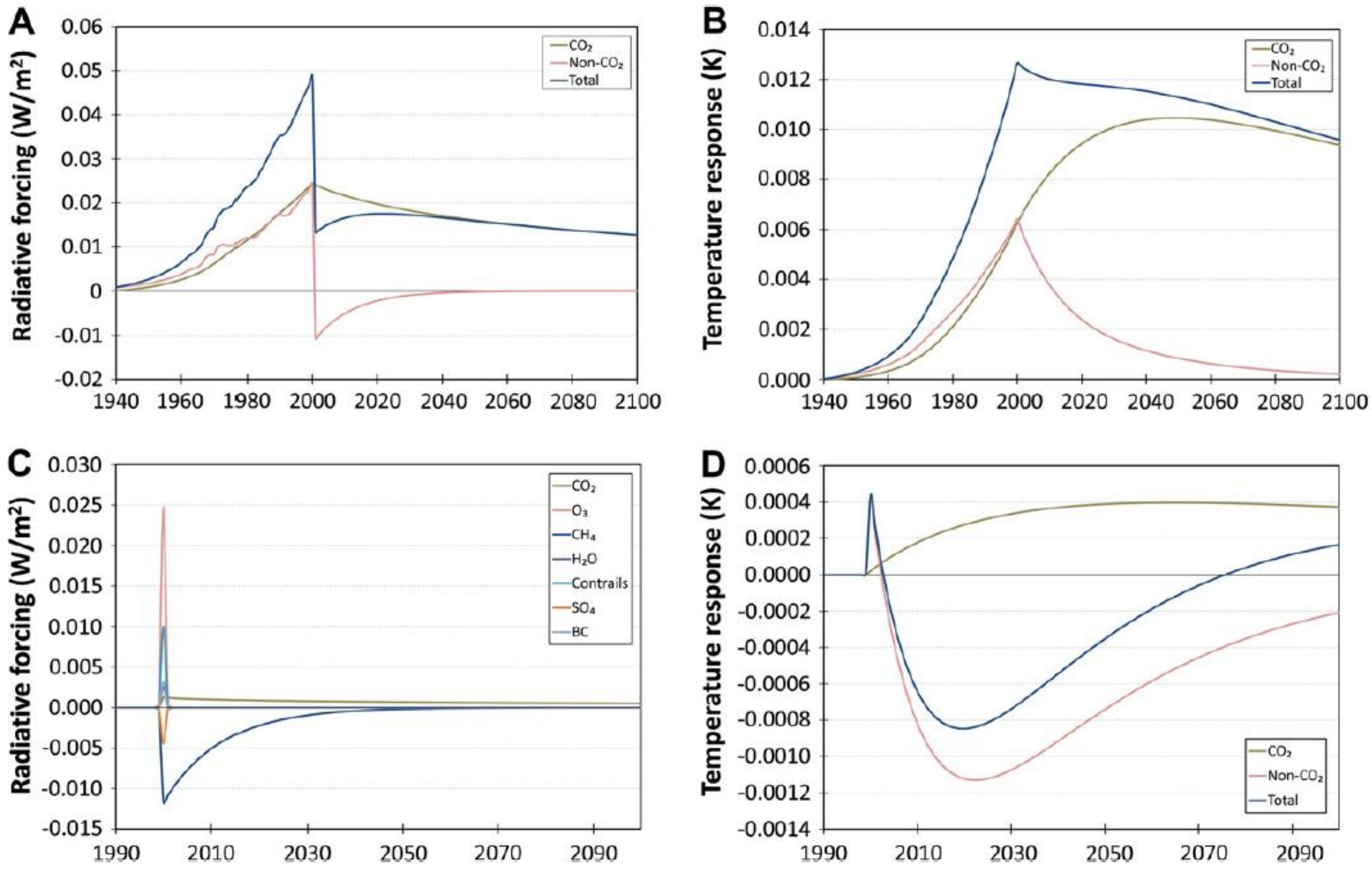

Fig. 27. Response of RF (W m^{-2}) and T (°K) to aviation emissions. (A &B) decay timescales of RF and T from different components following cessation of emissions in 2000. (C) An aviation fleet 'pulse' response of T assuming instantaneous fuel burn of 100 Tg C yr^{-1} and EINO$_x$ of 12 (from model of Lim et al. (2007), tuned to Stevenson et al. (2004)).

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Lee, D. S., G. Pitari, V. Grewe, K. Gierens, J. E. Penner, A. Petzold, M. J. Prather, et al. "Transport Impacts on Atmosphere and Climate: Aviation." *Atmospheric Environment*, Transport Impacts on Atmosphere and Climate: The ATTICA Assessment Report, 44, no. 37 (December 2010): 4678–4734. doi:10.1016/j.atmosenv.2009.06.005.

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Table 8
Emission metrics (GWP_{100}, GTP_{20}, GTP_{50}, GTP_{100}) and corresponding CO_2 equivalent emissions (in Tg (CO_2)/year for all metrics) for the various components of ship emissions. The range in the brackets represent the range caused by uncertainties in emissions and metric values. The metric values for SO_2 is given on SO_2 basis, while for NO_x it is given on N-basis (cf. Fuglestvedt et al., in this issue). Ranges for CO_2 emissions are taken from Table 7.

	GWP_{100}	GTP_{20}	GTP_{50}	GTP_{100}	CO_2-eq emissions (GWP_{100}-based)	CO_2-eq emissions (GTP_{20}-based)	CO_2-eq emissions (GTP_{50}-based)	CO_2-eq emissions (GTP_{100}-based)
CO_2	1	1	1	1	[501, 812]	[501, 812]	[501, 812]	[501, 812]
SO_2 (direct)	[−43, −11]	[−44, −11]	[−7.3, −1.8]	[−6.1, −1.5]	[−520, −75]	[−530, −75]	[−88, −12]	[−73, −10]
SO_2 (total)	[−480, −230]	[−380, −180]	[−63, −30]	[−53, −25]	[−5800, −1600]	[−4600, −1200]	[−760, −200]	[−640, −170]
NO_x	[−36, −25]	[−190, −130]	[−35, −30]	[−6.1, −4.2]	[−230, −73]	[−1240, −380]	[−230, −87]	[−40, −12]

Eyring, Veronika, Ivar S. A. Isaksen, Terje Berntsen, William J. Collins, James J. Corbett, Oyvind Endresen, Roy G. Grainger, Jana Moldanova, Hans Schlager, and David S. Stevenson. “Transport Impacts on Atmosphere and Climate: Shipping.” *Atmospheric Environment*, Transport Impacts on Atmosphere and Climate: The ATTICA Assessment Report, 44, no. 37 (December 2010): 4735–71. doi:10.1016/j.atmosenv.2009.04.059.

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