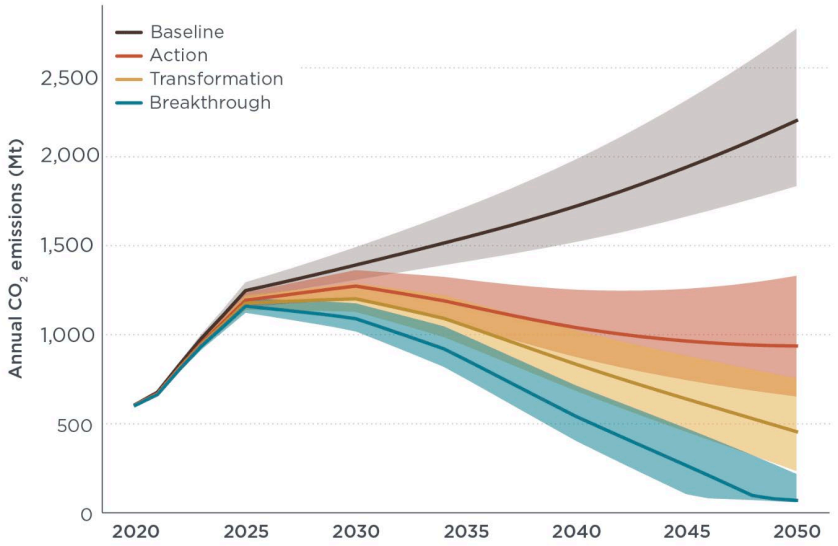
ICCT Vision 2050 Update: The Potential for Climate Neutral Growth

Supraja Kumar
International Council on Clean Transportation (ICCT)
9/16/26

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

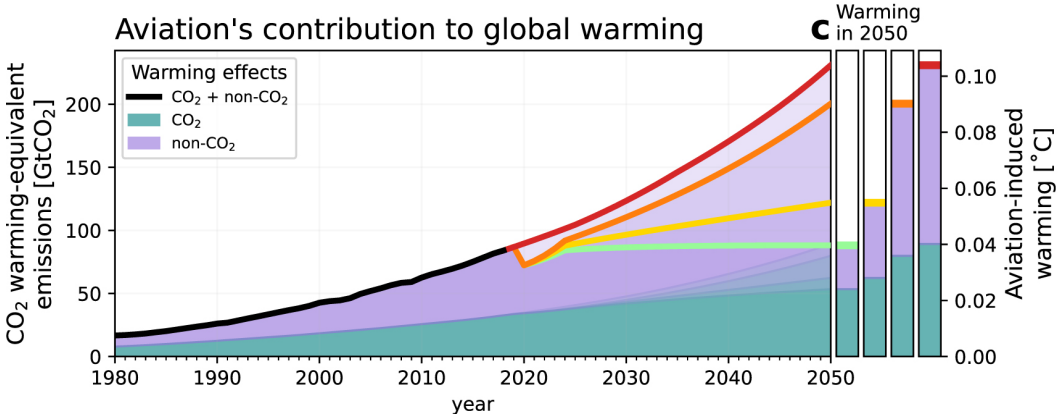
Net-zero CO_2 goal: how it started and how it is going

- Agreed by industry and codified by ICAO in 2022
- Consensus on the critical role of SAF, expected to be responsible for about half (24% to 70%) of CO_2 reductions
- Fuel efficiency (airframe + load factor + traffic) ~30% of the CO_2 reductions
- However, progress towards the net-zero goal has been slow
- Rate of SAF adoption, as well as other mitigation levers, is closer to ICCT's 2022 Action Scenario, with minimal emissions reduction compared to 2019 baseline



The growing importance of non-CO_2

- Greenhouse gases (GHGs)
  - Lifetimes of tens to thousands of years
  - CO_2, CH_4, N_2O
  - Impact is driven by ***accumulation*** in the atmosphere
- Short-lived climate pollutants (SLCPs)
  - Lifetimes of hours to days
  - Contrails, NOx, PM, water vapor, and sulfate aerosols
  - Impact is driven by ***continuing pulses*** of emissions



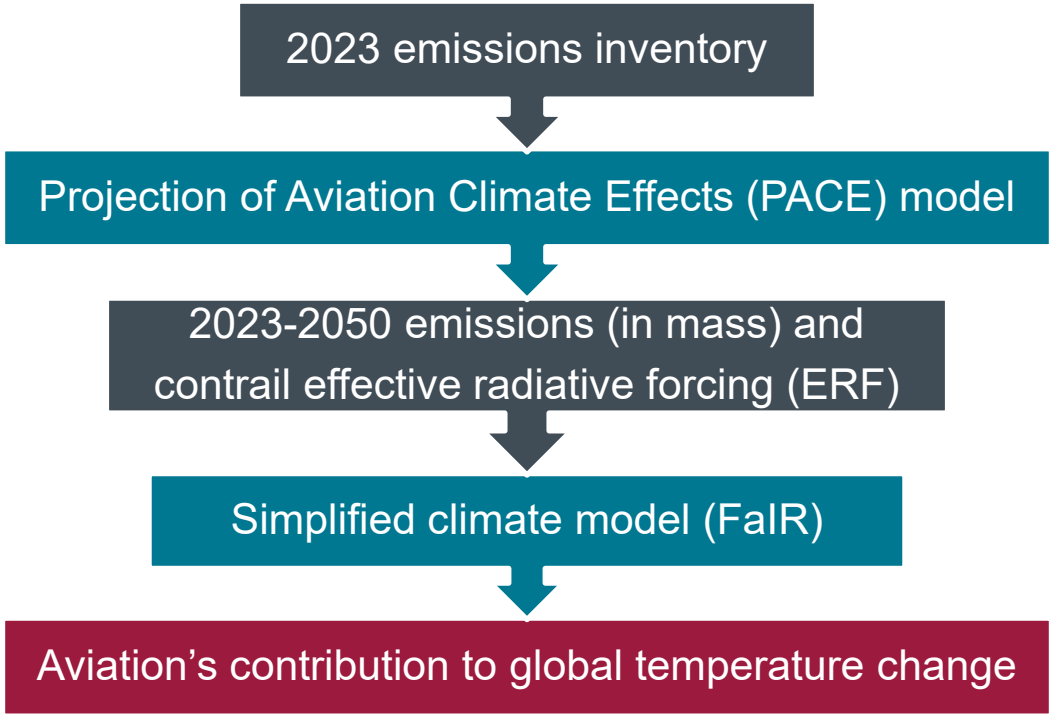
M Klöwer *et al* 2021 *Environ. Res. Lett.* **16** 104027

New research question

How can cuts to short-lived climate pollutants from global commercial aviation contribute to the Paris Agreement?

Methods

High-level Design



JETSTREAM: A trajectory-based emissions inventory



Weather data (ERA-5)

Trajectory data (ADS-B)

Aircraft performance model (BADA 3)

Payload data

Fuel flow

IBA Fleet data

ICAO Engine emissions database

Output: Emissions of CO2, nvPM, NOx, SOx, OC, water vapor

Mitigation Scenarios

Scenario Name	Definition	Role
Historical Trends	Counterfactual	Baseline aviation warming with no dedicated action
Current Commitments	Announced policies and industry goals	Indicate progress to date
GHG Forward	Maximum GHG reduction only	Investigate temperature reductions from dedicated GHG mitigation
SLCP Forward	Maximum mitigation of NOx, nvPM, and contrails	Investigate temperature reductions from dedicated SLCP cuts
Full Breakthrough	Maximum mitigation of both short and long-lived climate pollutants	Investigate maximum temperature reductions possible Determine relative importance of GHG vs. SLCP control

Key mitigation levers

GHG

- Aircraft fuel efficiency
- Payload and traffic efficiency
- Sustainable aviation fuels (SAFs)
- Zero emission planes (ZEPs)

SLCP

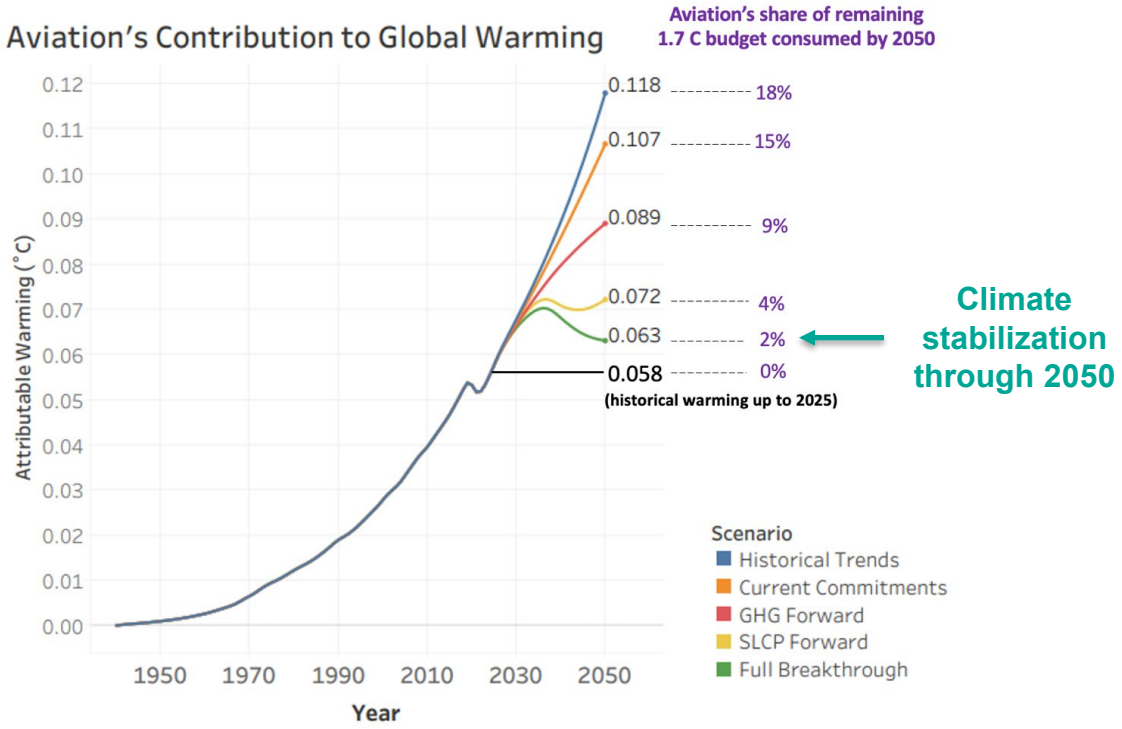
- Low-NOx/nvPM engines
- Contrail avoidance
- Hydrotreating fossil Jet A
- Sustainable aviation fuels (SAFs)

Cross-cutting

- Demand response to carbon pricing

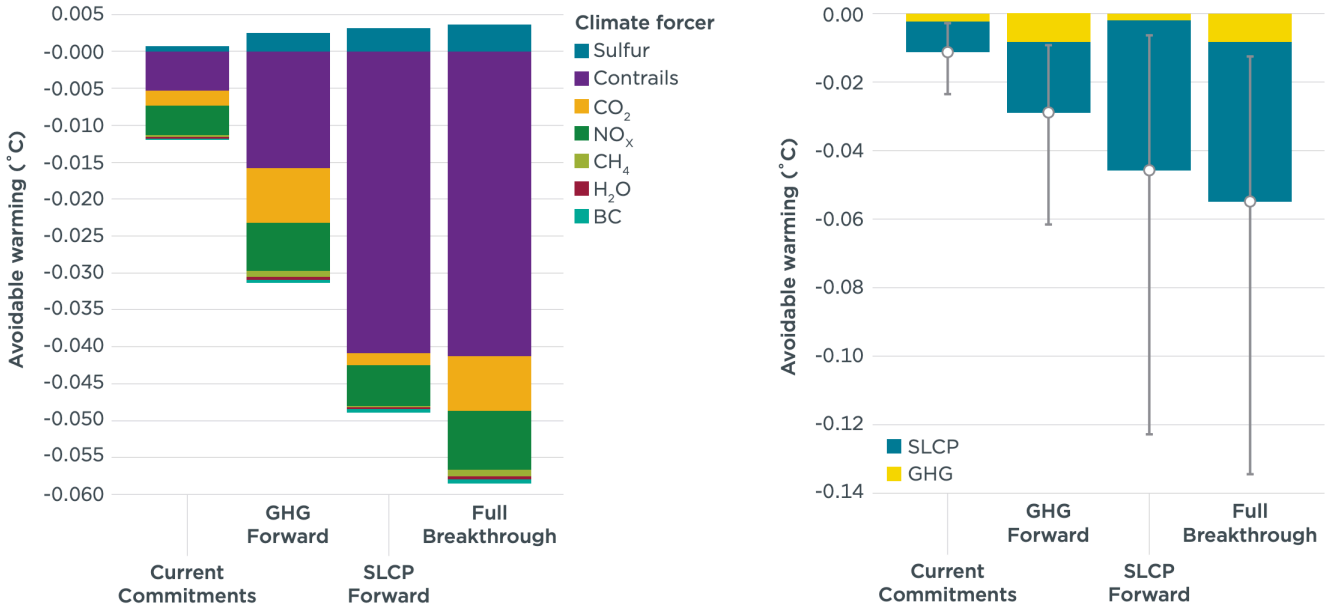
Results

Temperature response by scenario



Avoidable warming by pollutant species

Avoidable 2050 global warming by pollutant and scenario and aggregated by GHGs versus SLCPs groups



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Conclusions

- Concerted action on GHGs and SLCPs can cut additional warming from aviation by more than **90%** and put aviation on a path to “climate neutrality” after **2035**.
- While maximum level of GHG mitigation would cut additional aviation warming, it would not stabilize aviation’s contribution to global warming by 2050.
- Four mitigation levers—contrail avoidance, SAFs, hydrotreating, and operational efficiency—account for nearly **90%** of avoidable warming in 2050.
- To achieve mid-term climate stabilization, policymakers should adopt SLCP controls while continuing to develop long-term GHG-reduction technologies.

Questions?
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