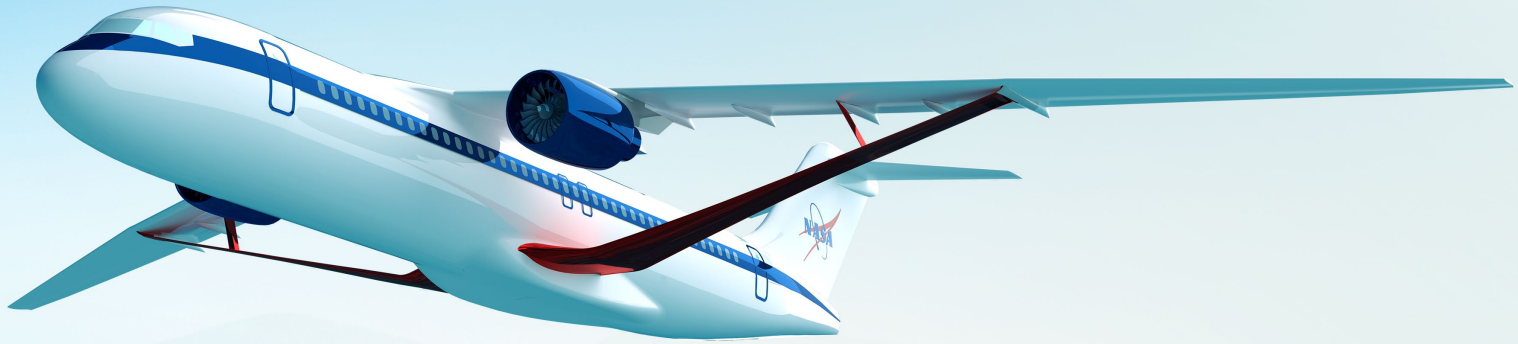
National Aeronautics and Space Administration



Panel on Sustainable Aviation including Fuels & Alternate Sources

Dr. Richard A. Wahls (Rich)
Sustainable Flight National Partnership Mission Integration Manager, Aeronautics Research Mission Directorate

Aeronautics and Space Engineering Board | The National Academies of Science, Engineering, and Medicine
Washington, DC

June 12, 2024

Vision for Sustainable Aviation

- Aviation system growth meets demand and improves quality of life for more people worldwide
- Aviation is broadly recognized for its value to society and as environmentally friendly
- Subsonic commercial airliners remain the 24/7 global backbone of domestic and international long-haul air transportation
- Small aircraft provide growing value relative to other modes of transportation at local and domestic regional range while incubating technology for airliners
- Aviation is safe, clean, quiet, efficient, economical, operable, marketable

Sustainable Flight National Partnership

Accelerating Toward Net-Zero Greenhouse Gas Emissions and Reduced Non-CO_2 Climate Impact in the 2030s

Advance engine efficiency and emission reduction

Enable integrated trajectory optimization

Advance airframe efficiency and manufacturing rate

Enable use of 100% sustainable aviation fuels

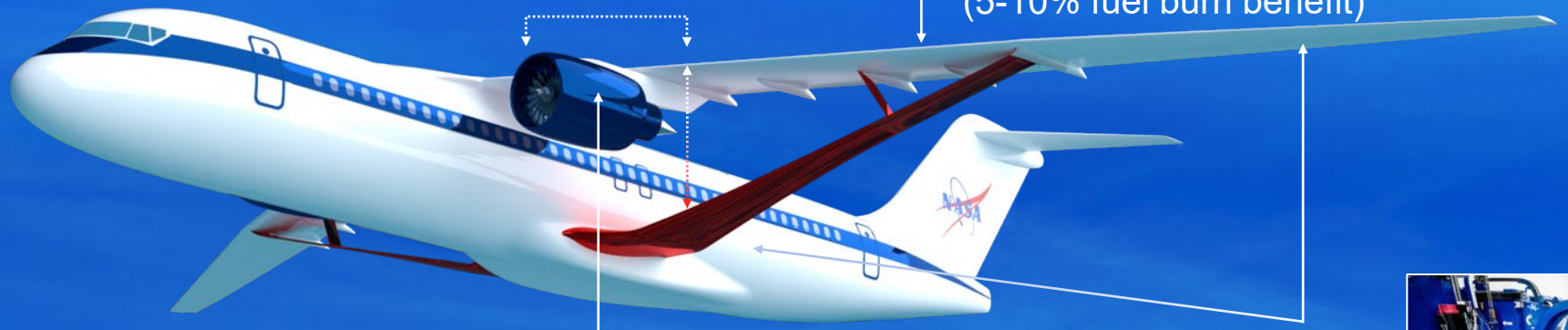
Next-generation transports using up to 30% less fuel, current & future fleet flying optimal trajectories, and engines burning SAF with greater than 50% reduction in lifecycle GHG emissions

Ultra-Efficient Airliner Technologies

Ensure U.S. industry is the first to establish the new “S Curve” for the next 50 years of airliners

Integrated Aircraft System Efficiency
Propulsion Airframe Integration Opportunity

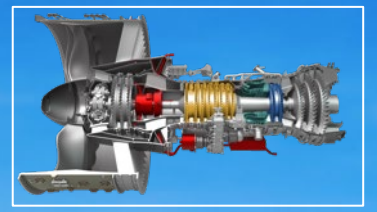
Aerodynamic Efficiency
Transonic Truss-Braced Wing
(5-10% fuel burn benefit)



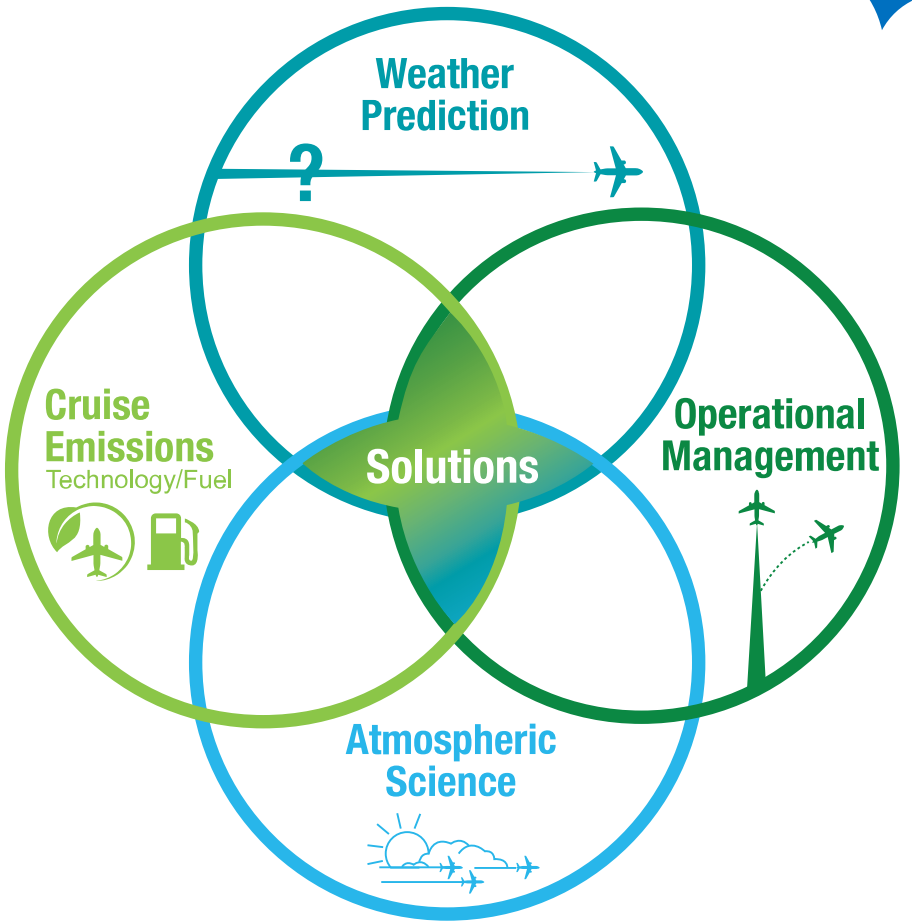
Lightweight Composites
4-6x manufacturing rate
(5-8% fuel burn benefit)

Electrified Aircraft Propulsion
~5% fuel burn and maintenance benefit

Engine Efficiency
Small Core Gas Turbine
(5-10% fuel burn benefit)



National Academies Study - Contrails



- 2024 Jan 23 – Task Order Awarded
  "*Research Agenda for Reducing the Climate Impact of Aviation-Induced Cloudiness and Persistent Contrails from Commercial Aviation*"
- 18 months
- Jointly funded by NASA ARMD and SMD

Link to the NASEM Study Site
https://www.nationalacademies.org/our-work/research-agenda-for-reducing-the-climate-impact-of-aviation-induced-cloudiness-and-persistent-contrails-from-commercial-aviation

Implications for Sustainable Aviation

Time is of the essence

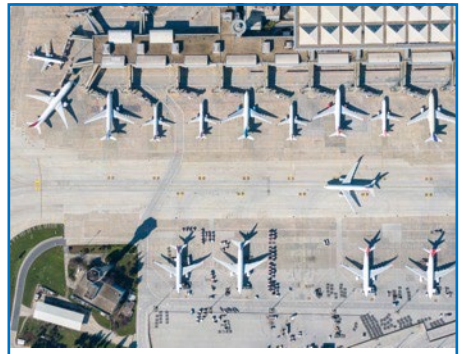
- 2050 is only 26 years away and the climate is not waiting
- Airplane development cycles are long
- Airplane, airport and broader energy sector must be compatible

Energy-sector transformation is critical

- Need clean electric grid across all sectors
- Need clean hydrogen – not inconsistent with a SAF future
- Need a lot of SAF
- Other energy alternatives for aviation?

Energy Efficiency is necessary but not sufficient

- Cannot “energy efficiency” our way to net-zero
- But less energy required reduces demand & cost



Fleet / Infrastructure Inertia is massive

- Large and growing fleet
- Need ”drop-in” energy for decades
- How could transformation to zero carbon energy occur? Is there a tipping point?

Business Physics of Todays Network is slow to change

- If lifecycle zero carbon small to regional aircraft become practical reality, can they substantially change todays aviation network?
- Can larger aircraft with substantially reduced range but cleaner tank to wake emissions substantially change todays aviation network?

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