Assistance for Action

Aviation and Climate Change Seminar

23 - 24 October 2012

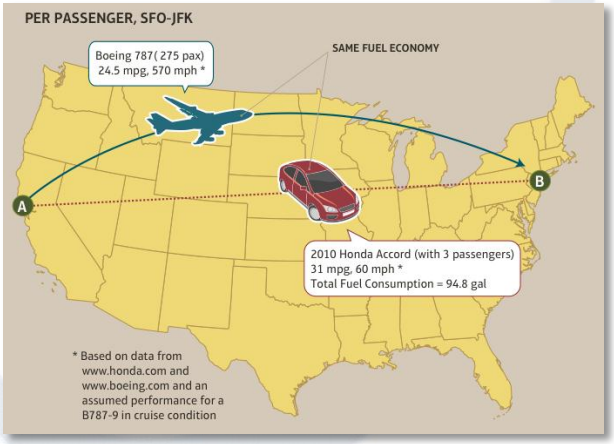
ICAO Headquarters, Montréal, Canada

The Role of New Technologies

Dr. Lourdes Q. Maurice
Executive Director, Environment and Energy, Federal Aviation Administration
And U.S. Member to ICAO/CAEP

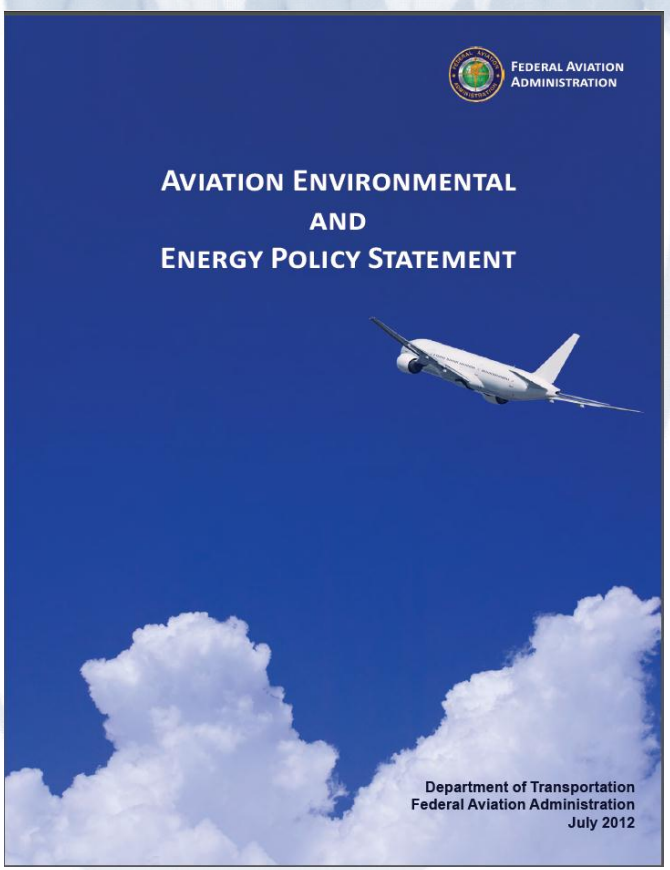
Record of Technology Achievement

- Over the past 30+ years, fuel burn improvements of approx. 70% achieved through aircraft technologies
- Key advances from aerodynamic, propulsion, and structural improvements
- Significant environmental gains: continuous reductions in absolute number of people exposed to objectionable noise, significant reductions in NO_x, other harmful emissions
- Significant reductions in fuel burn and CO_2 emissions
- Fully loaded B787 SFO-JFK yields similar fuel efficiency of a 2010 Honda Accord (with three passengers) at almost 10 x the speed



U.S. Aviation Environmental & Energy Policy

Policy statement affirms environmental and energy policy for U.S. civil aviation. The overarching environmental performance goal is environmental protection that allows sustained aviation growth.



Key Aspects of Policy Statement:

E&E Policy Framework and Principles

1. Limit and reduce future aviation environmental impacts to levels that protect public health and welfare.
2. Ensure energy availability and sustainability.

Aviation E&E Goals: Noise, Air Quality, Energy, Climate and Water Quality

Aviation E&E Strategies: Five Pillar Approach

5-Pillar Environmental Approach

To increase mobility with reduced environmental impacts and enhanced energy efficiency and security

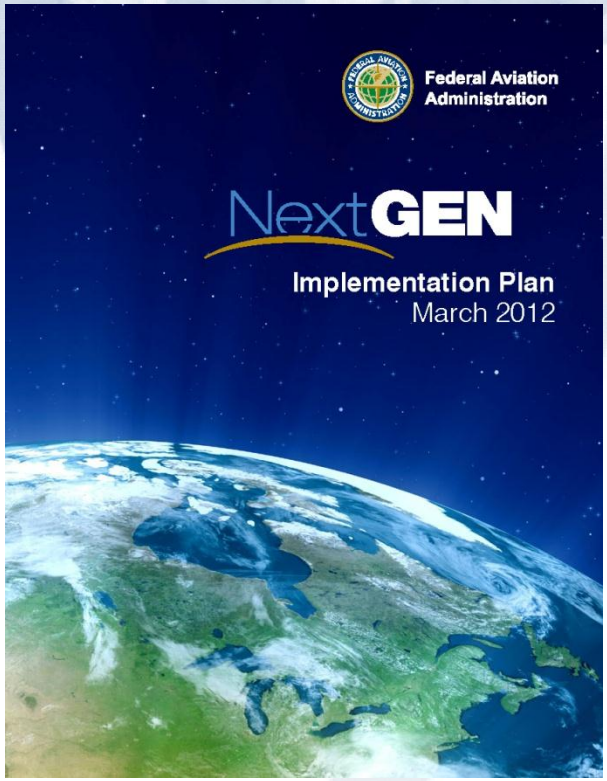
P1: Better Scientific Understanding and Improved Tools for Integrated Environmental Analysis

P2: Mature New Aircraft Technologies

P3: Develop Aviation Alternative Fuels

P4: Develop and Implement Clean, Quiet and Energy Efficient Operational Procedures

P5: Policies, Environmental Standards, Market Based Measures and Environmental Management System



Reducing Aviation's Environmental Footprint

To increase mobility with reduced environmental impacts and enhanced energy efficiency and security, we need to:

	Aircraft & Engine Design	Fuel Composition	Fuel Production	Operations
NOISE: Reduce noise impacts of flights	X			X
AIR QUALITY: Reduce NOx, SOx, and soot emissions	X	X		X
CLIMATE: Reduce GHG emissions and their impacts	X	X	X	X
SUSTAINABILITY: Develop sustainable alternative fuels			X	

P2: Mature New Aircraft Technologies

U.S. Aircraft Technology Goals

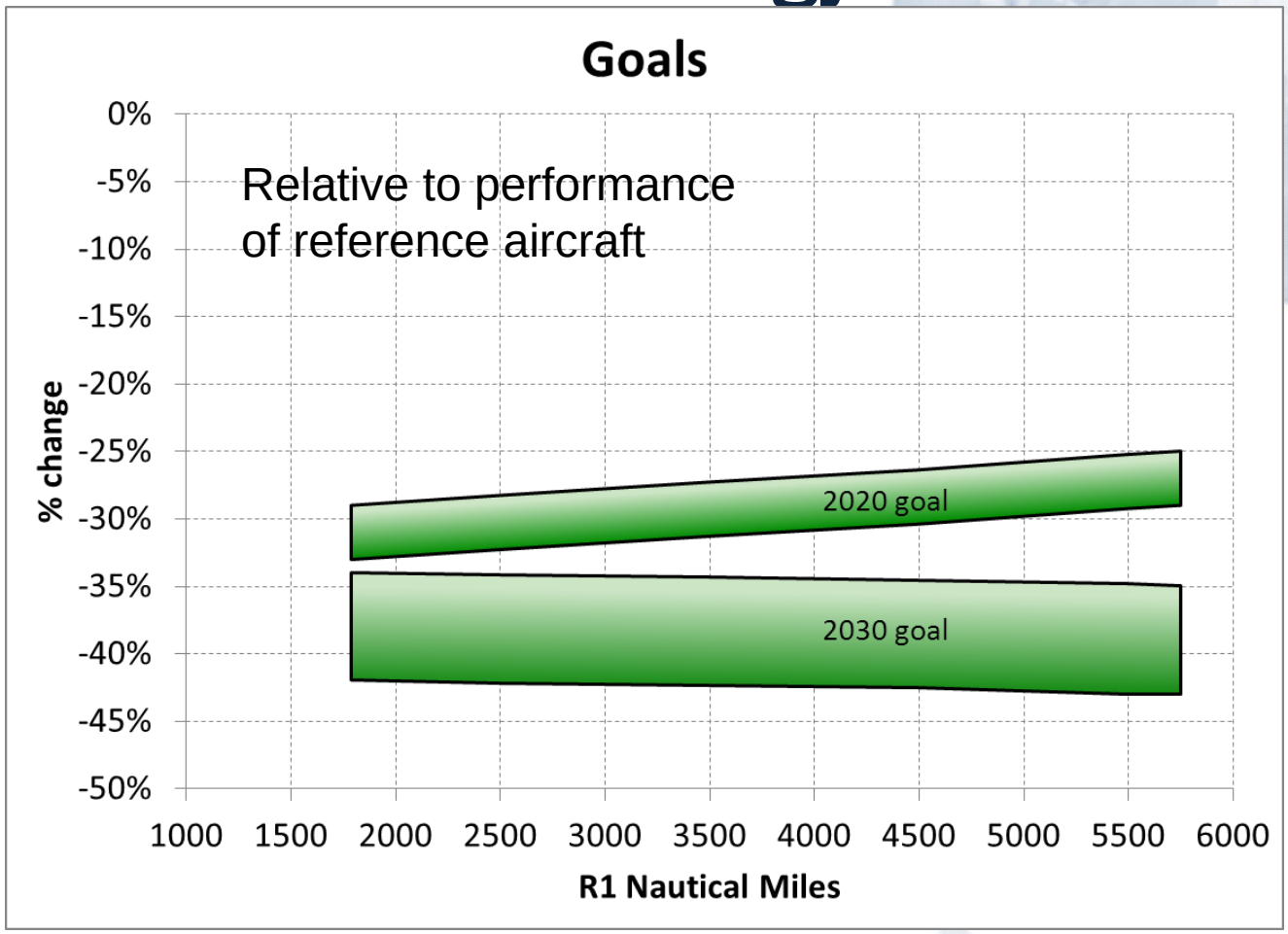
Environmental and energy drivers are shaping future aircraft and propulsion system design

U.S. National Plan for Aeronautics R&D laying foundation for next three generations of aircraft: N+1 (2017), N+2 (2025), N+3 (2030-35)

	N+1 (2015) CONVENTIONAL CONFIGURATION RELATIVE TO 1998	N+2 (2020-25) UNCONVENTIONAL CONFIGURATION RELATIVE TO 1998	N+3 (2030-35) ADVANCED CONCEPTS RELATIVE TO 2005
NOISE	-32 dB cum below Stage 4	-42 dB cum below Stage 4	-71 dB cum below Stage 4
LTO NOX EMISSIONS (BELOW CAEP 6)	-60%	-75%	better than -75%
AIRCRAFT FUEL BURN	-33%	-50%	better than -70%

Advanced engine technologies and dramatic changes in airframe configuration will be key contributors to a carbon-neutral commercial aviation system.

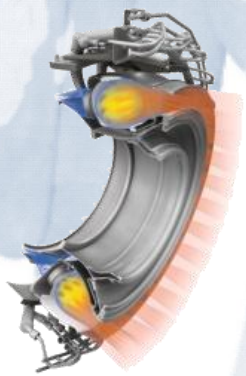
ICAO Independent Experts Aircraft Technology Goals



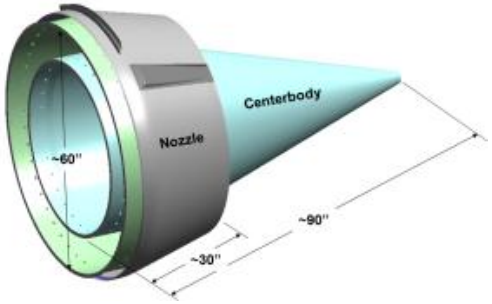
CLEEN

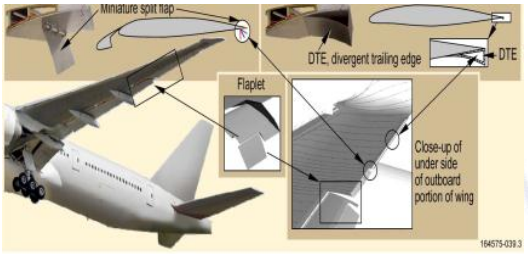
Continuous Lower Energy, Emissions and Noise

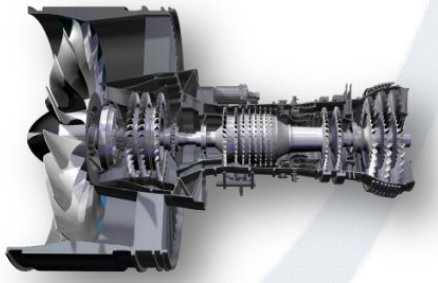
- 5 year effort to accelerate technology development and commercialization with 50 percent cost share
  - FAA budget: US$125 million
  - Industry budget: US$125 million+



- Mixed portfolio of technologies
  - *Engine*: GE, Honeywell, Pratt & Whitney, Rolls-Royce
  - *Aircraft*: Boeing
  - *Alternative Fuels*: Boeing, Honeywell, Rolls-Royce







Boeing-FAA ecoDemonstrator

Recently completed testing of 737 in Glasgow, Montana

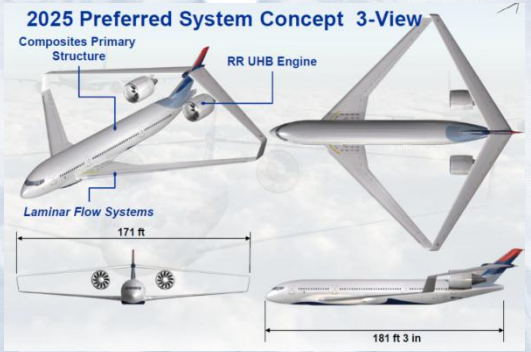
CLEEN funded adaptive wing trailing edges

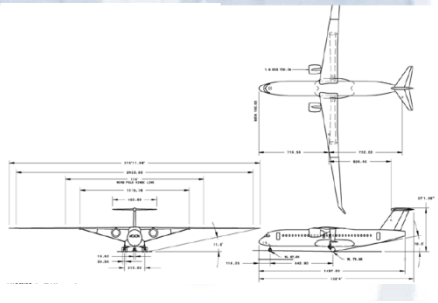
Better aerodynamic performance, reduced fuel burn, emissions and noise

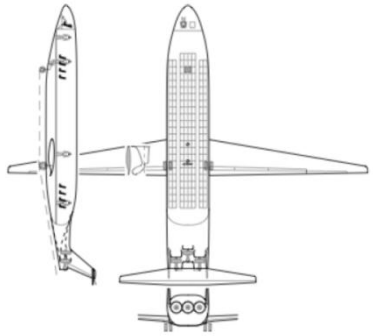
Photo: Boeing

Novel Ideas

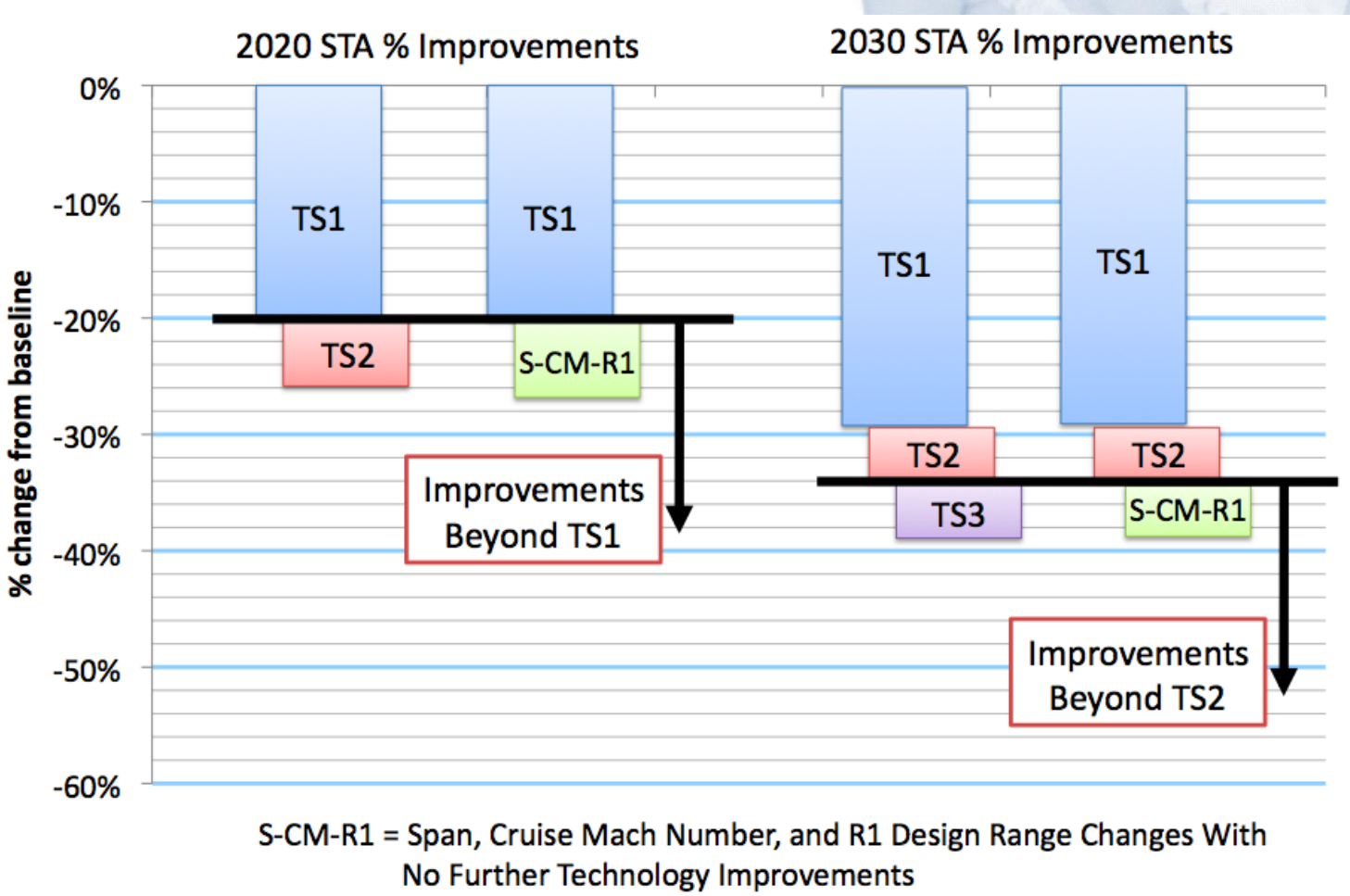
- Integrating engine, airframe and operations could lead to a step-change in environmental performance
- Some Examples:
  - Analysis of Mission Specification
  - NASA Environmentally Responsible Aviation and N+3 projects
  - Silent Aircraft Initiative
- Reduced cruise Mach number with unswept wings
- Change to configuration to allow larger bypass ratio engines
- Lifting fuselage
- Engines flush-mounted at aft fuselage with boundary layer ingestion







ICAO Independent Experts Aircraft Technology Goals



STA = Small-Twin Aisle

TS = Technology Scenario

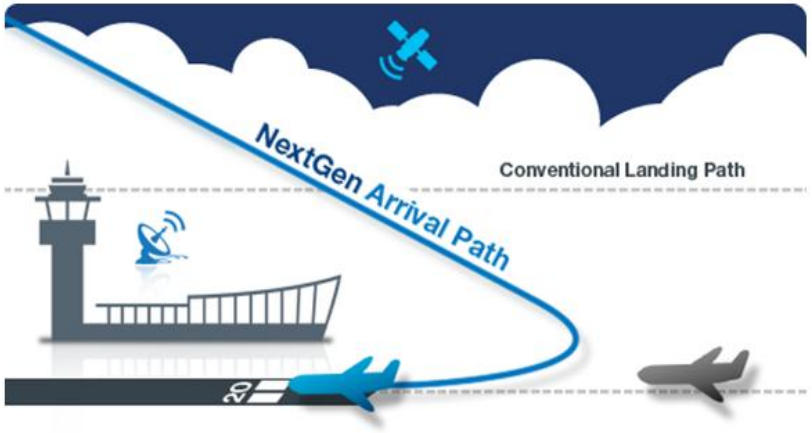
Other U.S. and International Technology Efforts

- FAA has made continued progress on ground-based cleaner technology at airports via the Voluntary Airport Low Emission Program (VALE)

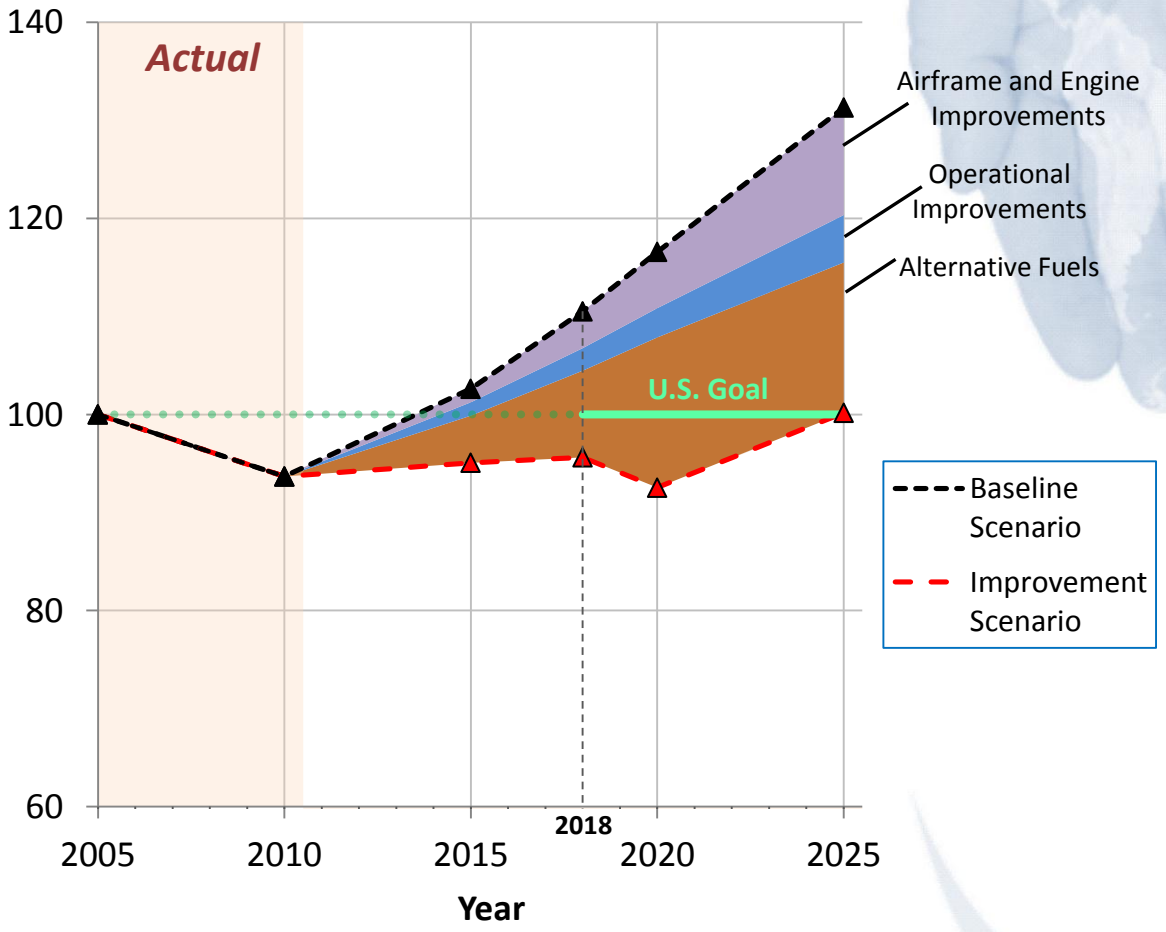
- ICAO Committee on Aviation Environmental Protection (CAEP) making continued progress on an aircraft CO_2 standard

Improving Aircraft Fuel Efficiency…

- Via both technology and operational improvement results in less fuel needed for a given aviation demand level and
- Increases alternative fuel viability as less alternative fuel feedstock will have to be grown



Sample Life-Cycle CO2 Reductions Emissions for U.S. System

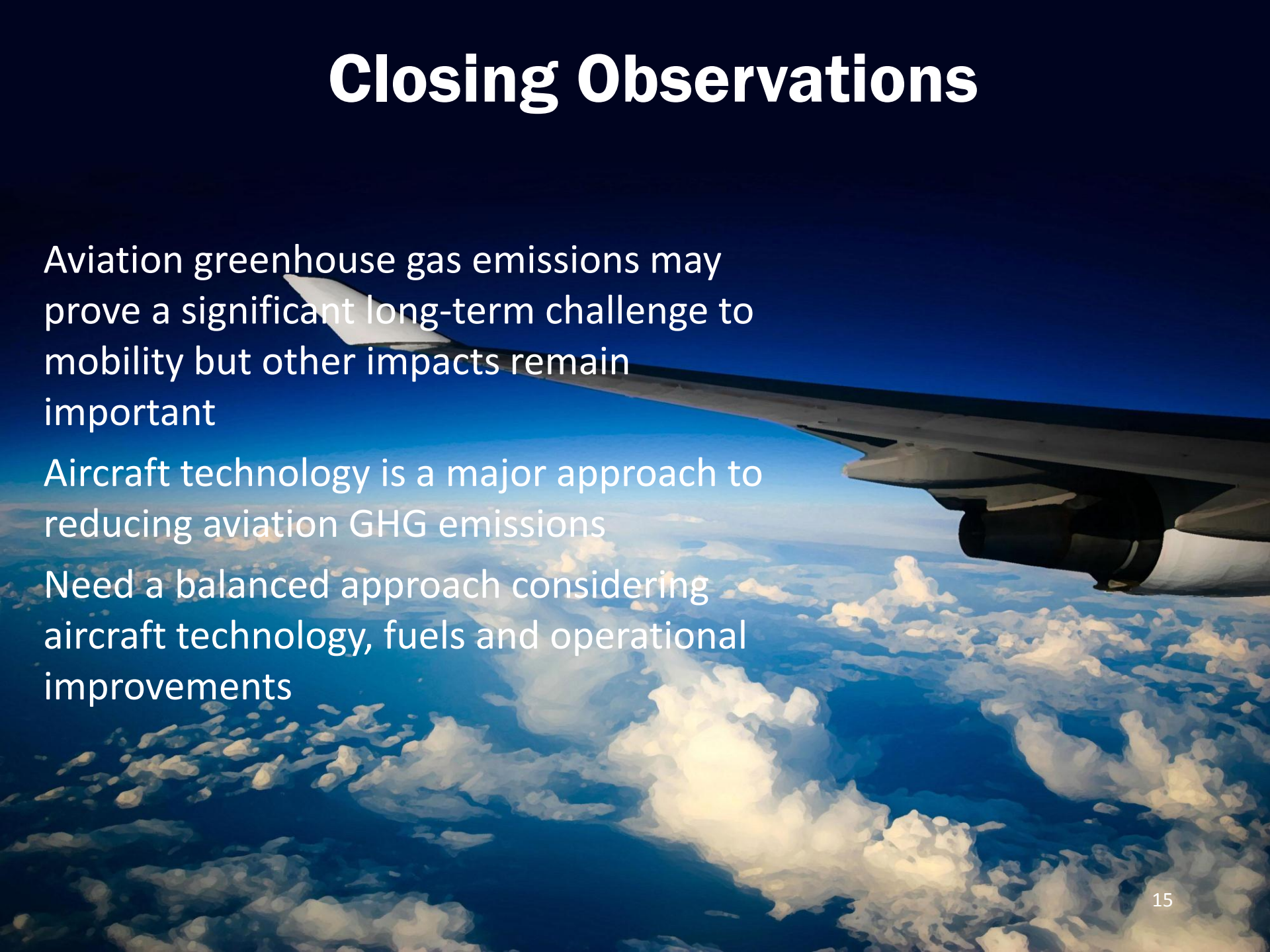


Sample scenario with many assumptions/uncertainties

Alternative Fuel Consumption

Year	Volume (million gallons)	Share of total fuel volume
2018	4,639	18%
2025	8,032	28%

Closing Observations



- Aviation greenhouse gas emissions may prove a significant long-term challenge to mobility but other impacts remain important
- Aircraft technology is a major approach to reducing aviation GHG emissions
- Need a balanced approach considering aircraft technology, fuels and operational improvements