

NASA Integrated Systems Research with an  
Environmental Focus

Green Aviation Summit  
Integrated Systems Research Program  
NASA Ames Research Center  
September 8-9, 2010

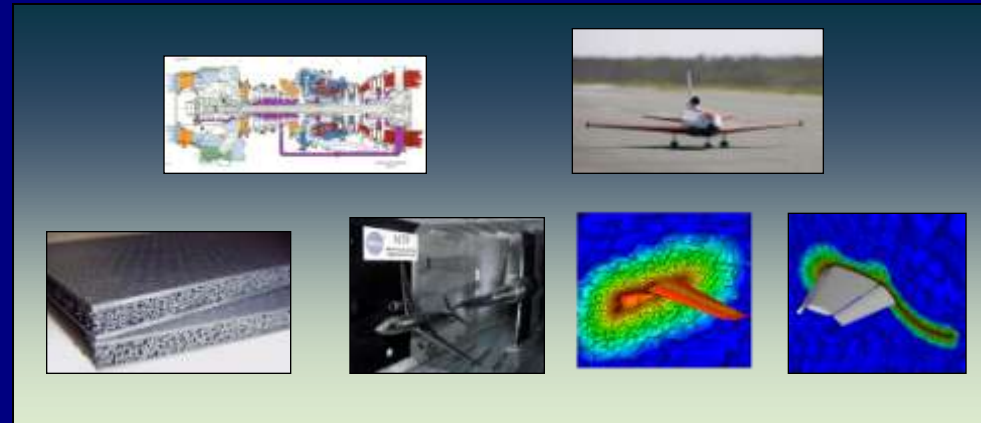
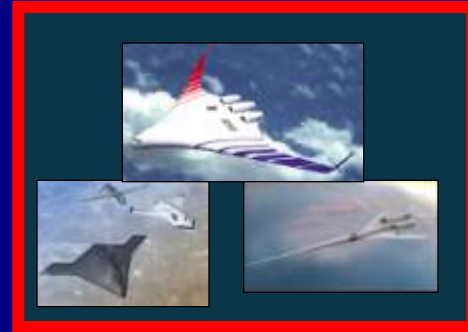
Jean Wolfe  
Program Director (Acting)  
Integrated Systems Research  
Program  
Aeronautics Research Mission  
Directorate

Dr. Fay Collier  
Project Manager  
Environmentally Responsible  
Aviation Project  
Integrated Systems Research  
Program  
Aeronautics Research Mission  
Directorate

# Outline

- NASA Aeronautics Investment Strategy
- Overview of Integrated Systems Research Program and its Projects
- E&E Challenges and Program/Project Alignment with National Goals
- Selection Criteria for ISRP Projects
- Innovative Concepts for Aviation
- Environmentally Responsible Aviation

# NASA Aeronautics Investment Strategy



# Integrated Systems Research Program Focus



Conduct research at an integrated system-level on promising concepts and technologies and explore, assess, or demonstrate the benefits in a relevant environment



# Program Organization

***Environmentally Responsible Aviation (ERA)*** Explore and assess new vehicle concepts and enabling technologies through system-level experimentation to *simultaneously* reduce fuel burn, noise, and emissions.

***UAS Integration in the NAS:*** Contribute capabilities that reduce technical barriers related to the safety and operational challenges associated with enabling routine UAS access to the NAS

***Innovative Concepts for Aviation (ICA):*** Spur innovation by offering research opportunities to the broader aeronautics community through peer-reviewed proposals, with a focus on making aviation more eco-friendly. Establish incentive prizes similar to the Centennial Challenges and sponsor innovation demonstrations of selected technologies that show promise of reducing aviation's impact on the environment



# Energy and Environmental Challenges

**1. Fuel Efficiency**



**2. Emissions**

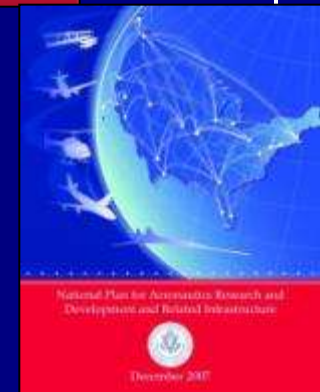


**3. Noise**



# The National Policy and Plan

–“Assuring energy availability and efficiency is central...” and “The environment must be protected...”



# Criteria for ISRP Projects

- Technology has attained enough maturity in the foundational research program that they merit more in-depth evaluation at an integrated system level in a relevant environment
- Technologies which systems analysis indicates have the most potential for contributing to the attainment of goals
- Technologies identified through stakeholder input as having potential for the attainment of goals
- Research not being done by other government agencies and appropriate for NASA to conduct
- Result of a budget augmentation



# Outline for ERA

- Tech Challenges
- NASA E&E Metrics
- Key technologies and systems analysis
- Examples of research/accomplishments in FY10
- Impact of the Research

## Technical Challenges for ERA

- Develop advanced vehicle concepts and technologies that simultaneously reduce:
  - Community noise
  - LTO and Cruise NO<sub>x</sub>
  - Mission fuel burn
- Assess the impact of vehicle concepts and technologies at the fleet level

## NASA Subsonic Transport System Level Metrics

*... technology for dramatically improving noise, emissions, & performance*

<b>CORNERS OF THE TRADE SPACE</b>	<b>N+1 (2015)*** Relative to Single Aisle Reference</b>	<b>N+2 (2020)*** Relative to Twin Aisle Reference</b>	<b>N+3 (2025)***</b>
Noise (cum below Stage 4)	-32 db	-42 db	-71 db
LTO NOx Emissions (below CAEP 6)	-60%	-75%	Better than -75%
Performance: Aircraft Fuel Burn	-33%**	-50%**	Better than -70%
Performance: Field Length	-33%	-50%	Exploit metroplex* concepts

\*\*\* Technology Readiness Level = 4 – 6, ERA pushing TRL to 6 for key technologies by 2015

\*\* Additional potential gains from operational improvements

\* Optimal use of available runways in metropolitan areas.

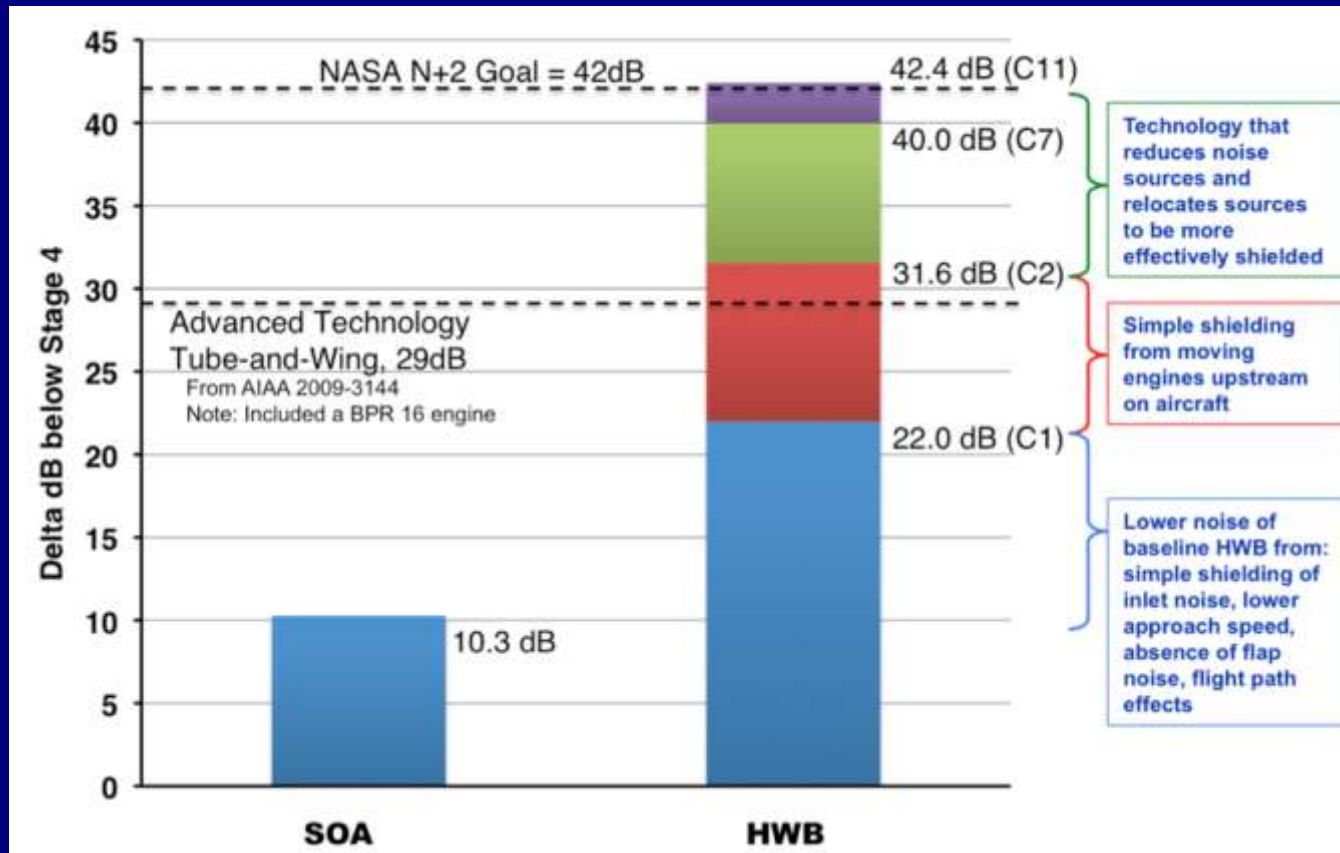
## Key Technologies

- Advanced resin infused, composite structural concepts for lower weight and damage tolerance
- Laminar flow and flow control concepts for drag reduction
- Ultra high bypass ratio engines for increased propulsive efficiency
- Acoustic shielding for significant noise reduction

## FY10 Accomplishments

- Completed Low Speed Flight Control Flight Demonstration on X-48B
- Completed mid-fidelity acoustic shielding assessment in the Boeing Low-Speed Acoustic Facility
- Initiated Fuel Flexible, Low NO<sub>x</sub> Combustor Tech Development Effort
- Initiated Advanced Vehicle Concept Dev.

# Impact of the Research - Noise

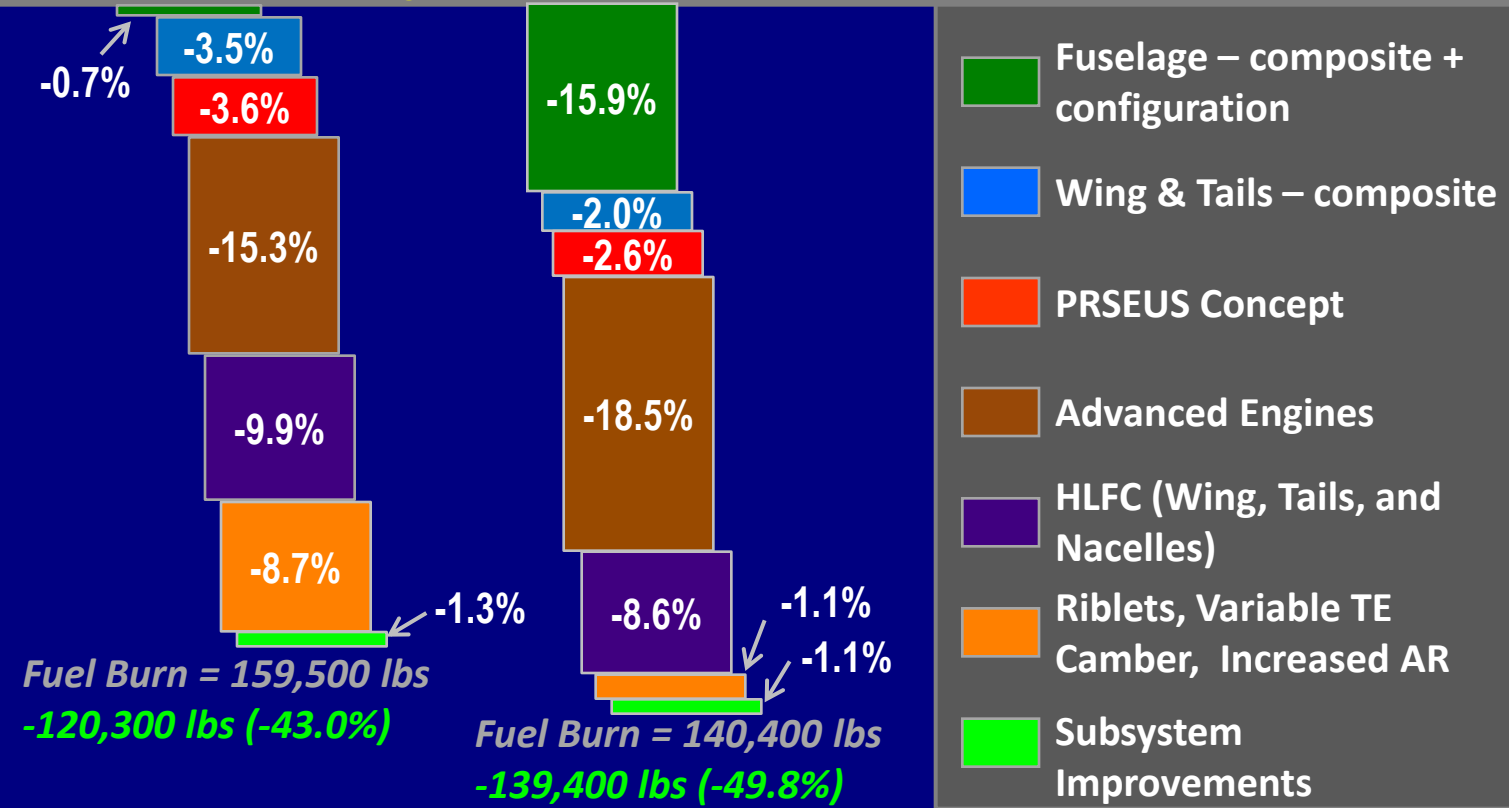


# Impact of the Research – Fuel Burn

N+2 adv. "tube-and-wing"

N+2 HWB300

Reference Fuel Burn = 279,800 lbs



# Impact of the Research – Fleet Emissions

