CAAFI – Biennial General Meeting

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NASA Aeronautics Six Strategic Thrusts

Safe, Efficient Growth in Global Operations

- Enable full NextGen and develop technologies to substantially reduce aircraft safety risks

Innovation in Commercial Supersonic Aircraft

- Achieve a low-boom standard

Ultra-Efficient Commercial Vehicles

- Pioneer technologies for big leaps in efficiency and environmental performance

Transition to Low-Carbon Propulsion

- Characterize drop-in alternative fuels and pioneer low-carbon propulsion technology

Real-Time System-Wide Safety Assurance

- Develop an integrated prototype of a real-time safety monitoring and assurance system

Assured Autonomy for Aviation Transformation

- Develop high impact aviation autonomy applications

Sustainable Alternative Jet Fuels – Strategic Relevance

Ultra-Efficient Commercial Vehicles

Efficiency (use less energy)
Emissions (use less energy)
Noise (less perceived noise)

Airframe
Propulsion – Advanced Gas Turbines and Propulsors
Vehicle System Integration

Fuel Flexible
Advanced Gas Turbines

Small Core

Fuel Flexible
Hybrid Systems

Transition to Low-Carbon Propulsion

Aviation Alternative Fuels (Drop-In)
- Reduce specific carbon (use cleaner energy)
- Clean, compact combustion
- Gas turbines needed for foreseeable future

Alternative Energy/Power Architectures
- Energy sector convergent technology*
- Promise of cleaner energy
- Potential for vehicle system efficiency gains (use less energy)
- Leverage advances in other transportation sectors
- Address aviation-unique challenges (e.g. weight, altitude)
- Recognize potential for early learning and impact on small aircraft

*energy sector includes other government agencies, industry, and academia

New Aviation Horizons Flight Demo Plan

FY17 Budget Request

"Purpose-Built" Ultra-Efficient Subsonic Transport (UEST) Demonstrators

Hybrid Electric Propulsion (HEP) Demonstrators

Transport Scale Ground Test Risk Reduction | Preliminary Design | Design & Build | Flight Test

Small Scale "Build, Fly, Learn"

Design & Build | Flight Test | Design & Build | Flight Test

Validated HEP concepts, technologies and integration for U.S. Industry to lead the clean propulsion revolution

Ground Test Risk Reduction | Preliminary Design | Design & Build | Flight Test

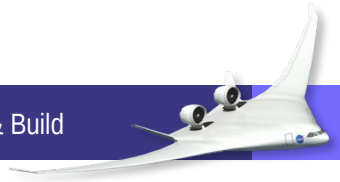
Images Credit: Lockheed Martin

Potential Candidates

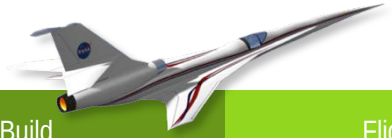
Ground Test Risk Reduction | Preliminary Design | Design & Build | Flight Test

Validated ability for U.S. Industry to build transformative aircraft that use 50% less energy and contain noise within the airport boundary

Preliminary Design | Design & Build | Flight Test



Fully integrated UEST Demonstrator



Design & Build | Flight Test

Enables low boom regulatory standard and validated ability for industry to produce & operate commercial low noise supersonic aircraft

FY17 FY18 FY19 FY20 FY21 FY22 FY23 FY24 FY25 FY26

NASA Response to Community Drivers Transition to Low-Carbon Propulsion

Community Outcomes	2015	2025	2035
	Introduction of Low-Carbon Fuels for Conventional Engines and Exploration of Alternative Propulsion Systems	Initial Introduction of Alternative Propulsion Systems	Introduction of Alternative Propulsion Systems to Aircraft of All Sizes

NASA Strategies

Sustainable Alternative Jet Fuels (drop-in)

- Explore and demonstrate combustor concepts that exploit future alternative fuels
- Characterize the performance and emissions of an increasing spectrum of alternative jet fuels in advanced combustors
- Advance scientific understanding relating fuels to combustion to emissions to atmospheric impact

Alternative Propulsion Systems (Energy/Power Arch)

- Explore and demonstrate vehicle integration synergies enabled by electrified aircraft propulsion
- Enable increasingly electrified aircraft propulsion systems with minimal change to aircraft outer mold lines
- Gain experience through integration and demonstration on progressively larger platforms

Federal Alternative Jet Fuel Strategy
Fuel Development Path

Federal Partner Agency Contributions

Feedstock Development & Production

Feedstock Logistics

Fuel Conversion

Fuel Conversion Scale-Up

Fuel Testing & Evaluation

Integrated Challenges

DOC	X				X
DoD			X	X	
DOE	X	X	X		X
DOT				X	X
EPA					X
NASA				X	
NSF	X	X	X		
USDA	X	X	X		X

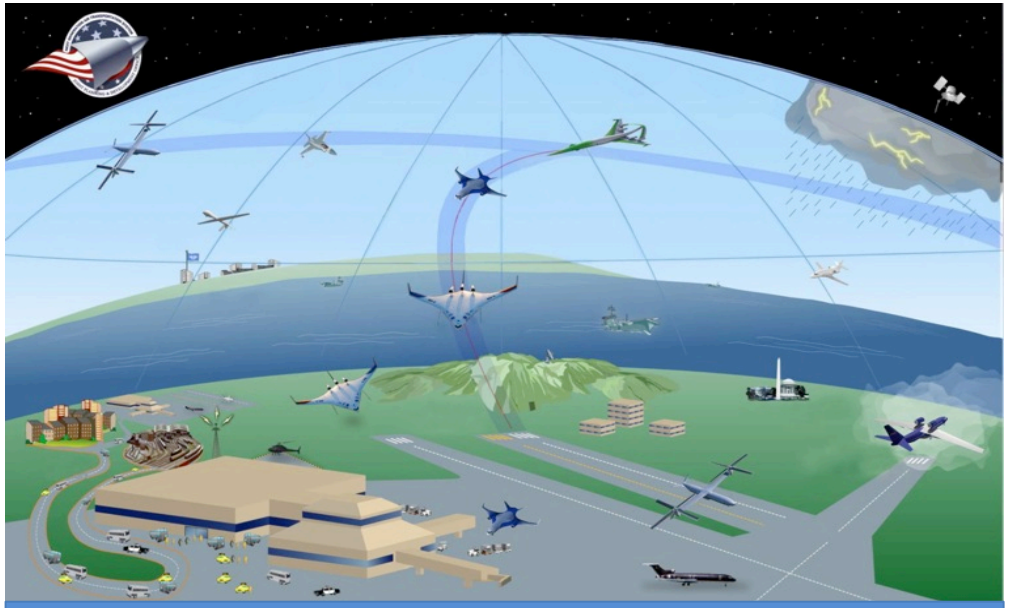
Diverse industry contributions along full development path

Academia contributions in low TRL and FRL*

* Fuel Readiness Level

A Vision for the Future of Civil Aviation

- There will be a radical increase in new and cost-effective uses of aviation
- The skies will accommodate thousands of times the number of vehicles flying today
- Travelers will have the flexibility to fly when and where they want in a fraction of the time that it takes today
- All forms of air travel will be as safe as commercial air transport is today
- Subsonic transports will remain the backbone of long-haul global and domestic travel
- Significantly reduced carbon and noise footprints from aviation



Low-carbon propulsion –

- will be designed into vehicles of all sizes and missions
- will have its largest impact on aviation's carbon footprint via subsonic transports
- will enable new vehicles that create economic benefit for unique missions/services.

Sustainable alternative jet fuels will be the norm.