NASA Aeronautics Six Strategic Thrusts

6 Strategic Research and Technology 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
## ARMD Programs with Strategic Thrusts

### MISSION PROGRAMS

<table>
<thead>
<tr>
<th><strong>Airspace Operations and Safety Program</strong></th>
<th><strong>Advanced Air Vehicles Program</strong></th>
<th><strong>Integrated Aviation Systems Program</strong></th>
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<tbody>
<tr>
<td>• Safe, Efficient Growth in Global Operations</td>
<td>• Ultra-Efficient Commercial Vehicles</td>
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<td>• Real-Time System-Wide Safety Assurance</td>
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<td>• Assured Autonomy for Aviation Transformation</td>
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<td></td>
<td>• Flight Research-Oriented Integrated, System-Level R&amp;T support all six thrusts</td>
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<td>• X-Planes / Test Environment</td>
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### SEEDLING PROGRAM

<table>
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<tr>
<th><strong>Aeronautics Concepts Program</strong></th>
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<tr>
<td>• High-risk, leap-frog ideas supporting all six thrusts</td>
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<tr>
<td>• Critical cross-cutting tools and technology development</td>
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</table>
NASA Aeronautics Ready for Flight

2008-2013

N+3 Subsonic & Supersonic Concept/Technology Studies

N+2 Environmentally Responsible Aviation (ERA) Project Initiated

2014/15

Ground Testing of N+3 configurations and technologies

8 Integrated Tech Demos Completed, Tech transitioned to industry. HWB ready for Flight Dem/Val.

2016/17

LBFD PDR Completed

2018-2026

UEST PDR Completed

Ready for X-Plane Integration & Demonstration

Ready for NextGen TBO Integration & Demonstration

Roadmaps Completed

NASA FAA NextGen Research Transition Teams (RTTs) Initiated

Technology Transitions to FAA: MSP, EDA, PDRC, TSAS

ATD-1 Completed and transferred to FAA

ATD-2, 3 Completed & Transferred to FAA

NASA Aero Vision and Strategy Established

www.nasa.gov
Ten Year Investment Plan—FY 2017 Budget Accelerates Key Components of NASA Aeronautics Plan

Fund the Next Major Steps to Efficient, Clean and Fast Air Transportation Mobility

**New Aviation Horizons**

- Start a continuing series of experimental aircraft to demonstrate and validate high impact concepts and technologies. Five major demonstrations over the next 10+ years in the areas of Ultra-Efficiency, Hybrid-Electric Propulsion, and Low Noise Supersonic Flight.
- **Major New Initiative within IASP**

**Enabling Tools & Technologies**

- Major series of ground experiments to ready key technologies for flight.
- Research and ground demonstration for an advanced small engine core for very high bypass engines and as a hybrid-electric propulsion enabler.
- Development of next generation physics-based models needed to design advanced configurations.
- Increases to AAVP and TACP

**Revolutionizing Operational Efficiency**

- Accelerate demonstration of full gate-to-gate Trajectory Based Operations.
- Increase to AOSP

**Fostering Advanced Concepts & Future Workforce**

- Increased investment in new innovation through the NASA workforce and Universities.
- Increase to TACP

**UAS**

- Strong continued research leadership in enabling UAS integration into the National Airspace. Extending the UAS in the NAS project for an additional 4 years.
- Increases to IASP and AAVP

**Hypersonics**

- Increased investment to ensure a strong National fundamental research capability.
- Increases to IASP and AAVP

Build off of major current developments and accomplishments

Continue to incentivize new innovation
### FY 2017 Budget

#### Aeronautics

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Aeronautics budget includes paid-for 10-year mandatory funding from the Administration’s 21st Century Clean Transportation Plan. See appendix for additional detail.

#### Mandatory Budget Authority

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NASA Aeronautics Strategic Portfolio Model

SIP Outcomes Drives Top-Down Planning

Roadmaps Provide Guidance for Project / Center Innovation and Planning

Strategic Thrust Roadmaps

Partnerships & Performance Create a Feedback Loop

6 Strategic Thrusts

- Safe, Efficient Growth in Global Operations
- Innovation in Commercial Supersonic Aircraft
- Ultra-Efficient Commercial Vehicles
- Transition to Low-Carbon Propulsion
- Real-Time System-Wide Safety Assurance
- Assured Autonomy for Aviation Transformation

www.nasa.gov

NASA strategy supports each of the three Community Outcomes (2015-2025, 2025-2035, 2035+)

**COMMUNITY OUTCOMES**

**2015**
- Meet the economic and environmental demands and on a defined path to fleet-level carbon neutral growth

**2025**
- Revolutionary improvements in community noise and energy efficiency to achieve fleet-level carbon neutral growth relative to 2005

**2035**
- Transforming capabilities in community noise and energy efficiency enabling a 50 percent reduction in fleet-level carbon output relative to 2005

**NASA Strategy**

Prove practicality of revolutionary and transformational aircraft concepts and technology *via large-scale integrated demonstrations*

Execute early-stage *exploration and development of game-changing concepts and technology* to overcome the technical challenges of efficient, quiet flight

Develop and validate *enabling tools, methods, and processes*

June 14, 2016
NASA Low Carbon Propulsion: Research Strategy, 2015-2035+

**Aviation Alternative 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

**NASA Strategies**
- **2015**
  - Introduction of Low-carbon Fuels for Conventional Engines and Exploration of Alternative Propulsion Systems
- **2025**
  - Initial Introduction of Alternative Propulsion Systems
- **2035**
  - Introduction of Alternative Propulsion Systems to Aircraft of All Sizes

**Alternative Energy/Power Architectures**
- Explore and demonstrate vehicle integration synergies enabled by hybrid electric propulsion
- Increasingly electric aircraft propulsion with minimal change to aircraft outer mold lines
- Gain experience through integration and demonstration on progressively larger platforms

June 14, 2016
Summary – A New Era for NASA Aeronautics

Investing In Our Future - Investments in NASA’s cutting edge aeronautics research today are investments in a cleaner, safer, quieter and faster tomorrow for American aviation:

• A future where Americans are working in stable, well-paying jobs.
• A future where we fly on aircraft that consume half as much fuel and generate only one quarter of current emissions.
• A future where flight is fueled by greener energy sources.
• A future where our air transportation system is able to absorb nearly four billion more passengers over the next 20 years without compromising the safety of our skies.
• A future where our airports are better neighbors because aircraft noise is contained well within the airport boundary.
• A future where people can travel to most cities in the world in six hours or less in an airplane that can fly faster than the speed of sound on bio-fuels.