



# NASA Fundamental Aeronautics Program

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# Four Emphases



## Conduct world class research

- Research at four research centers (LaRC, GRC, ARC, and DFRC), each with unique capabilities and facilities
  - 1377 civil servants and 680 contractors; \$308 M or 62% of the ARMD budget
- Integrated collaboration of research and management across research centers
- National recognition:
  - Back-to-back Collier trophies (ADS-B, CAST)

## Transition research to the nation

- Supporting research needs and discovering advancements with industry and academia (over 80 Space Act Agreements with large and small manufacturers; 380 NASA Research Announcements awarded since 2006)
- Transitioning research results for real-world application (chevron nozzles, SFO stratus and flow scheduling)
- Partnerships with federal agencies such as FAA (JPDO/RTTs), DOD (NPAT, ERC) through policy, research and infrastructure

## Inspire a new generation workforce

- Scholarships and research grants
- NASA Research Announcements attracting students across 68 universities
- Education outreach across K-12 on aeronautics disciplines

## Leverage world-wide capabilities

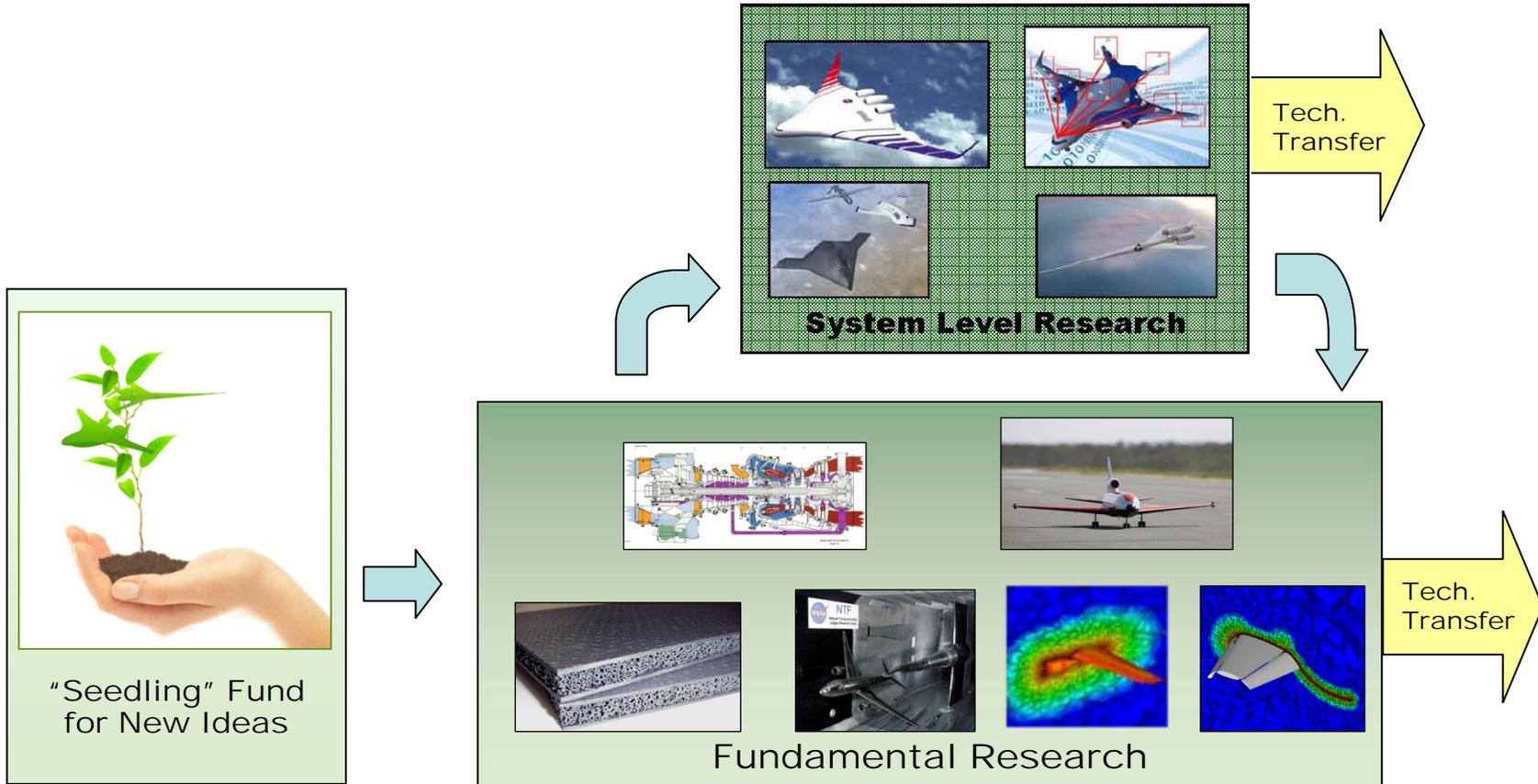
- Strong partnerships with European and Canadian agencies (France, UK, Germany, Netherlands, Canada) –
  - 20 agreements in force, 11 agreements under development
- New partnerships to leverage emerging capabilities
  - Supersonics research with Japan, rotorcraft research with Korea

# Major Aeronautics Challenges & Opportunities



- **Environmental Compatibility**
  - Emissions - CO<sub>2</sub> and NO<sub>x</sub>
    - **Aviation creates 2% of worldwide emissions**
  - Noise
    - **Airport community noise reduction**
      - > Increased access to 5,221 US public use airports
      - > FAA attempt to reconfigure New York airspace resulted in 14 lawsuits
      - > Since 1980 the FAA has invested over \$5 billion in airport noise reduction programs
      - > Noise insulation of 6000 Chicago homes cost over \$18M and \$285M allocated for schools
    - **Sonic Boom over land**
      - > Enhance Supersonic Transport economic viability
- **Economic Efficiencies**
  - Airspace System Capacity
    - **56 minute average flight delay in 2007**
    - **\$5.9B economic impact of airline delays in 2005**
  - Fuel Consumption
    - **Exceeded 26% of airline operating cost in 2006**

# NASA Aeronautics Investment Strategy



Enabling "Game Changing" concepts and technologies from advancing fundamental research ultimately to understand the feasibility of advanced systems

# Chevrons - The Road From Idea to Deployment



Initial service entry,  
2002

## Systems Assessment: 2001-2005

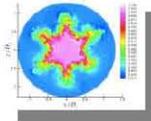
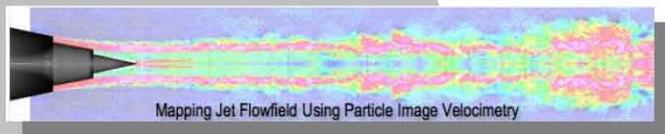
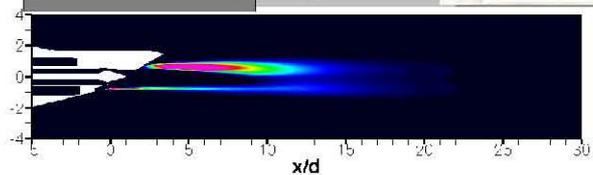
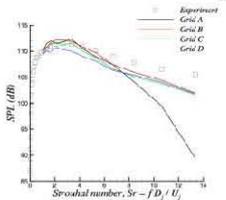
- Ground-test evaluation in engine test stands
- Flight evaluation in relevant environments

## Fundamental Research: 1996-2000

- Computational and experimental research to develop a fundamental understanding of the fluid mechanics governing the effectiveness of the concept
- Development of practical implementations (chevrons)

## Seedling Idea: 1994-1996

Basic studies on jet mixing suggest that tabs can enhance jet mixing, with the potential to reduce noise



# NASA Aeronautics Programs in FY2010

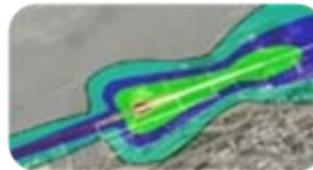


## Fundamental Aeronautics Program

Conduct cutting-edge research that will produce innovative concepts, tools, and technologies to enable revolutionary changes for vehicles that fly in all speed regimes.

## Integrated Systems Research Program

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



## Airspace Systems Program

Directly address the fundamental ATM research needs for NextGen by developing revolutionary concepts, capabilities, and technologies that will enable significant increases in the capacity, efficiency and flexibility of the NAS.

## Aviation Safety Program

Conduct cutting-edge research that will produce innovative concepts, tools, and technologies to improve the intrinsic safety attributes of current and future aircraft.



## Aeronautics Test Program

Preserve and promote the testing capabilities of one of the United States' largest, most versatile and comprehensive set of flight and ground-based research facilities.





# ISRP Goal and Characteristics

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## **Integrated Systems Research Program (ISRP):**

Research and technology (R&T) program, that will conduct research at an integrated system-level on promising concepts and technologies and explore, assess, or demonstrate the benefits in a relevant environment

## **Criteria for selection of projects for Integrated Systems Research:**

- 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 simultaneous attainment of goals
- Technologies identified through stakeholder input as having potential for simultaneous attainment of goals
- Research not being done by other government agencies and appropriate for NASA to conduct

The ISRP will be governed by NPR 7120.8 “*NASA Research and Technology(R&T) Program and Project Management Requirements*”

# Environmentally Responsible Aviation Project Goals

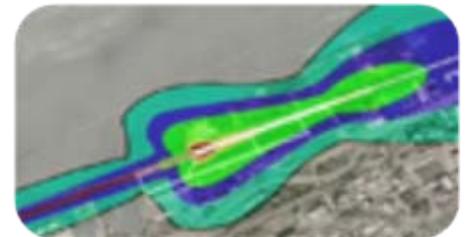


## Environmentally Responsible Aviation (ERA) Project:

Technology development project, that will explore and assess new vehicle concepts and enabling technologies through system-level experimentation to *simultaneously* reduce fuel burn, noise, and emissions

- *Airframe Technology*
- *Propulsion Technology*
- *Vehicle Systems Integration*

The ERA Project will be governed by NPR 7120.8  
“*NASA Research and Technology Program and Project Management Requirements*”



# FY 2010 President's Budget



	<u>FY08 1/</u>	<u>FY09 2/</u>	<u>FY 10</u>	<u>FY 11</u>	<u>FY 12</u>	<u>FY 13</u>	<u>FY 14</u>
<b>Aeronautics Total (\$ Millions)</b>	<b>\$511.4</b>	<b>\$650.0</b>	<b>\$507.0</b>	<b>\$514.0</b>	<b>\$521.0</b>	<b>\$529.0</b>	<b>\$536.0</b>
<b>Aviation Safety</b>	<b>\$66.5</b>	<b>\$89.3</b>	<b>\$60.1</b>	<b>\$59.6</b>	<b>\$59.2</b>	<b>\$61.7</b>	<b>\$62.5</b>
Aircraft Aging and Durability	9.1	13.4	11.4	11.2	11.7	12.1	12.1
Integrated Intelligent Flight Deck	14.1	16.3	12.5	13.3	11.6	12.6	13.3
Integrated Resilient Aircraft Control	21.8	37.3	16.4	17.0	17.6	18.2	18.2
Integrated Vehicle Health Management	21.5	22.2	19.8	18.2	18.3	18.9	18.9
<b>Airspace Systems</b>	<b>\$100.1</b>	<b>\$121.5</b>	<b>\$81.4</b>	<b>\$82.9</b>	<b>\$83.9</b>	<b>\$87.2</b>	<b>\$88.3</b>
NextGen - Concepts and Tech Development	0	0	53.3	54.5	55.3	57.8	58.7
NextGen - Systems Analysis & Integration	0	0	28.1	28.4	28.5	29.5	29.6
Next Gen - Airspace	83.3	105.3	0.0	0.0	0.0	0.0	0.0
Next Gen - Airportal	16.8	16.2	0.0	0.0	0.0	0.0	0.0
<b>Fundamental Aeronautics</b>	<b>\$269.6</b>	<b>\$307.6</b>	<b>\$228.4</b>	<b>\$230.0</b>	<b>\$233.6</b>	<b>\$239.0</b>	<b>\$245.9</b>
Subsonic Fixed Wing	119.6	155.2	101.6	103.7	105.4	107.3	110.8
Subsonic Rotary Wing	30.8	38.9	26.1	26.1	26.3	27.4	27.9
Supersonics	53.0	55.6	40.6	40.0	40.7	42.0	42.8
Hypersonics	66.2	57.9	60.0	60.2	61.1	62.3	64.4
<b>Aeronautics Test Program</b>	<b>\$75.1</b>	<b>\$131.6</b>	<b>\$74.7</b>	<b>\$77.1</b>	<b>\$77.2</b>	<b>\$76.6</b>	<b>\$78.7</b>
Aero Ground Test Facilities	50	100	48.6	50.1	50.2	49.8	51.2
Flight Ops & Test Infrastructure	25.1	31.6	26.1	27.0	27.0	26.8	27.5
<b>Integrated Systems Research</b>	<b>\$0.0</b>	<b>\$0.0</b>	<b>\$62.4</b>	<b>\$64.4</b>	<b>\$67.1</b>	<b>\$64.4</b>	<b>\$60.5</b>
Environmentally Responsible Aviation	0.0	0.0	62.4	64.4	67.1	64.4	60.5

1/ FY08 reflects the September Operating Plan including Augmentation (\$60M)

2/ FY09 reflects the Enacted Appropriation Augmentation (\$53.5M) plus the Recovery Act (\$150M)