



NASA Aeronautics Strategy Update

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NRC Aeronautics Research and Technology Roundtable

100 Years of Excellence

The NACA and NASA Aeronautics have made amazing contributions to U.S. and global aviation.

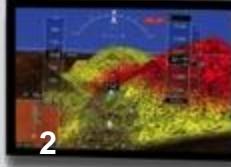


1903

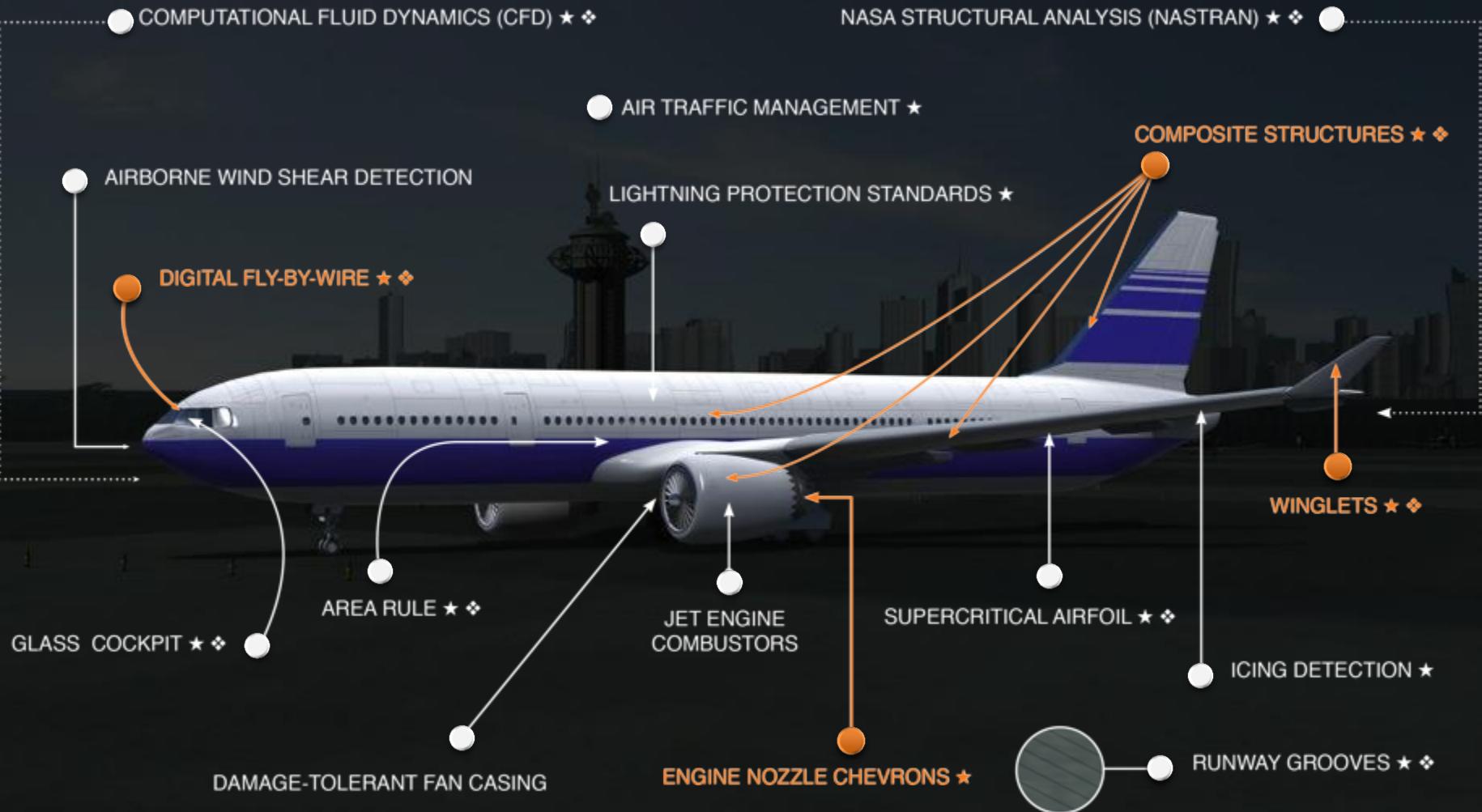
1915

1958

2015



NASA AERONAUTICS RESEARCH ONBOARD DECades of CONTRIBUTIONS to AVIATION



★ Applies also to general aviation aircraft

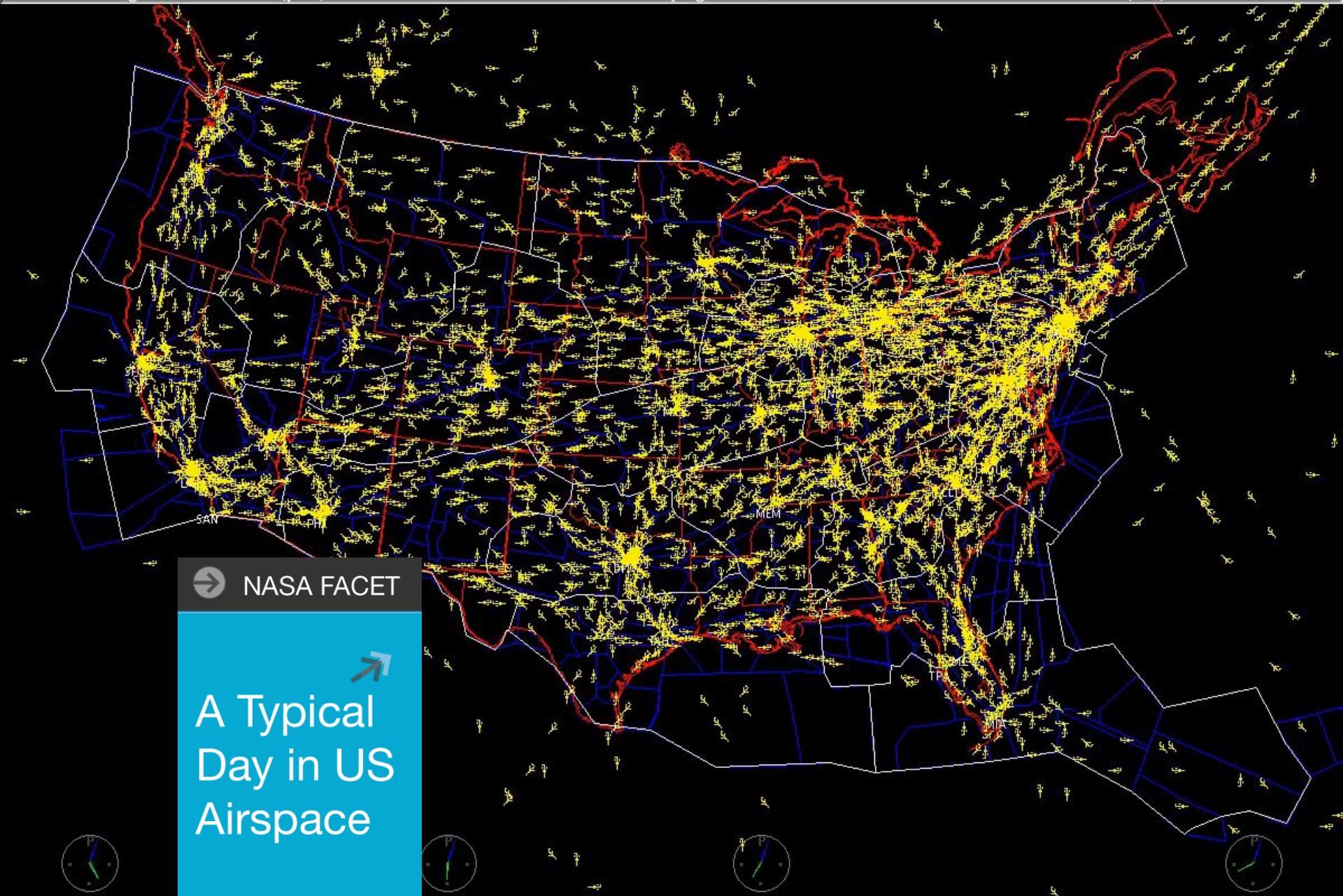
❖ Applies also to military aircraft



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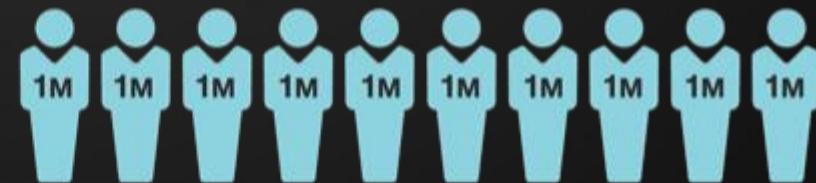
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Why is aviation so important?

The air transportation system is critical to U.S. economic vitality.



Growing and Moving East

Growth in passengers and traffic dominated by Asia Pacific region and aircraft orders and deliveries reflect this shift

Traffic in Asia-Pacific is forecasted to triple by 2030

Adding 360 million passengers in Asia Pacific

Additional passengers 2014 vs 2009

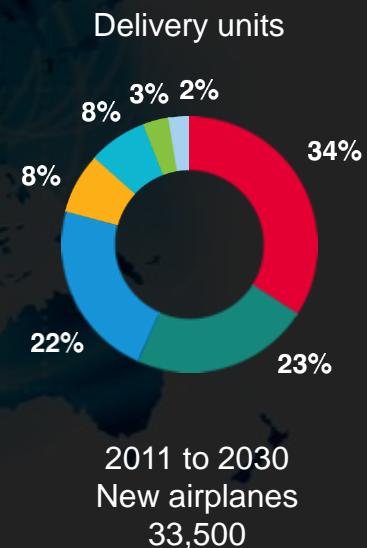


Source: IATA

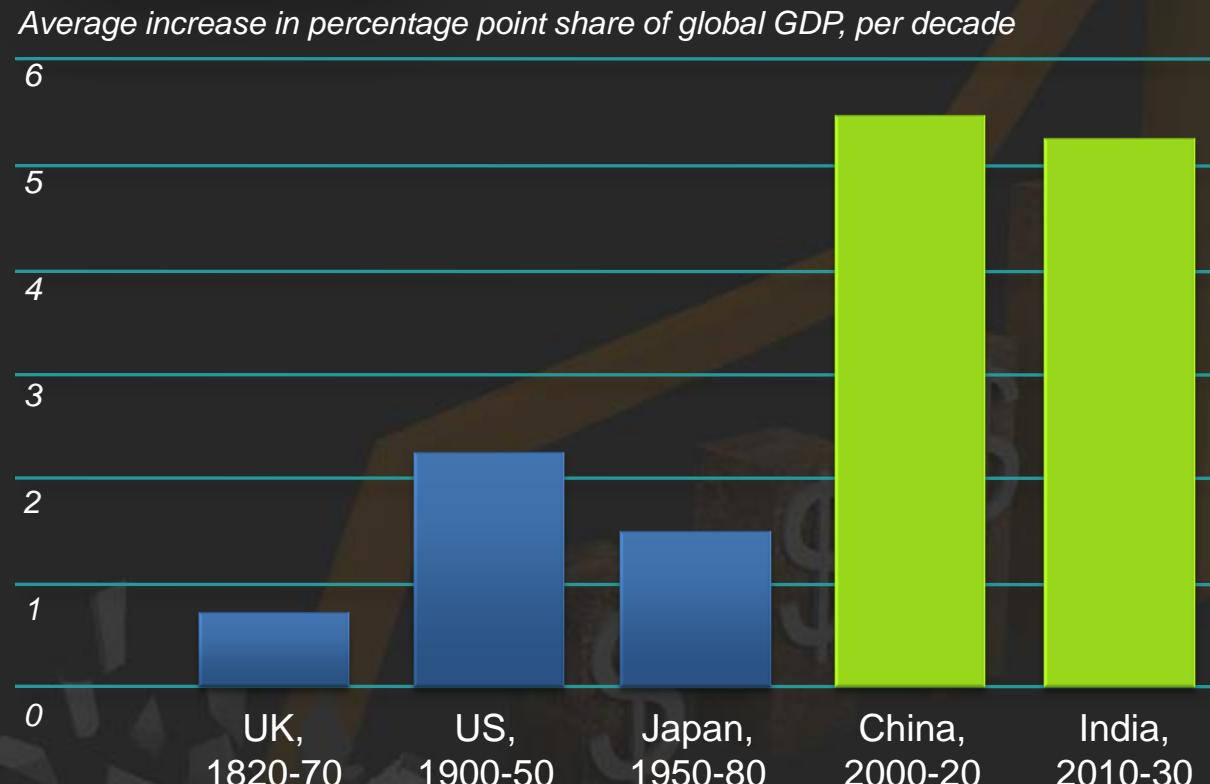
New airplanes
Deliveries by region

Region	New airplanes
Asia Pacific	11,450
Europe	7,550
North America	7,530
Latin America	2,570
Middle East	2,520
CIS	1,080
Africa	800
Total	33,500

Current Market Outlook
2011-2030



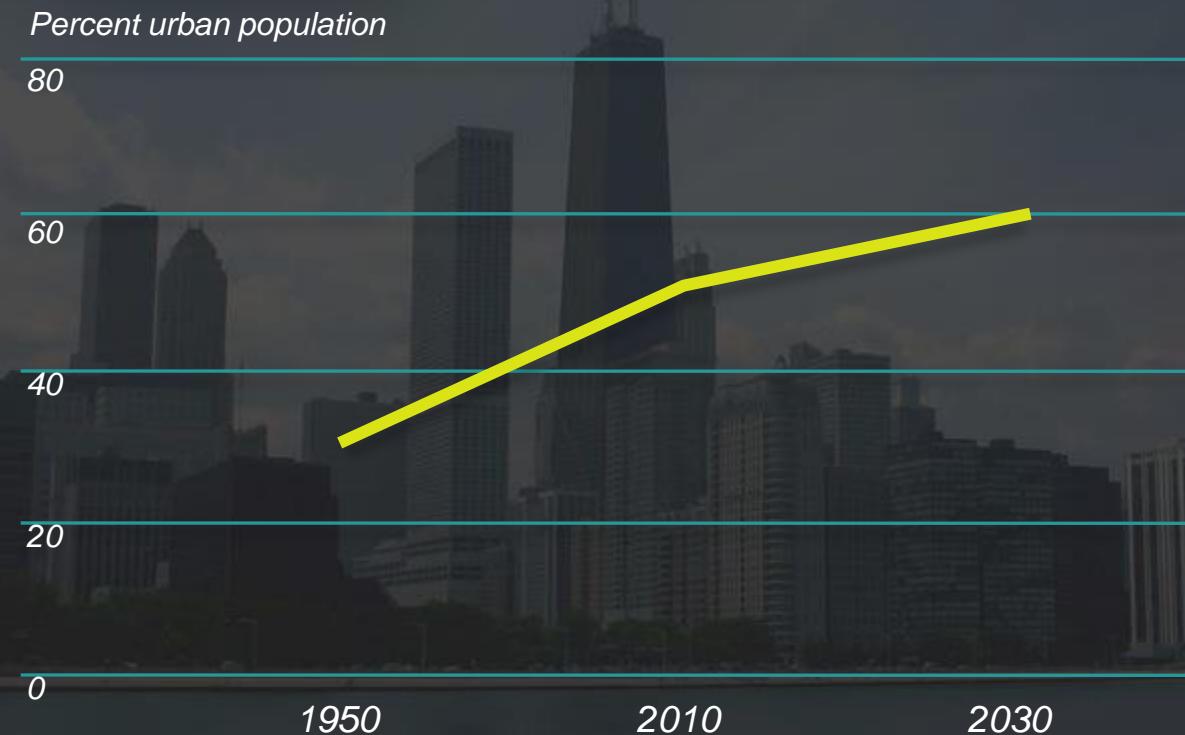
What kind of world will you be living in 2030?



Global Footprint Network Living Planet Report 2010, p89.

China & India Growing Economically at Historically Unprecedented Rates

What kind of world will you be living in 2030?



Source: National Intelligence Council

The World will be Predominantly Urban

What kind of world will you be living in 2030?



Source: National Intelligence Council

Technology Development and Adoption is Accelerating

3 Mega Drivers Emerge

How Do These Trends Affect Aviation?

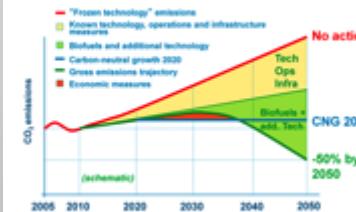


Traditional measures of global demand for mobility—economic development, urbanization—are growing rapidly



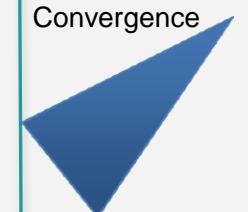
Severe energy and climate issues create enormous affordability and sustainability challenges

Emissions reduction roadmap



Revolutions in automation, information and communication technologies enable opportunity for safety critical autonomous systems

Technology Convergence



Why a New Aeronautics Research Strategy?

Now is the time to lay the groundwork for the next 100 years of excellence.

- * NASA Aeronautics has solid partnerships, high relevancy, and is delivering high impact
- * But need to recognize:
 - * Rising competition in international R&D
 - * Challenges in mobility, energy and climate
 - * Opportunities to infuse rapidly advancing non-aerospace sector technologies
- * ARMD's new strategy builds on current leadership and focuses on enabling revolutionary advances



"Civil aviation [is] blessed with growing demand, record orders and increasing deliveries, but facing global competitors, affordability and sustainability challenges, and an industry-shaking technological revolution."

Graham Warwick,
AvWeek, September 2013

The Time Bomb of Complacency – AvWeek Editorial, September 2, 2013

"An alarm needs to be sounded. A vital and vigorous aeronautics research program is essential... NASA's unveiling of a new strategy for aeronautics research is a bold and welcome move."



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 Transports

- 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 Program Reorganization

Promoting Innovation and Convergent Research

Goal 1: Pursue Innovative Solutions Aligned to the Strategic Thrusts

Enable programs to clearly define most compelling technical challenges and retire them in a timeframe that is supportable by stakeholders and is required by our customers.

Addressed through the formation of three Mission Programs and the integration of safety research throughout all programs.

- Airspace Operations and Safety Program
- Advanced Air Vehicles Program
- Integrated Aviation Systems Program

Goal 2: Incentivize Multi-Disciplinary “Convergent” Research

Establish a flexible and organic environment to allow for the development of high-risk, leap-frog ideas to address “big problems.” This will allow rapid demonstration of feasibility with high turnover rates, conducted in a convergent, multi-disciplinary, integrated manner.

Addressed through the formation of the Transformative Aeronautics Concepts Program

Goal 3: Enable Greater Workforce and Institutional Agility and Flexibility

- Enable more flexibility to embed flight research throughout research phases and bring back X-plane culture.
- Enable more agile research practices that combine high-fidelity simulation, ground testing, and flight research.

Addressed by embedding the Aeronautics Test facilities and aircraft into the Advanced Air Vehicles and Integrated Aviation Systems Programs.



All of the new programs address more than one, or all, of the research thrusts.

Vision and New Program Intersection

MISSION PROGRAMS

Airspace Operations and Safety Program



AOSP



Safe, Efficient
Growth in Global
Operations



Real-Time System-
Wide Safety
Assurance



Assured Autonomy
for Aviation
Transformation

Advanced Air Vehicles Program



AAVP



Ultra-Efficient
Commercial
Vehicles



Innovation in
Commercial
Supersonic Aircraft



Transition to Low-
Carbon Propulsion



Assured Autonomy
for Aviation
Transformation

Integrated Aviation Systems Program



IASP

Flight research-oriented,
integrated, system-level
R&T that supports all
six thrusts

X-planes / test environment



SEEDLING PROGRAM

Transformative Aeronautics Concepts Program



TACP

High-risk, leap-frog ideas
that support all six
thrusts

Critical cross-cutting tool
development



Lab-to-Market

NASA's work on these technologies

- Advanced composite structures
- Chevrons
- Laminar flow aerodynamics
- Advanced CFD and numerical simulation tools
- Advanced ice protection system

Was transferred for use here



1,031 confirmed orders through 2012

Source: Boeing

Product Strengths

- 20% more fuel efficient reduced CO₂ emissions
- 28% lower NO_x emissions
- 60% smaller noise footprint

NASA's work on these technologies

- Advanced composite structures
- Chevrons
- Laminar flow aerodynamics
- Advanced CFD and numerical simulation tools

Was transferred for use here



119 confirmed orders through January 2012

Source: Boeing

Product Strengths

- 16% more fuel efficient/ reduced CO₂ emissions
- 30% lower NO_x emissions
- 30% smaller noise footprint than 747-400

NASA's work on these technologies

- Low NO_x Talon combustor
- Fan Aerodynamic and Acoustic Measurements
- Low noise, high efficiency fan design
- Ultra High Bypass technology
- Acoustics Modeling and Simulation tools

Was transferred for use here



Won contracts for Airbus A320NEO, Bombardier C-Series, Mitsubishi Regional Jets

Source: Pratt & Whitney

Product Strengths

- 16% reduction in fuel burn/reduced CO₂ emissions
- 50% reduction in NO_x
- 20dB noise reduction

NASA's work on these technologies

- Compression system aerodynamic performance advances
- Low NO_x TAPS II combustor
- Low pressure turbine blade materials
- High-pressure turbine shroud material
- Nickel-aluminide bond coat for the high pressure turbine thermal barrier coating

Was transferred for use here



Won contracts for Airbus A320NEO, Boeing 737MAX

Source: CFM

Product Strengths

- 15% reduction in fuel burn/ reduced CO₂ emissions
- 50% less NO_x
- 15dB noise reduction

Major US Airlines Collaborating with NASA

American Airlines



Weather Rerouting

- Changing non-profitable flights into profitable flights

Southwest



Data Mining

- Improving efficiency and safety

US Airways



Surface Management

- Reducing delays and fuel consumption



open en route slot

NASA's ATM Technologies on the Move

Transferred Precision Departure Release Capability (PDRC)

- Conducted two operational evaluations over 29 weeks at Dallas-Ft. Worth International Airport and Dallas-Ft. Worth FAA Air Route Traffic Control Center
- Average OFF time improved by about 1 min, and number of flights departing within release window improved by more than 50% when compared to the baseline

Transition to Low Carbon Propulsion



NASA Falcon Aircraft in Flight Behind DC-8 Aircraft

NASA'S Vision for Aviation

A revolution in sustainable
global air mobility

TRANSFORMATIVE



On Demand

Fast

SUSTAINABLE



Intelligent



Low Carbon

GLOBAL

Safety, NextGen
Efficiency, Environment

