NASA Update
REDAC E&E Subcommittee Meeting

March 2018

NASA Aeronautics

NASA Aeronautics Vision for Aviation in the 21st Century

ARMD continues to evolve and execute the Aeronautics Strategy *https://www.nasa.gov/aeroresearch/strategy*

6 Strategic Thrusts

- Safe, Efficient Growth in Global Operations
- Innovation in Commercial Supersonic Aircraft
- Ultra-Efficient Commercial Transports
- Transition to Alternative Propulsion and Energy
- In-Time System-Wide Safety Assurance
- Assured Autonomy for Aviation Transformation

U.S. leadership for a new era of flight

Research Programs align with Strategic Thrusts

MISSION PROGRAMS

Airspace Operations & Safety

AOSP

Safe, Efficient Growth in Global Operations

Real-Time System-Wide Safety Assurance

Advanced Air Vehicles

AAVP

Ultra-Efficient Commercial Vehicles

Innovation in Commercial Supersonic Aircraft

Transition to Alternative Propulsion and Energy

Integrated Aviation Systems

IASP

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

X-planes/ test environment

SEEDLING PROGRAM

Transformative Aeronautical Concepts

TACP

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

Critical cross-cutting tool development

Assured Autonomy for Aviation Transformation

FY 2019 Budget Request - Aeronautics

$ Millions	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Aeronautics	**$656.0**	**$655.5**	**$633.9**	**$608.9**	**$608.9**	**$608.9**	**$608.9**
Airspace Operations and Safety	140.6		90.8	96.2	120.4	122.7	122.9
Advanced Air Vehicles	274.6		230.6	248.5	257.1	257.8	258.3
Integrated Aviation Systems	125.0		189.2	154.1	106.6	103.3	102.5
Transformative Aeronautics Concepts	115.8		123.3	110.1	124.9	125.1	125.1

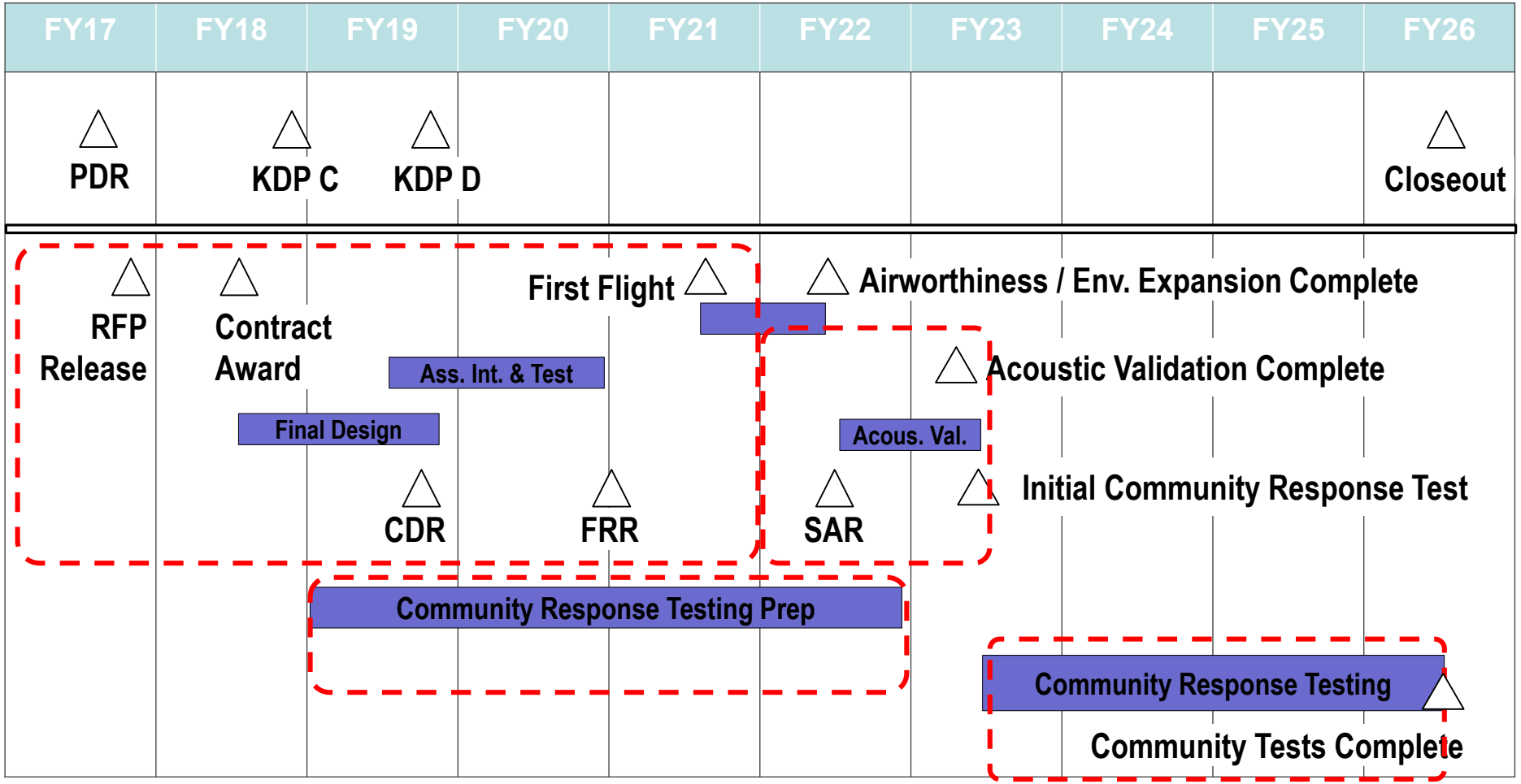
FY 2017 reflects funding amounts specified in Public Law 115-31, Consolidated Appropriations Act, 2017. Table does not reflect emergency supplemental funds also appropriated in FY 2017, totaling $184 million.

FY 2018 reflects Continuing Resolution funding as enacted under Public Law 115-56, as amended.

Low Boom Flight Demonstrator (LBFD) Update

- Completed Preliminary Design Review
- Project team established and formulation activities on track
- Award Design and Build Contract early 3rd Quarter FY 2018
- First Flight planned for FY 2021

LBFD Project Life Cycle

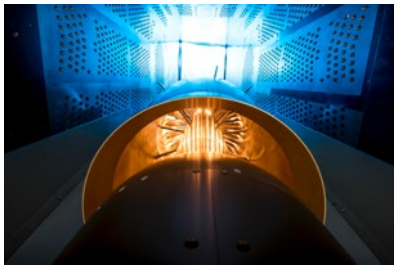


Major Reviews

PDR, Preliminary Design Review
CDR, Critical Design Review
FRR, Flight Readiness Review
SAR, System Acceptance Review

Enabling U.S. Leadership in Subsonic Transport Markets

- Suite of 5 Key Technologies coupled into Transformative Configurations will Win the Subsonic Transport Future
  - Light Weight, Very High Aspect Ratio Wings
  - Propulsion – Airframe Integration, Especially Boundary Layer Ingestion
  - Tailored Non-Circular Fuselage
  - Hybrid Electric Propulsion
  - Small Core Turbine Engines
- ARMD is advancing these key technologies to create market opportunities



Boundary Layer Ingestion

Very High Aspect Ratio Wing

Hybrid Electric Propulsion

Subsonic Transport Technology Strategy

Ensuring U.S. technological leadership

Prove out transformational propulsion technologies

Prove out transformational airframe technologies

Energy usage reduced by more than **60%**

Harmful emissions reduced by more than **90%**

Objectionable noise reduced by more than **65%**

Current Generation

Next Generation -Transitional-

Future Generations -Transformational-

Image Credit: Denis Fedorko

Image Credit: pjs2005 from Hampshire, UK

Image Credit: Weimeng

Image Credit: Don-vip

Create technology pathway for U.S. competitive leadership

2040

2030

2020

Emerging Aviation Markets

Global Race to Achieve Leadership

Urban Air Mobility Example

Ehang - China

E-Volo - Germany

Joby - US

And many other U.S. and international competitors have the same vision and are capable of innovative vehicle design, development and flight demonstration

The race to capture the market will be won based on…

- Ability to safety certify innovative aviation technologies and configurations
- Achieving equitable community noise standards
- Enabling safe airspace access at high densities
- Achieving safe vertiport infrastructure standards

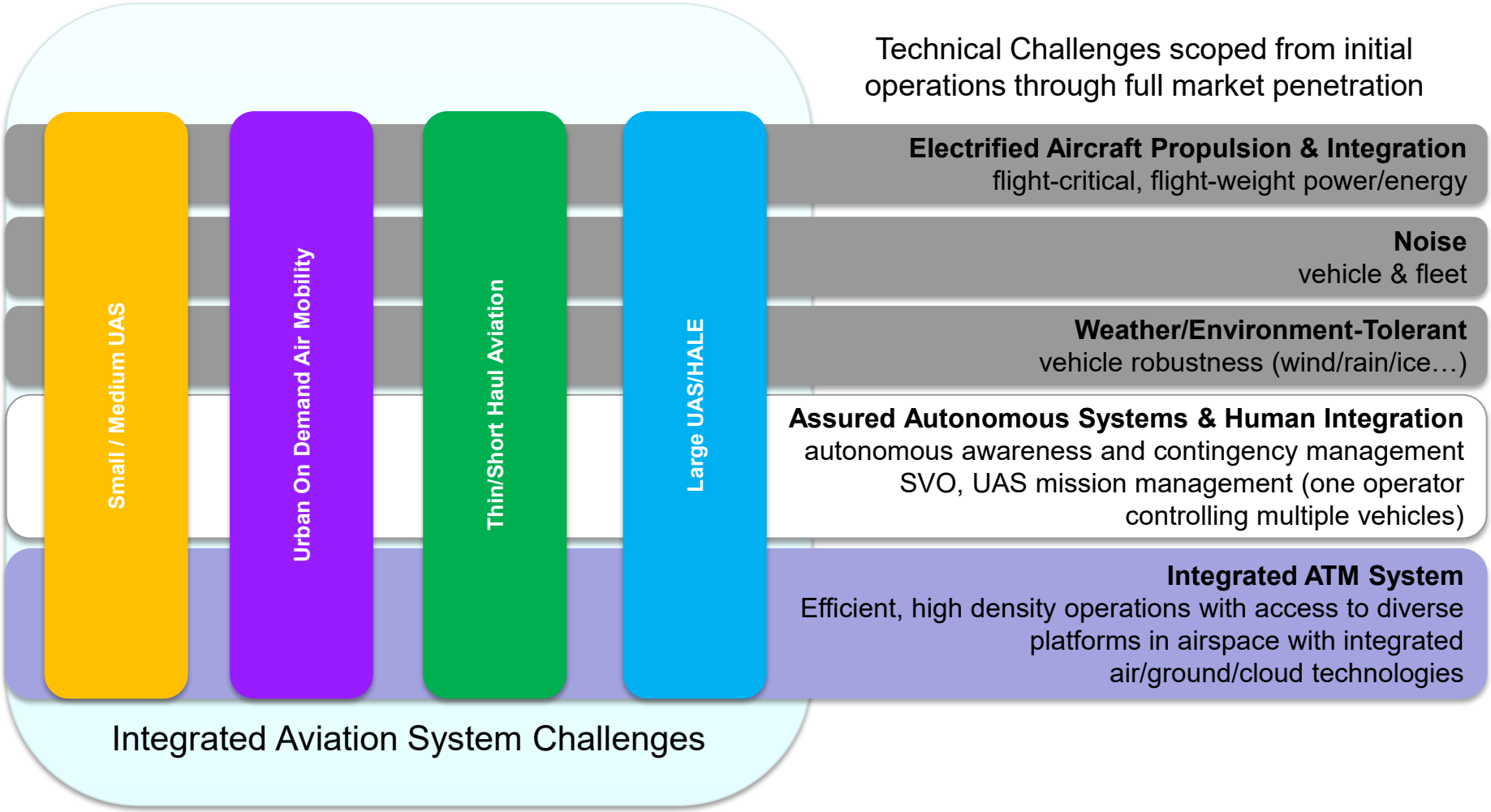
But most demonstrations and early market growth are overseas – all four key issues easier to manage in many other countries. The U.S. must lead or fall behind.

NASA is adjusting its portfolio to address the issues, support FAA and industry to accelerate U.S. competitive posture, and do it through a technically sound, sustainable and scalable approach

Emerging Markets - Integrated Challenges

NASA ARMD Programs pivoting to address complex challenges

ARMD has developed a holistic understanding of the challenges for enabling the enormous potential of emerging aviation global market opportunities



Laying the Ground Work for Aviation in 2040

- The global aviation system of 2040 is emerging today – new companies and new systems built on advanced technologies pioneered by NASA based on steady U.S. investment
- Based on what is emerging today, what can we see for 2040:
  - An Urban Air Mobility system that is all electric, autonomous and environmentally friendly moving billions of commuters and packages across the world's megacities. As a result, ground-based traffic congestion will be reduced, local air quality will be improved, and urban areas will be transformed
  - Transformative subsonic airliners developed by U.S. industry will approach near-optimal levels of efficiency, reducing cost and environmental impact, and will continue to enable more people to travel around the world supporting a vibrant and growing U.S. and global economy
  - A growing segment of increasingly affordable and environmentally friendly supersonic air travel. This will once again shrink our world and project U.S. technological leadership.
  - All of this will ride upon a transformed airspace system that provides the access and efficiency to enable this broad range of business models and provides proactive and prognostic "in-time" safety assurance, providing all citizens confidence that every flight is safe and secure.