National Aeronautics and Space Administration

NAC Aeronautics Committee Report

Dr. John-Paul Clarke
Chair, NAC Aero Committee
NASA Headquarters
January 18, 2023

Aeronautics Committee Membership

Dr. John-Paul Clarke, Chair
University of Texas at Austin

Mr. Peter Bunce
General Aviation Manufacturers Association

Mr. Michael Dumais
Raytheon Technologies (Retired)

Mr. Jay Dryer
Office of the Secretary of Defense

Ms. Lisa Ellman
Commercial Drone Alliance

Dr. Naveed Hussain
Boeing Research and Technology

Dr. Nicole Key
Purdue University

Mr. Natesh Manikoth
Federal Aviation Administration

Ms. Susan Pfingstler
United Airlines

Dr. Helen Reed
Texas A&M University

Dr. Hassan Shahidi
Flight Safety Foundation

Mr. David Silver
Aerospace Industries Association

Aeronautics 101

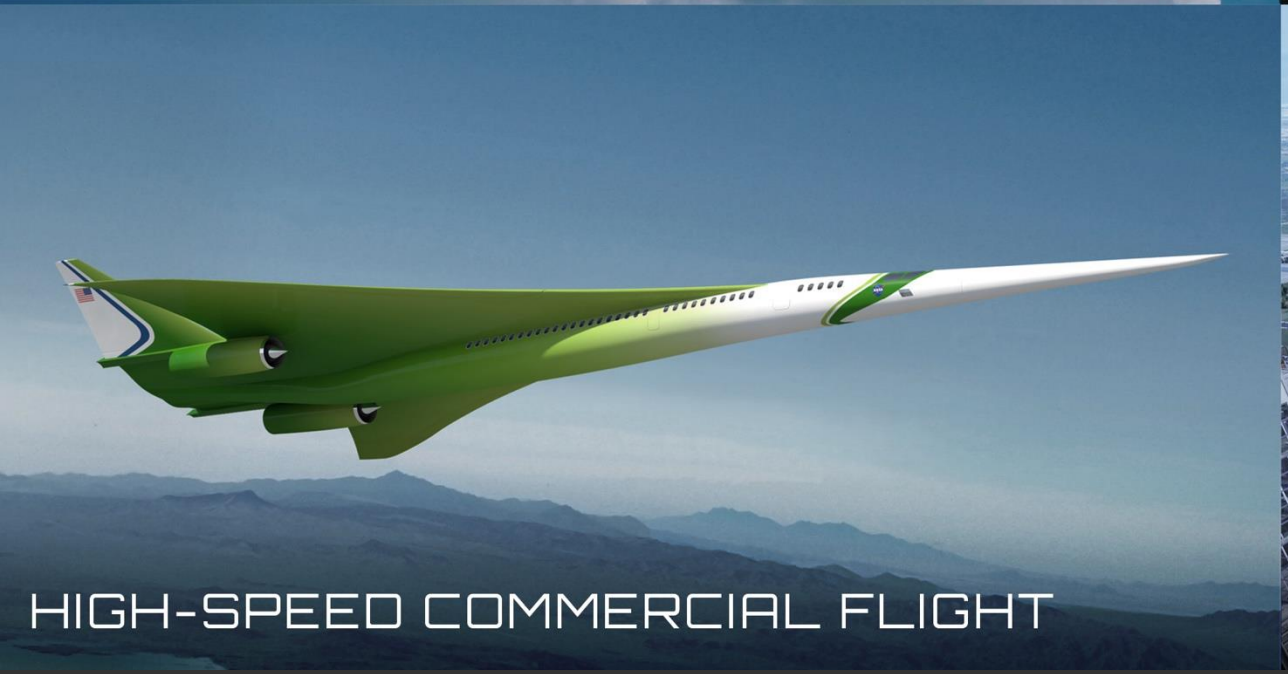
NASA Aeronautics – Vision for Aviation in the 21st Century

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

6 Strategic Thrusts

- Safe, Efficient Growth in Global Operations
- Safe, Quiet, and Affordable Vertical Lift Air Vehicles
- Innovation in Commercial Supersonic Aircraft
- In-Time System-Wide Safety Assurance
- Ultra-Efficient Subsonic Transports
- Assured Autonomy for Aviation Transformation

U.S. leadership for a new era of flight



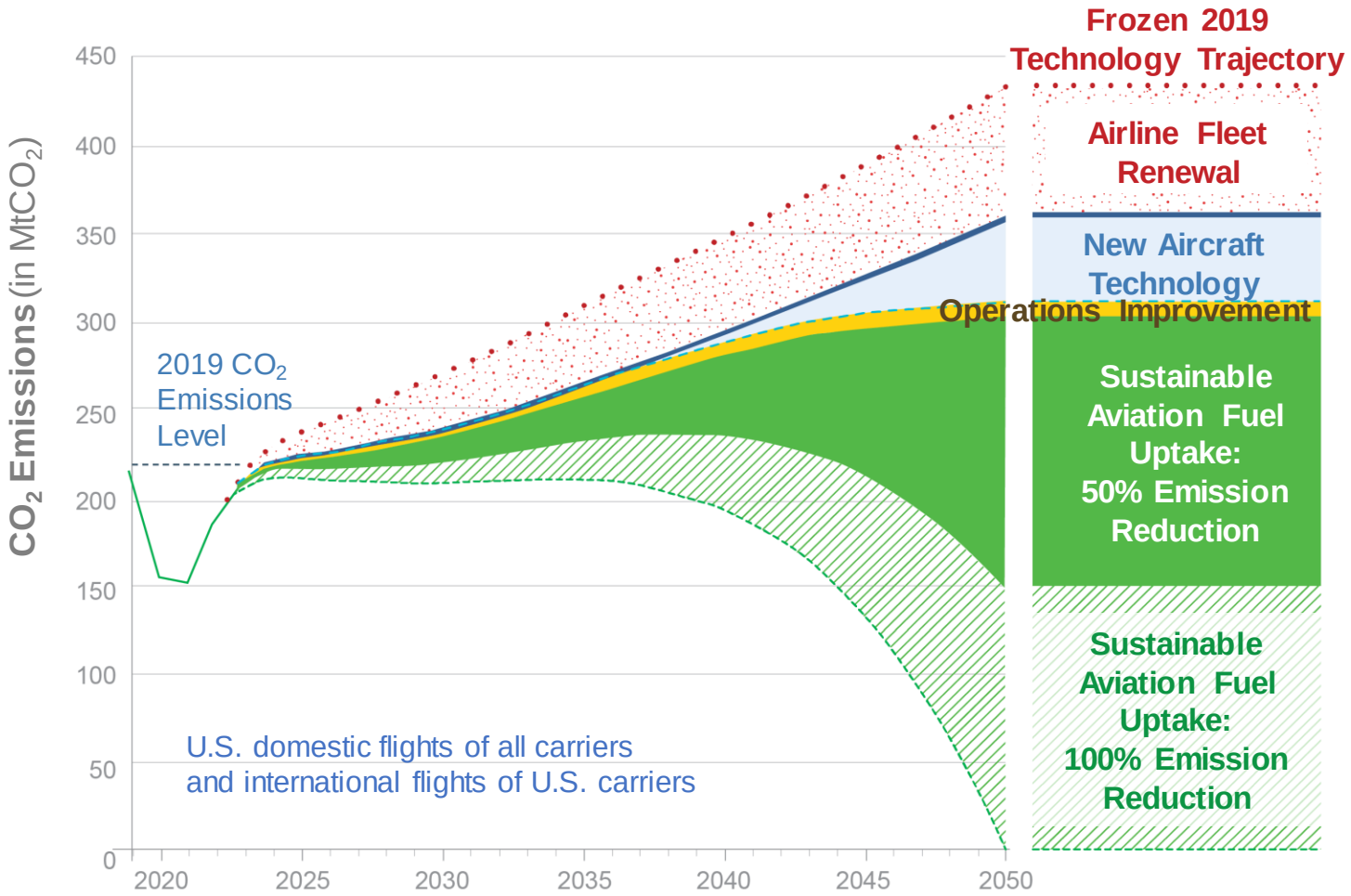
Four Transformations for Sustainability, Greater Mobility, and Economic Growth

U.S. Aviation Climate Action Plan

Global Context for Sustainable Aviation

U.S. aviation goal is to achieve
net-zero greenhouse gas emissions by 2050.

U.S. Aviation Climate Action Plan is aligned with
- U.S. economy-wide goal
- International Civil Aviation Organization
- Air Transport Action Group



The U.S. is working with the global community to achieve net-zero greenhouse gas emissions by 2050 using a common basket of measures.

Sustainable Flight National Partnership

Next-Generation Capability on the Path to Net-Zero Greenhouse Gas Emissions by 2050

Advance engine efficiency and emission reduction

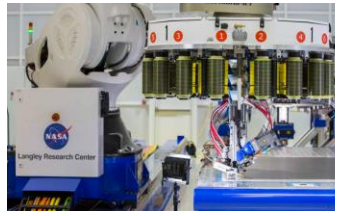
Enable integrated trajectory optimization

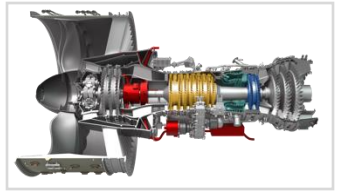
Advance airframe efficiency and manufacturing rate

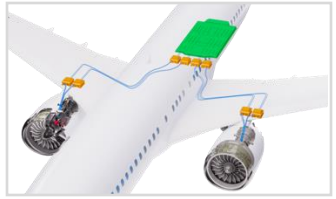
Enable use of 100% sustainable aviation fuels

Accelerate toward net-zero greenhouse emissions by 2050 through 25-30% energy efficiency improvements in next-generation transports, 100% sustainable aviation fuel, and optimal trajectories.

Subsonic Transports: Integrated Technology Development







FY20 | FY21 | FY22 | FY23 | FY24 | FY25 | FY26 | FY27 | FY28 | FY29

Technology Readiness Target

"Digital Flight Test"

Model Based Systems Analysis & Engineering

Sustainable Flight Demonstrator (SFD)

Flight Test

Transonic Truss Braced Wing (AATT)

TC Completion

Hi-Rate Composite Aircraft Manufacturing (HiCAM)

Mfg & Structural Demonstration

Hybrid Thermally Efficient Core (HyTEC)

Core Demonstration

Electrified Powertrain Flight Demonstration (EPFD)

Flight Tests

Electrified Aircraft Propulsion Technologies (AATT)

TC Completion

Achieve TRL 6 in time for industry product decision-making

Planned

Notional

High-Speed Commercial Flight

Sustainable transformation of the speed of air travel

Addressing the unique barriers to sustainable, environmentally responsible high-speed flight

The Quesst Mission generates key data to support development of en route certification standards based on acceptable sound levels

Advanced Air Mobility Mission

Safe, sustainable, affordable, and accessible aviation for transformational local and intraregional missions

NASA's X-57 is Pathfinder for Electric Propulsion

First flight is early 2023

Ground and flight validation of electric motors, battery, and instrumentation

INDUSTRY

ACADEMIA

Enable new configurations

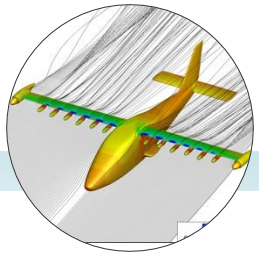
Share technical insights and lessons learned

LEAPTech experiment

Wind-tunnel validation

Motor nacelle design & testing

Structural testing

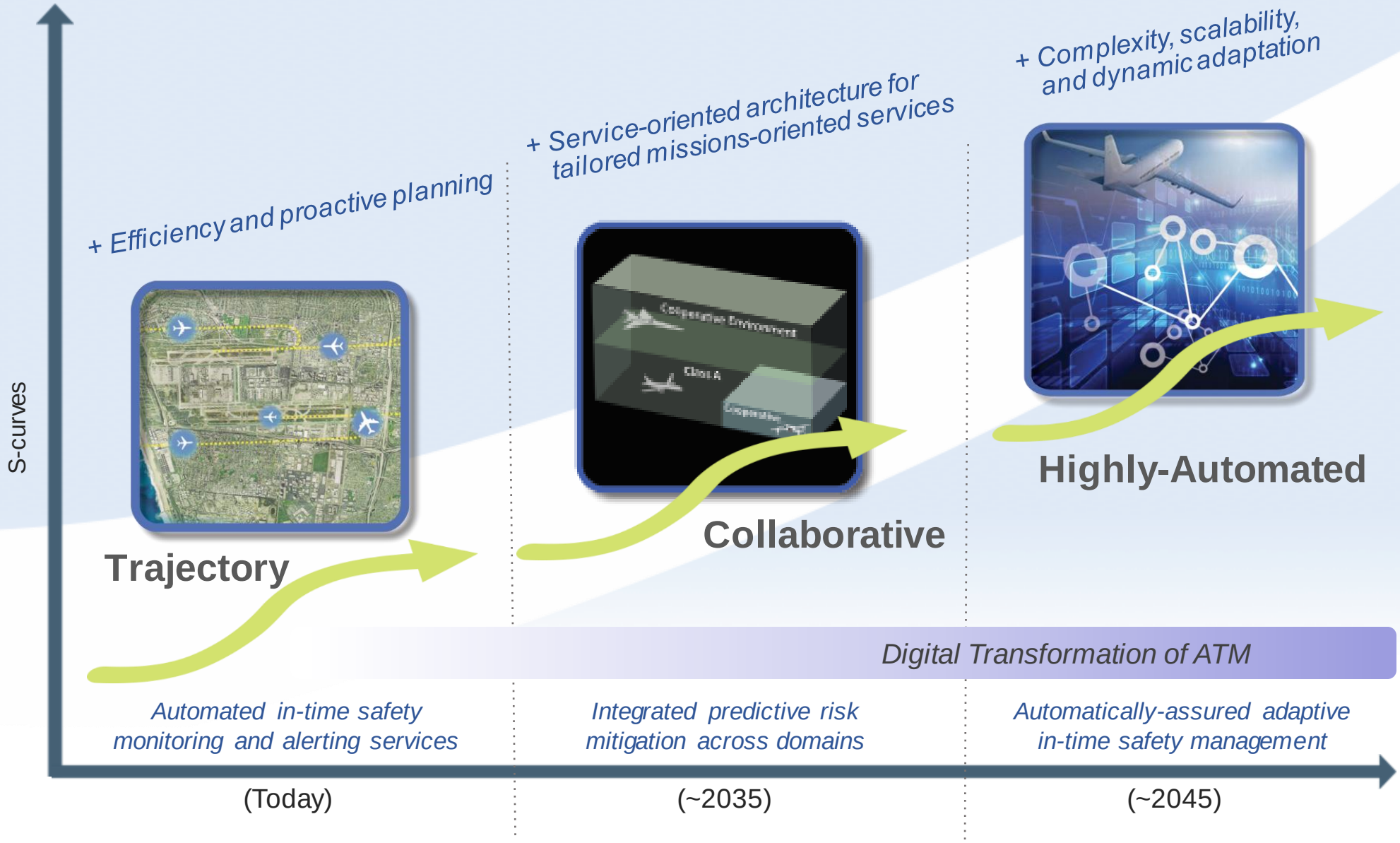


Computational simulations

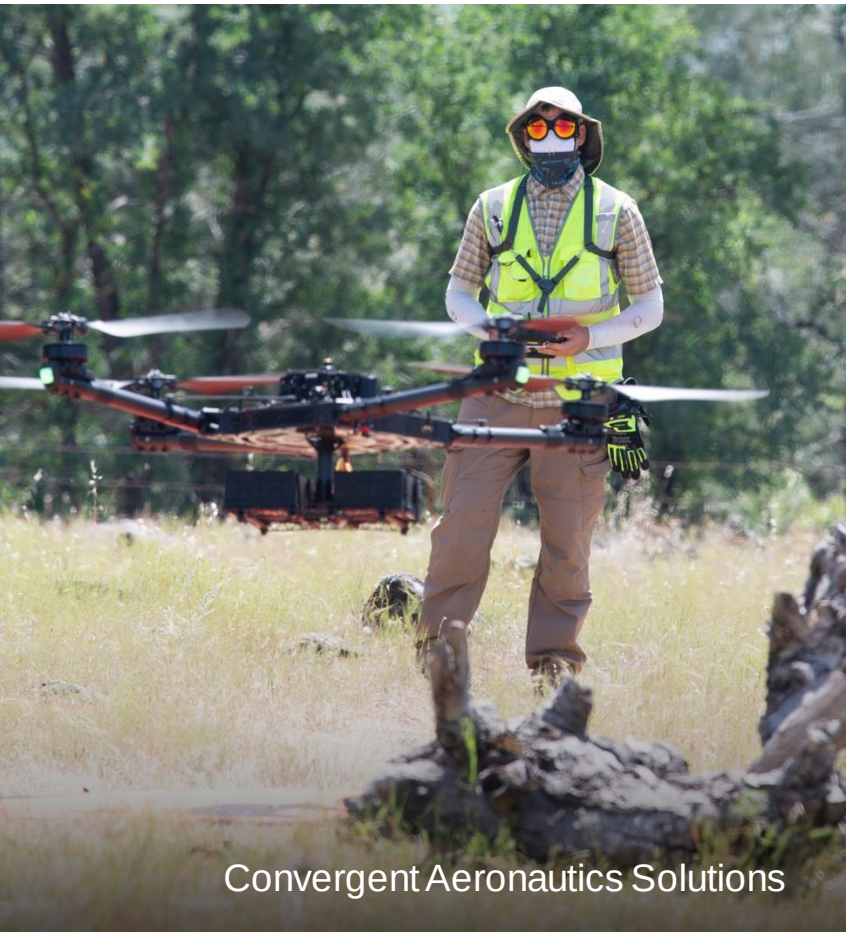
Operational checkouts

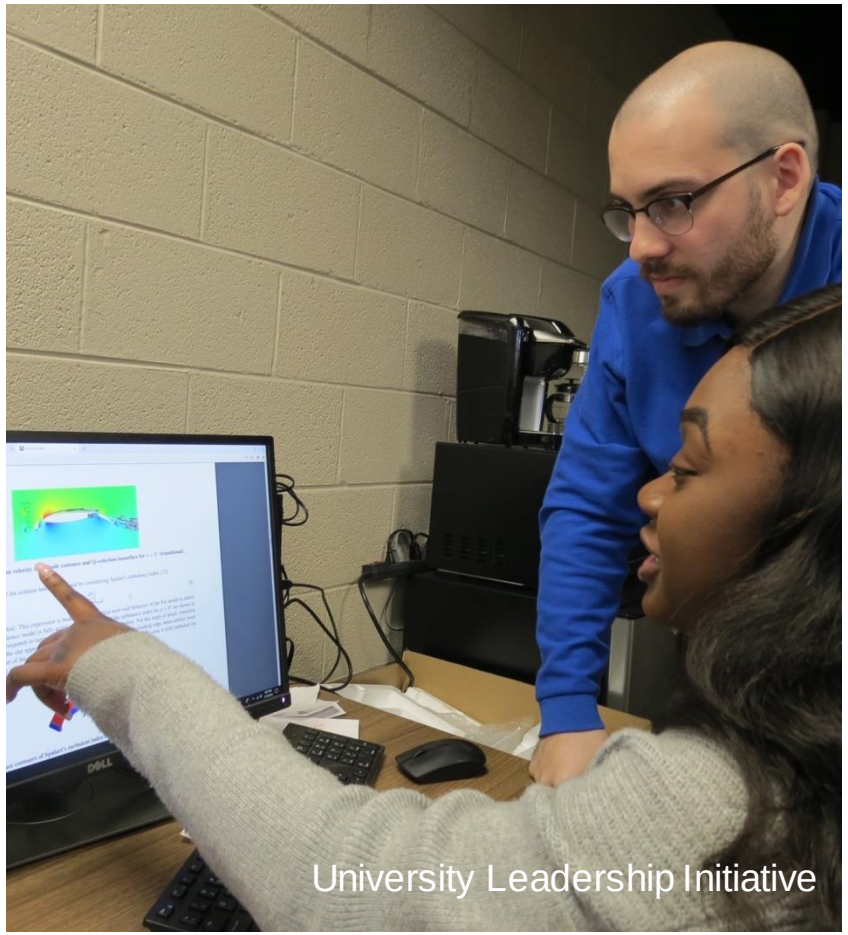
Inform Small Electric Aircraft Propulsion Standards and Certification

Evolution of Airspace Operations and Safety



ARMD's Agile Innovation Ecosystem





NASA Leadership for the Aviation Community –
Exploration, Invention, and Innovation

University Leadership Initiative (ULI) Engaging the University Community

5 rounds of solicitations
$157M of awards

Seeking and awarding proposals addressing all strategic thrusts and special topics

- 23 awards with 64 universities
- 7 HBCUs and 10 other MSIs
- 406 proposals submitted
- 280 different proposing Principal Investigators
- 3189 team members
- 20–50 students per team

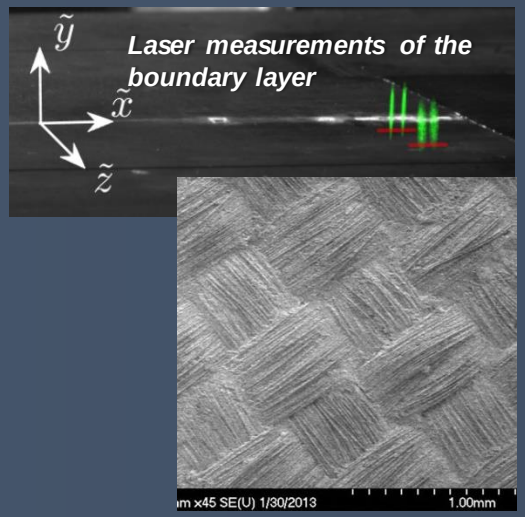
In ULI, the universities take the lead, build their own teams, and set their own research path.

Wildfire Detection/Mitigation Concept of Operations

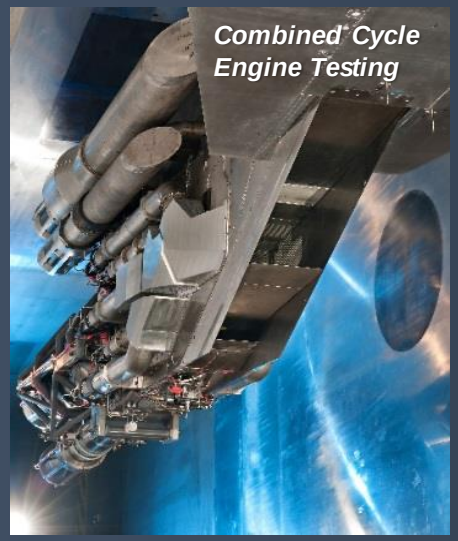
NASA Hypersonic Research

- NASA considering an integrated commercial high-speed strategy to leverage synergy across the portfolio
- Advance fundamental research and maintain strong partnership with DoD to support national security priorities, leverage DOD technology/flight demonstrations
- Understanding and solving significant technical challenges to enable commercial opportunities

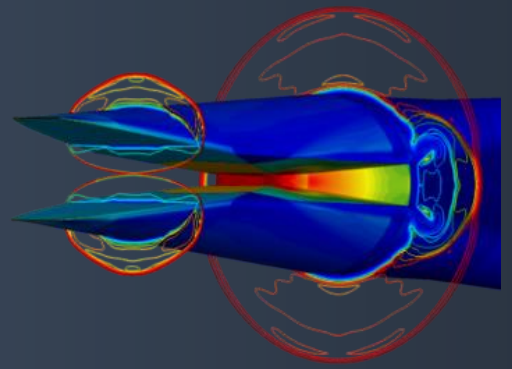
FOCUS AREAS



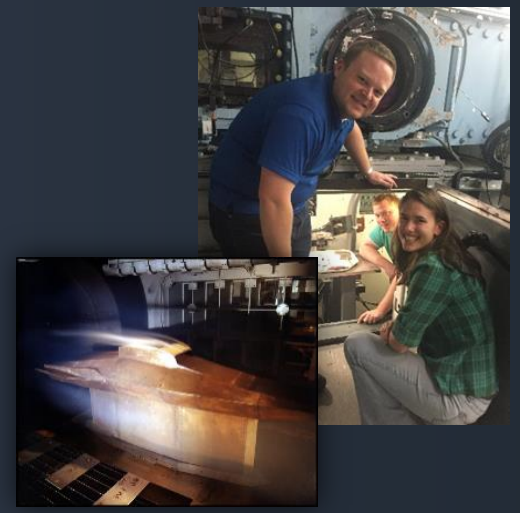
Fundamental Research
Flow Physics & High Temp Materials



Re-usable Hypersonic Propulsion



Design Tools & Uncertainty Quantification



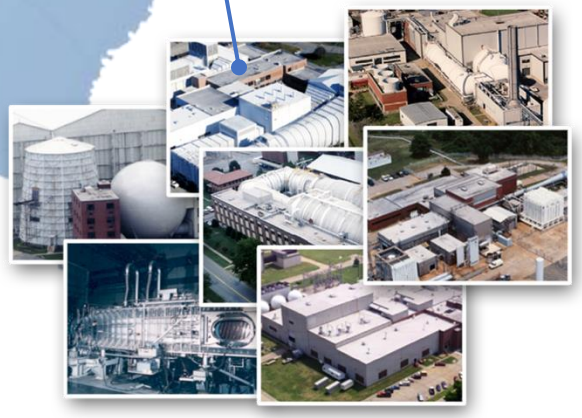
Facility Capabilities and Workforce Development

Aerosciences Evaluation and Test Capabilities (AETC) Portfolio

NASA Ames Research Center (ARC)
Moffett Field, CA

NASA Glenn Research Center (GRC)
Cleveland, OH

NASA Langley Research Center (LaRC)
Hampton, VA



Portfolio Objectives

- **Strategically manage**, operate, sustain, and improve a critical portion of aerosciences ground test capabilities in support of Agency testing requirements, DOD collaboration
- Ensure the strategic **availability and ease of access** of a **minimum critical suite of aerosciences ground test assets** that are necessary to meet the long-term needs of the nation.

Portfolio Scope

- Aerosciences ground test facilities deemed critical to Agency
- Investments in operations, maintenance, new capability and test technology, data systems and security, and CFD-experimental integration investments

Aeronautics Committee Report

Aeronautics Committee Meetings in 2022

- The Committee met three times in 2022: April (hybrid); August (ARC); November (virtually)
- Topics Discussed at the November 30th Virtual Meeting
  - Aeronautics Associate Administrator Update
  - Aerosciences Evaluation and Test Capabilities (AETC) Strategic Plan
  - Quesst (Low Boom Flight Demonstrator) Mission Status
  - X-57 Progress and Outlook
  - Hypersonics Portfolio and Activities

ARMD Associate Administrator Update

- The AA provided updates on NASA Aeronautics and its activities as highlighted below:
  - Forthcoming budgets
  - Collaboration with the FAA
  - Programs, projects, and research objectives including:
    - Sustainable Flight Demonstrator
    - Electrified Powertrain Flight Demonstrator
    - Wildfire management initiatives
    - Advanced Air Mobility (AAM) and progress made in enabling its fruition
  - Discussion developed around:
    - NASA's support to the FAA on certification
    - Concern that the UAS industry may not survive long enough to wait until the FAA's latest advanced aviation deadline of 2028.
    - NASA's capabilities to create technological tools and processes that could stand to ease the process.
  - The Committee suggested that NASA examine the entire certification process across the board and identify the individual steps in the process that, if changed, would have the greatest impact in reducing cost or time.

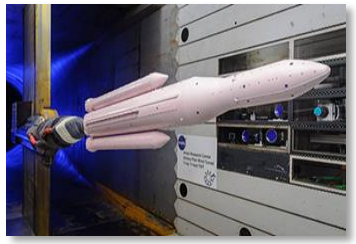
Committee Finding – Associate Administrator (AA) Update

- The Committee finds that there is a need for NASA, in partnership with the FAA, to determine how their capabilities, technologies, processes, and tests could have greater (individual and collective) impact in terms of reducing the cost and time for certification and enhancing the introduction of new vehicles into the NAS.

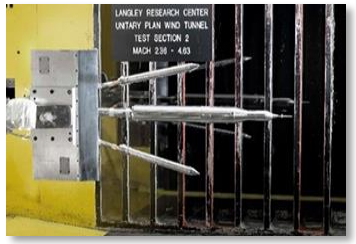
AETC Portfolio

LaRC 14'x22' Subsonic Tunnel
Subsonic, Alternate Uses

LaRC National Transonic Facility
High Reynolds Number Flow



ARC Unitary Plan Wind Tunnels
11'x11' Transonic Wind Tunnel
9'x7' Supersonic Wind Tunnel



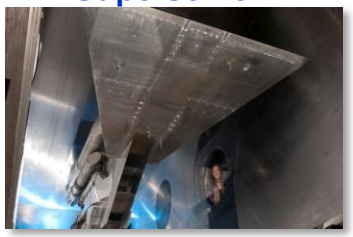
LaRC Unitary Plan Wind Tunnel
Supersonic Speed Range

LaRC Aerothermodynamics Laboratory
Exploration Workhorse

Subsonic | **Transonic** | **Supersonic** | **Hypersonic**

GRC 9'x15' Low Speed Wind Tunnel
Low-speed Propulsion Acoustic
GRC 8'x6' Supersonic Wind Tunnel
Transonic-Propulsion

LaRC Transonic Dynamics Tunnel
Aeroelasticity & Flutter



GRC 10'x10' Supersonic Wind Tunnel
Large-scale Supersonics & Propulsion

LaRC 8' High Temperature Tunnel
Large-scale Hypersonics & Propulsion

Specialty Tunnels

GRC Icing Research Tunnel
Aircraft Icing Condition Simulation

GRC Propulsion Systems Laboratory
Engine (and Icing) Simulation at Altitude

LaRC 20' Vertical Spin Tunnel
Spin Characteristics & Dynamic Stability

AETC Investment Areas

Operations

Fund labor and equipment costs to keep facilities available to NASA researchers and projects. External test revenue offsets operations costs, freeing funds for strategic reinvestment.

Maintenance

Sustain key facilities to ensure current and future operations while minimizing risk to customer testing.

Capability Improvement

Create new capabilities needed by NASA in specific facilities (e.g., tunnel and model controls, new test environments and facility systems, improved measurement and operations, etc.).

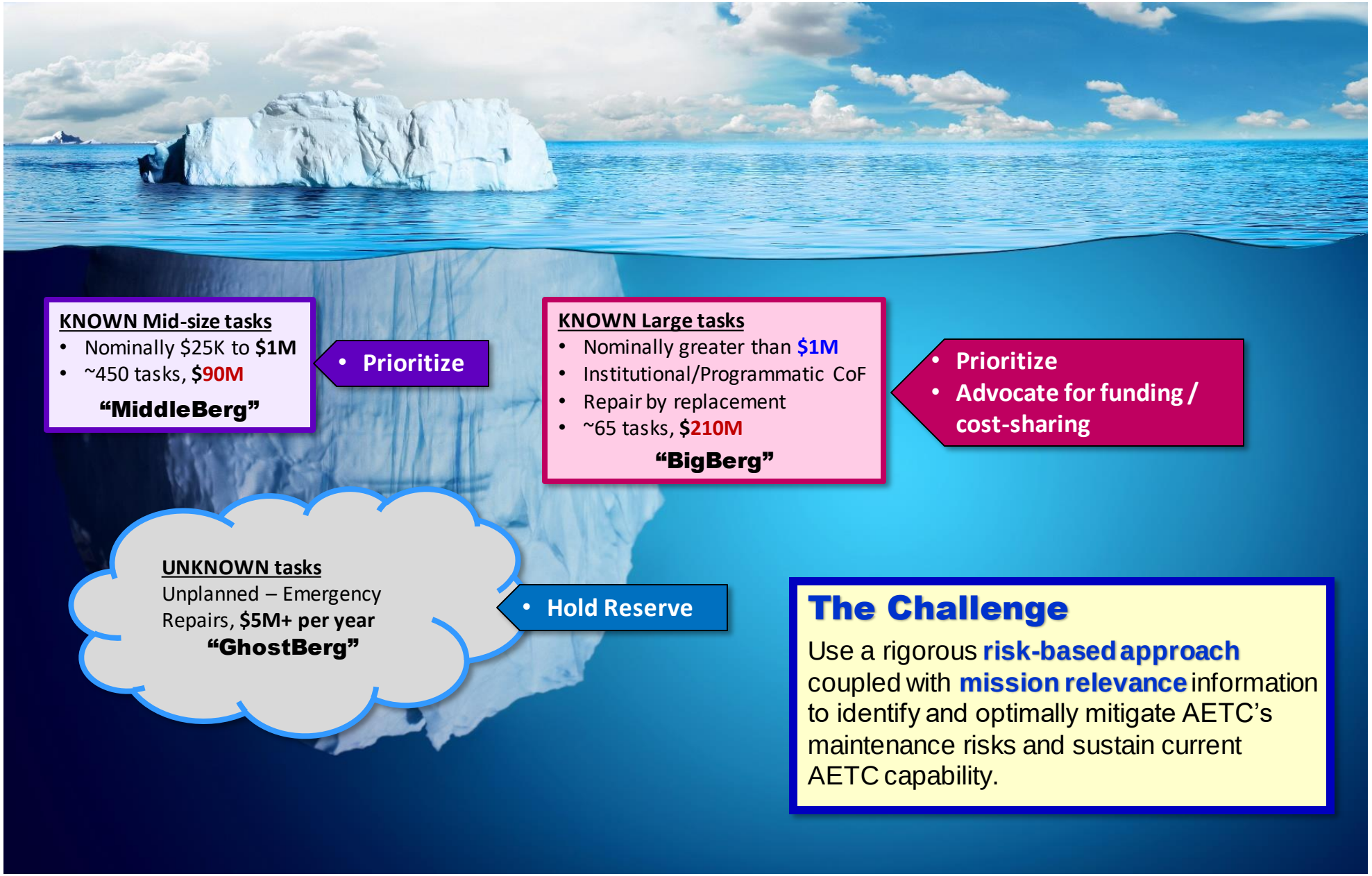
Data Systems and Security

Improve data systems and large instrumentation systems (measuring temperature, pressures, flow, time code) and address IT and Operational Technology security concerns.

CFD and Test Integration

Evaluate accuracy and cost of CFD compared to wind tunnel testing for past, present, and future problems of interest.

Deferred Maintenance Iceberg



FY22 Key Maintenance Activities

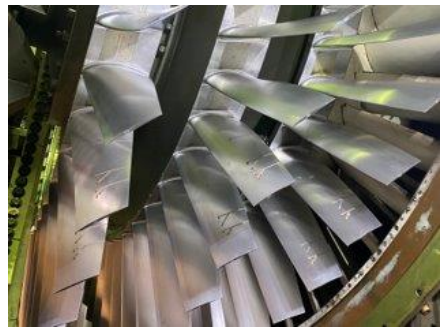
Corrosion Control of 10 x 10 Supersonic Wind Tunnel

Electrical Transformer Replacement for Central Air Equipment Building

Motor Control Center Replacement for 8 Foot HTT

PSL Spray Receiver Tank Replacement

FY22 Investments Have Maintained Current Level of Overall Risk-to-Test



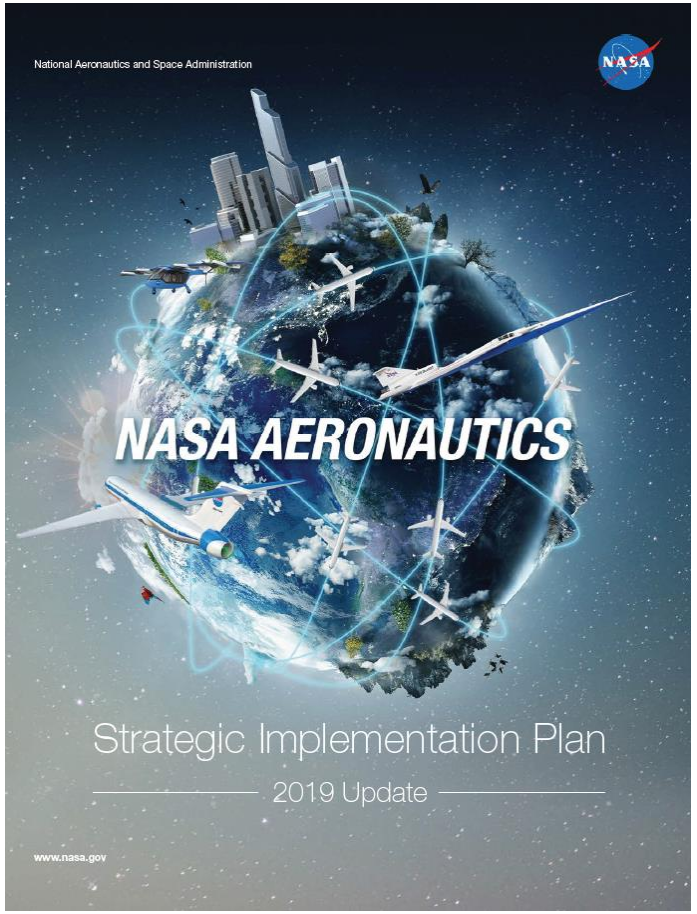
Ames UPWT 11-Foot Blade Replacement

PSL Thrust Stand Refurbishment

Ames UPWT Variable Drive Control

LaRC National Transonic Facility Nearside Plenum Door Repair

NEW - AETC Portfolio Strategic Plan



- Strategic direction for **evolution of the Portfolio**
- Defines the approach to evolving the set of capability components to better **support current and future customers** and requirements
- Informs the development and **prioritization** of change to be implemented
- 10-year out plan
- Executable in existing budget
- Aligned with 2019 ARMD Strategic Implementation Plan and 2022 NASA Strategic Plan

Committee Finding – Aerosciences Evaluation and Test Capabilities (AETC) Portfolio

- The Committee finds that the current approach that NASA is taking to managing their Aerosciences Evaluation and Test Capabilities (AETC) Portfolio is excellent and commends the management team for its strategic planning initiative and innovation. However, there is a need to better quantify the (monetary and opportunity) costs of addressing deferred maintenance items and explore alternative ways such as public private partnerships of funding these activities. NASA also needs to quantify and take a proactive action with respect to inflation and supply chain issues.

NASA's Flagship Aeronautics Mission has a new brand

- Mission name is now Quesst *(no longer Low-Boom Flight Demonstration)*
- Aircraft is now referred to as the X-59

Image credit: NASA

Quesst Mission Overview and the X-59 Aircraft

Use the X-59 Research Aircraft to gather data on community response to quiet supersonic flight

Phase 1: Research Aircraft Development
Design, fabrication, ground test, and envelope expansion

Phase 2: Acoustic Validation
Detailed ground and flight measurement to prove design

Phase 3: Community Response Testing

- Overflights, sound measurement, surveys

Key requirements drive X-59 design

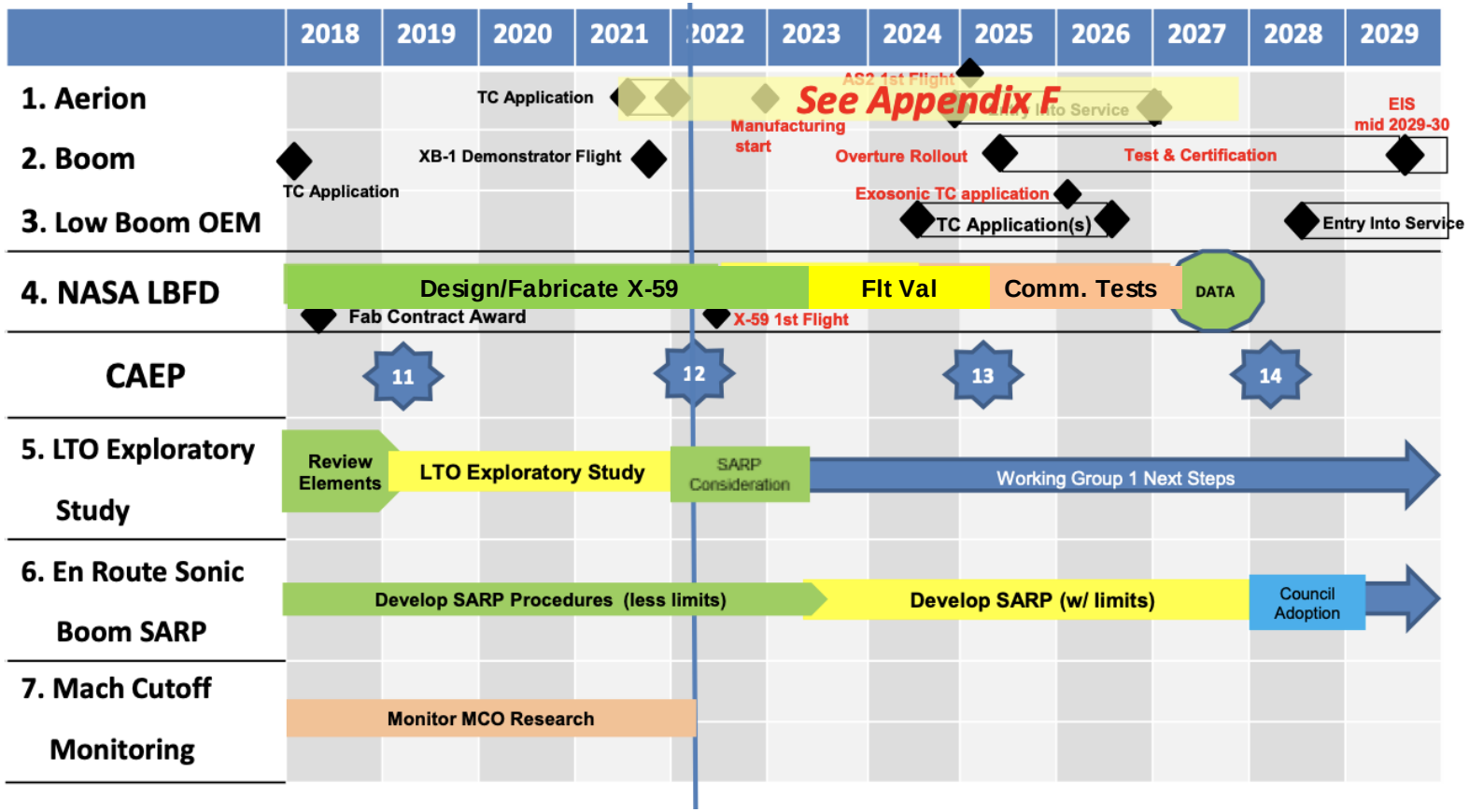
- The acoustic signal of the X-plane must effectively replicate that of future larger supersonic commercial aircraft.
- The X-plane must conduct community overflight tests using normal commercial aircraft flight maneuvers.

Image credit: Lockheed Martin

ICAO Update: Impact to the CAEP Timeline

- Overall, COVID impact on CAEP activities was small
  - Virtual environment effective, focusing effort on completing discussions
- ”Exploratory study” of global LTO noise and emissions impact of supersonic aircraft completed in CAEP 12
- Supersonic en route noise standard development made progress in CAEP 12
- For CAEP 13, focus in on completing an LTO standard for supersonic aircraft
- Main focus of CAEP 13 work is a joint noise-emissions stringency update for subsonic aircraft
- En route standard preparation is continuing with good support from CAEP
- NASA is keeping FAA and CAEP up to date on Quesst progress and timeline status

Impact of Quesst mission timeline changes



Quesst Summary

- The Quest mission is focused on overcoming the technical and regulatory barriers to quiet supersonic flight over land
  - Critical Commitment to deliver data to ICAO on community response to quiet overflight sounds
- The development of a new supersonic X-plane is the core of the mission
  - Fantastic Team effort on accomplishments to date
  - X-59 aircraft is undergoing powered system check out and will fly in 2023
- Preparation for acoustic validation and community overflight tests is also progressing
- Many elements of the mission have experienced delays, but X-59 completion is still the critical path element
- Near term focus is on completing an X-59 aircraft that is safe to fly in the National Airspace System and meets the mission performance goals
- Meeting the NASA Critical Commitment CAEP 14 goal is still possible, but challenging
- NASA, FAA and CAEP are still fundamentally aligned on the goal of developing a noise standard for supersonic overland flight

Committee Finding – Quesst (Low Boom Flight Demonstrator)

- The Committee finds the goals of the Quesst (Low Boom Flight Demonstrator) Mission to be both appropriate and comprehensive, but it is concerned that further delays in the X-59 program might negatively impact the utility of the Mission to inform regulatory changes. The Committee also finds that the program could explore using SAFs in the flight test program.

SCEPTOR/X-57 Build Up Approach

SCEPTOR → **X-57**

TACP/CAS (2014-2016) | **IASP/FDC (2016-present)**

Mod I

Ground Validation of DEP

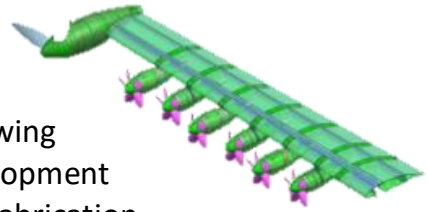
Flight test baseline Tecnam P2006T

Mod II

Ground and flight test validation of electric motors, battery, and instrumentation

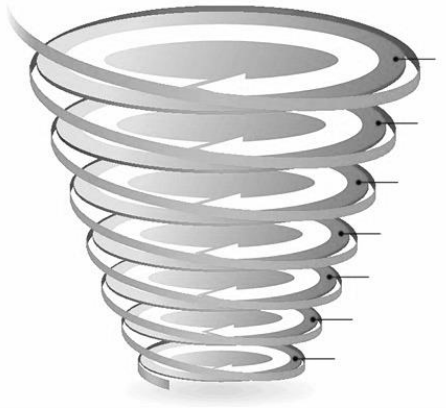
Mod II flights in FY23

Mod III



DEP wing development and fabrication

Flight test electric motors relocated to wingtips on DEP wing including nacelles (but no DEP motors or folding props)



Mod IV

Flight test with integrated DEP motors and folding props (cruise motors remain on wing-tips)

Mod I

Mod II

Mod III

Mod IV

Motivation for X-57

Modification II (Retiring Electric Propulsion Barriers)

- Advance the Technology Readiness Level for aircraft electric propulsion.
  Aerospace has weight, safety, and flight environment challenges which complicate adaptation of COTS technologies
- Pathfinder for aircraft electric traction system standards.
  Lessons learned used to inform FARs and standards
- Reduce electrified system development risk for Mod III and IV through early testing on a proven vehicle configuration
- Develop capability within NASA to design, analyze, test, and fly electric aircraft

Modification III/IV (Leveraging Distributed Electric Propulsion)

- Mature Distributed Electric Propulsion system architectures
- Demonstrate high-aspect ratio experimental wing design, fabrication, and integration
- Explore novel, optimized configuration and anticipated aircraft performance improvement enabled by DEP
  - Cruise-optimized wing enabled by blown high-lift system

X-57 Maxwell: Final Goals and Objectives

Tech Challenge	IASP 22: Demonstrate the performance of a complex, integrated Electric Propulsion system through manned flight test and collaborate with standards and certification agencies to develop a certification basis for electric aircraft. 
Goals	Share NASA X-57 design & airworthiness process with regulators and standards organizations
	Establish a reference platform for integrated approaches of distributed electric propulsion technologies
Objectives	Develop electric aircraft propulsion airworthiness standards with industry
	Participate with regulators in standards development for electric aircraft
	Share X-57 design & lessons learned with industry and academic stakeholders

X-57 Maxwell Relevance

First flight in FY2023

Ground and flight validation of electric motors, battery, and instrumentation

INDUSTRY

ACADEMIA

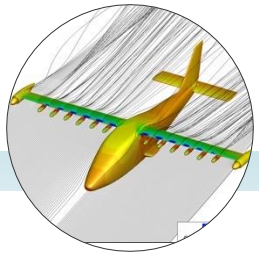
Enable new configurations

LEAPTech experiment

Wind-tunnel validation

Motor nacelle design & testing

Structural testing



Computational simulations

Operational checkouts

Share technical insights and lessons learned

Inform Small Electric Aircraft Propulsion Standards and Path to Certification

X-57 Summary

- X-57 supports ARMD strategic implementation to advance Electrified Aircraft Propulsion
- Addressing challenges of integrating highly electrified systems onto aircraft is a key focus and contribution of X-57
- Small business participation has contributed to U.S. competitiveness and the introduction of commercial products
- Public distribution of lessons learned and design practices enables the broad aeronautics community to benefit for future products
- Mod II flights on track for FY23
- Mod III and Mod IV development winding down by the end of FY23

NASA is making significant contributions to electric aircraft standards development... will continue through the Electrified Powertrain Flight Demonstration project

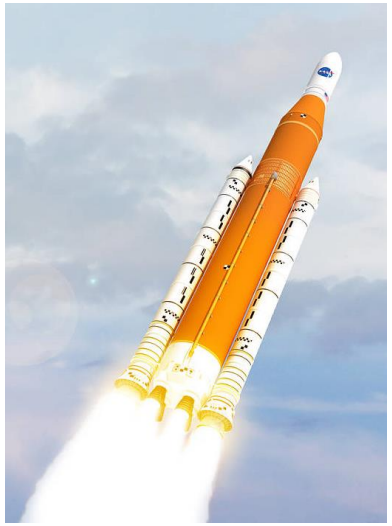
Committee Finding – X-57 Progress and Outlook

- The Committee finds that the X-57 project has adapted well to the changing industry landscape. The Committee also finds that there is a need for continued NASA research to support the FAA with both the certification and operational risk assessment of aircraft with electric or hybrid-electric propulsion.

NASA Hypersonic Applications

HYPERSONICS

- **Blunt Body Re-entry**
- **Launch**
- **Unpowered Atmospheric Flight**
- **Powered Atmospheric Flight**



Multiple NASA applications require mastery of hypersonic flight

HTP Investment Areas in the Common Barriers to Reusable Hypersonic Flight

Conventional & Conformal Cryo-Tank Materials & Structures

Leading Edges, **Hot Structures, Advanced Materials and Manufacturing, High-Temperature Instrumentation & Static Seals**

Vehicle Flow Physics (High Speed Boundary Layer Transition, aerodynamics, aero-heating), drag, trim, etc…

Control Surfaces, Airframe Integrated Acreage TPS Strategies & **Dynamic Seals**

System Analysis methods development/ validation, System Level Uncertainty Quantification Methods, (-ilities, cost)

Propulsion/ Vehicle **Control and advanced sensor technologies**

Innovative High-Speed Inlets, Nozzles & Vehicle Integration Technologies & **Dynamic Seals**

Turbine Thermal Management and Wide Operating Range Technologies

DMRJ Durability, Thermal Management, and **Wide Operating Range Technologies, CMC HEX**

Combined Cycle Mode Transition & Propulsion Integration Technologies

- **RT-1/TC-1: Systems Design & Analysis**
- **RT-2/TC-2: Propulsion Techs**
- **RT-3: Vehicle Techs**
- **RT-4: High Temp, Durable Materials**

NASA-DoD Major Collaborations

Hypersonic Airbreathing Weapon Concept (HAWC)
USAF-DARPA

- SME support including Airframe IPT lead
- System analysis
- Aero and propulsion analysis ground testing

Advanced Full Range Engine (AFRE)
DARPA

- SME support including Propulsion IPT leads
- System studies
- Mode transition design, analysis & testing
- Propulsion testing

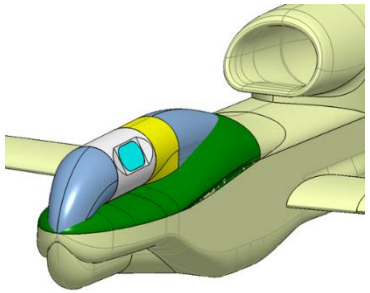
HIFiRE-2C
AFRL

- Joint NASA-AFRL project
- SME support including CE, Co-PI, S&A and ModSim IPT Leads
- Propulsion testing
- CFD

Tactical Boost Glide (TBG)
USAF-DARPA

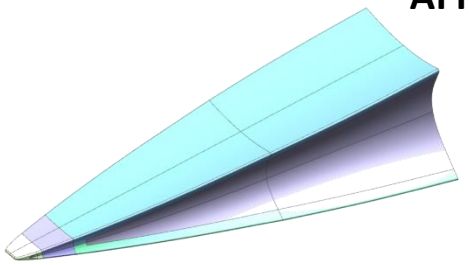
- SME support including Materials IPT lead
- High temp materials analysis, test & database
- Aero/Aerothermal analysis & test

SkyHawk Technology Demonstrations
TRMC



- Imaging Instrumentation
- Development and ground test
- Global Hawk Integration
- Flight testing
- Capability Transition Planning

Boundary Layer Transition (BOLT/BOLT2)
AFRL-AFOSR



- Testing – ground & launch services
- CFD
- Co-Principal Investigator

What Are We Trying To Do?

Enable high-speed commercial flight

To connect people and businesses faster

Why? – Commercial Market Interest

Favorable High-Speed Market Characteristics

	SAIC (with Bryce Space and Technology)	Deloitte (with SpaceWorks and NIA)
Mach	3	2 to 4[(1)]
Range	4,500 nmi	4,000 nmi to 4,500 nmi
Number of routes[(2)]	300	90
Aircraft Size (# PAX)	10 GA or 50 Commercial	20 to 50
Aircraft Cost	$200M to $300M	$131M to $228M[(3)]

References:
- SAIC Final Report: https://ntrs.nasa.gov/citations/20210015471
- Deloitte Final Report: https://ntrs.nasa.gov/citations/20210014711

(1) Analysis showed profitable routes up to M5.25
(2) Deloitte only considers over-water routes
(3) Mach 3 at 4,500 nmi

Hypersonics Summary

NASA hypersonic investments aligned with dual-use/civil applications

Addressing major technical barriers

- System analysis and uncertainty quantification
- Mode transition between a turbine and scramjet
- Fundamental research in aerothermodynamics and materials

Continuing to develop NASA's strategy to support commercial high-speed/hypersonic market

Beginning conceptual vehicle design studies for airbreathing enabled access to space applications

Strongly leveraging partnerships

- NASA leveraging comprehensive DoD ground and flight tests
- NASA facilities and expertise highly valued by government, industry, and academia
- Investing in academic outreach

Working to enable routine, reusable, airbreathing hypersonic flight

Committee Finding – Hypersonics

- The Committee commends NASA's ability to bring its unique capabilities and effectively coordinate with DoD to support important hypersonic initiatives.

Backup

Aeronautics FY 2023 Budget Request

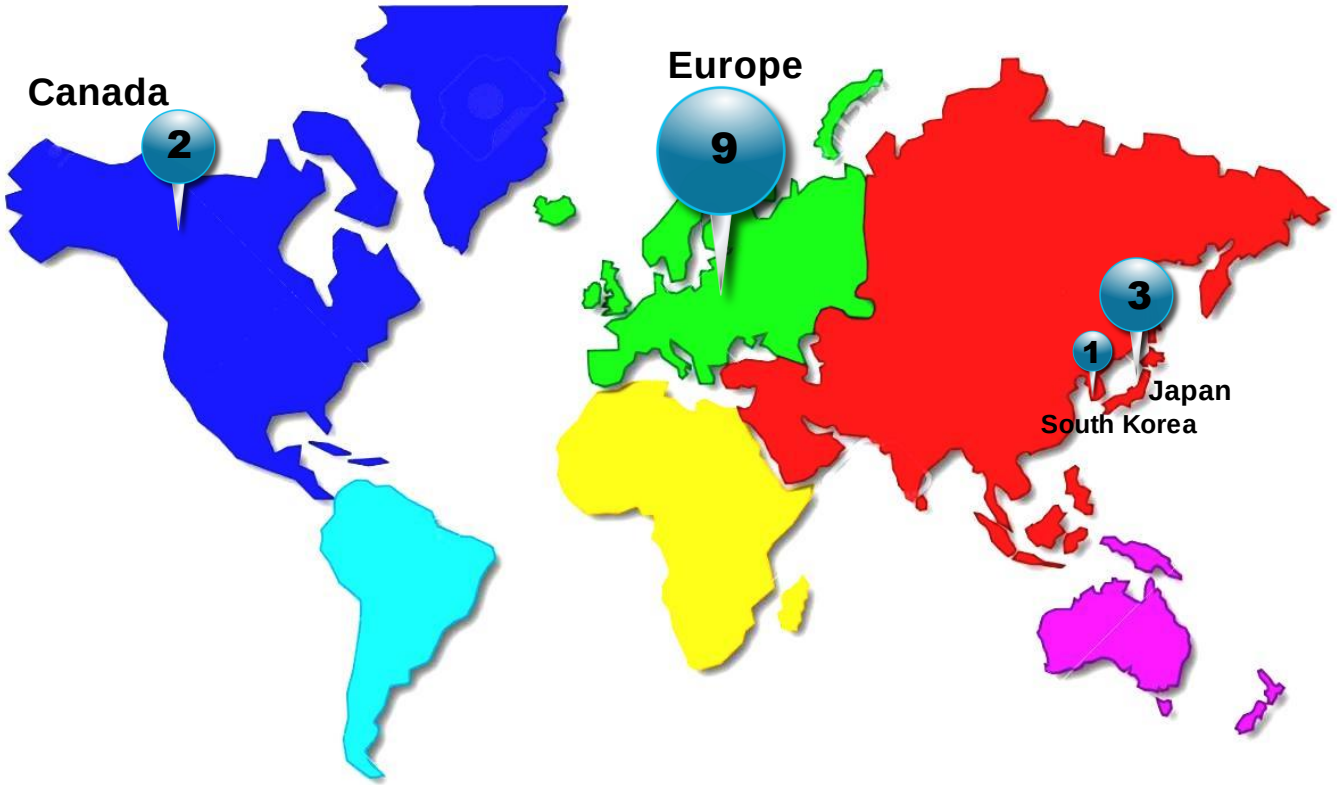
$ Millions	FY 2022 Request 1/	FY 2022 Enacted 2/	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Aeronautics	**$914.8**	**$880.7**	**$971.5**	**$990.9**	**$1,010.7**	**$1,030.9**	**$1,051.5**
Airspace Operations and Safety	147.4		156.2	159.0	164.2	183.6	196.8
Advanced Air Vehicles	243.7		253.2	269.5	287.2	270.5	235.9
Integrated Aviation Systems	258.6		288.9	287.1	284.0	296.4	322.3
Transformative Aeronautics Concepts	148.0		155.9	158.0	158.0	163.0	176.6
Aerosciences Evaluation and Test Capabilities	117.0		117.3	117.3	117.3	117.3	119.9

1/ - Full-year appropriations for FY 2022 were not enacted at the time this budget was prepared. Therefore, the FY 2022 column reflects the FY 2022 President's Budget Request.
2/ - FY 2022 Enacted reflects amounts specified in H.R. 2471, Consolidated Appropriations Act, 2022 at the Account level.

- Supports a robust Sustainable Flight National Partnership to enable highly efficient next generation aircraft and ensure U.S. leadership in aviation
- Conducts the first flight of the X-59 Low Boom Flight Demonstrator in 2023. These flight tests will provide data to the global aviation community to reassess the ban on supersonic flight over land and implement noise regulations acceptable to local communities
- Supports Advanced Air Mobility to ensure U.S. leadership in an emerging aviation market that studies have projected to generate an annual market value of $115 billion by 2035
- Increases funding to develop revolutionary, beyond next-generation zero-emissions aircraft concepts and technologies through the highly successful University Leadership Initiative
- Funds a new effort to improve aerial responses to wildfires by leveraging NASA UAS traffic management (UTM) technologies

International Cooperation

NASA ARMD has bilateral agreements in aeronautics research with the following IFAR organizations: DLR, JAXA, KARI, NRC and ONERA



NASA ARMD is contributing to international standards.
(AAVP is working with ICAO working group on sonic boom standards. Through IFAR, NASA is also contributing a scientific assessment on UAM to ICAO.)

Recent partnerships with the EU include:

- Icing Research
- ATM Work

NASA ARMD currently has 15 international aeronautics agreements spread across the globe.

2022 NAC Aeronautics Committee Work Plan Completed

SPRING	SUMMER	FALL
ARMD FY23 Budget Overview	UTM Closeout	X-57 First Flight
Sustainable Flight National Partnership	Advanced Air Mobility (AAM) Mission Update	High Speed Research
Future Airspace Vision	Zero Emissions/Impact Strategy	Quesst (Low Boom Flight Demonstrator) Mission Status
	University Initiative (ULI, USRC)	Aerosciences Evaluation and Test Capabilities (AETC) Strategic Plan
	Advanced Capabilities for Emergency Response Operations (ACERO) Formulation	
April 27, 2022 (Virtual)	August 31 to September 1, 2022 (ARC)	November 30, 2022 (HQ)




2023 NAC Aeronautics Committee DRAFT Work Plan

SPRING	SUMMER	FALL
ARMD FY24 Budget Overview	Future of Flight	AACES 2050 awards
SFD Award	Material and Structures	
ULI Awards Round 6	NASA Support to Certification	
March 22, 2023 (AFRC)	July 2023 (TBD)	November 2023 (TBD)




The inspiration for this design draws heavily from the images captured from 2019's Air-to-Air Background Oriented Schlieren flight series, which recorded images of intersecting shockwaves from supersonic jets.

SHOCKWAVES

The supersonic shockwaves do not merge, enabling the X-59 to produce a quieter sound to people on the ground.

AIRCRAFT

The aircraft represents the X-59, which will be flown over U.S. communities to elicit residents' responses to its sounds.

LAND CRESCENT

The crescent represents land, highlighting the crucial and unique aspect of our mission – commercial supersonic flight **over land**.

HOUSES

The three houses represent the communities of residents who will provide the data that could lead to commercial supersonic flight over land.

Blue and green symbolize the Earth, which is where NASA's Quesst to enable quiet supersonic flight over land is taking place, and where the value of NASA's aeronautics research is experienced by humankind every day.

Quesst Mission Overview and the X-59 Aircraft

X-plane approach that meets key requirements in a cost-effective design

External and forward visions systems for forward visibility

T-38 aft canopy and ejection seat to minimize qualification cost and schedule

Long nose to shape forward shock

Fixed canard for nose-up trim at low-boom design point

Large, unitized skins reduce parts count and manufacturing cost

T-tail to minimize aft shock

- F-16 landing gear and other systems from high performance aircraft to minimize qualification cost and schedule

Wing shielding to minimize impact of inlet spillage on sonic boom

Conventional tail arrangement to simplify stability and control considerations

Single GE-F414 engine with standard nozzle to minimize cost and schedule

Design Parameters

- **Length: 99 ft**
- **Span: 29.5 ft**
- **Speed: Mach 1.4 (925 mph)**
- **Altitude: 55,000 ft**

Image Credit: Lockheed Martin

Acronyms

- AA – Associate Administrator
- AAM – Advanced Air Mobility
- AFRE – Advanced Full Range Engine
- AETC – Aerosciences Evaluation and Test Capabilities
- AFRL – Air Force Research Lab
- ARC – Ames Research Center
- ARMD – Aeronautics Research Mission Directorate
- BOLT – Boundary Layer Transition
- CAEP – Committee on Aviation Environmental Protection
- CAS – Convergent Aeronautics Solutions
- CFD – Computational Fluid Dynamics
- COTS – Commercial Off-the-shelf
- DARPA – Defense Advanced Research Projects Agency
- DEP – Distributed Electric Propulsion
- DOD – Department of Defense
- FAA – Federal Aviation Administration
- FAR – Federal Aviation Regulations
- FDC – Flight Demos & Capabilities
- GE – General Electric
- GRC – Glenn Research Center
- HAWC – Hypersonic Airbreathing Weapon Concept
- IASP – Integrated Aviation Systems Program
- ICAO – International Civil Aviation Organization
- IT – Information Technology
- Quesst – Quiet Supersonic Transport
- LARC – Langley Research Center
- LTO – Landing and Take-Off
- NAS – National Airspace System
- OEM – Original Equipment Manufacturer
- SARP – Standards and Recommended Practices
- SME – Subject Matter Expert
- TACP – Transformative Aeronautics Concepts Program
- TBG – Tactical Boost Glide
- TRMC – Test Resource Management Center
- USAF – United Stated Air Force