National Aeronautics and Space Administration

NASA Aeronautics Research

John-Paul Clarke
Chair, NAC Aeronautics Committee
January 18, 2023

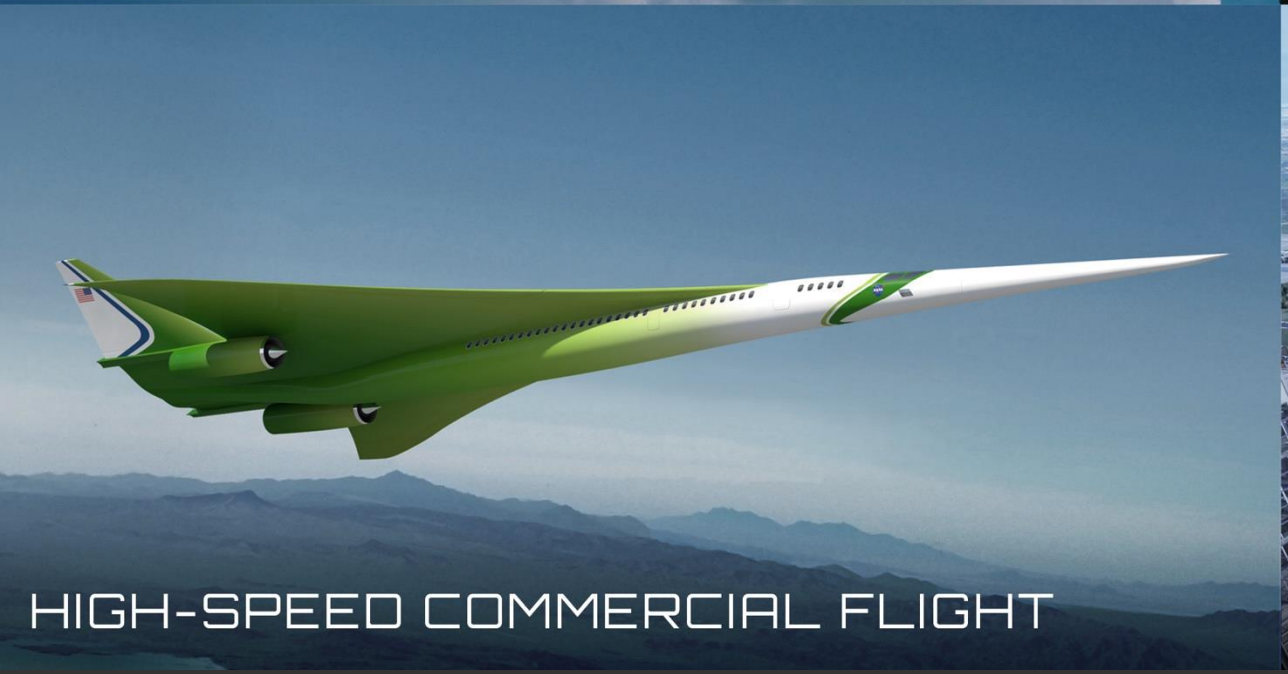
NASA Aeronautics – Vision for Aviation in the 21st Century

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



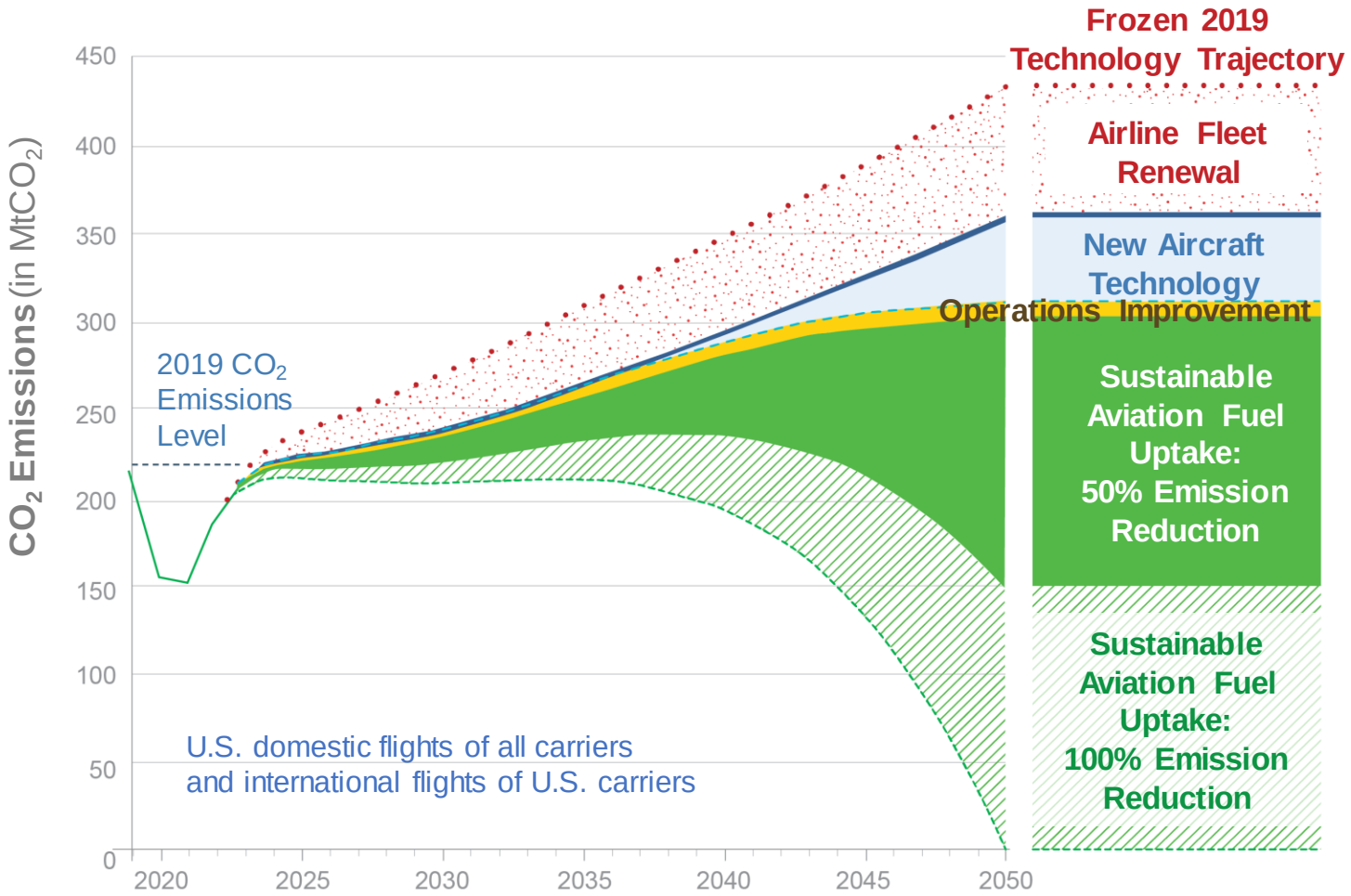
Four Transformations for Sustainability, Greater Mobility, and Economic Growth

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

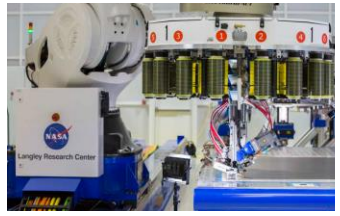
Enable integrated trajectory optimization

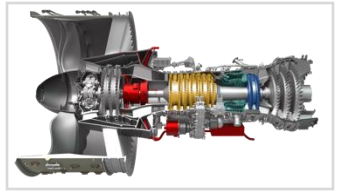
Advance airframe efficiency and manufacturing rate

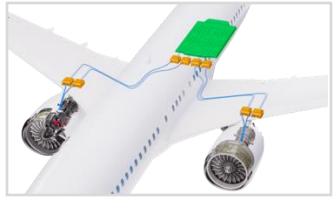
Enable use of 100% sustainable aviation fuels

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

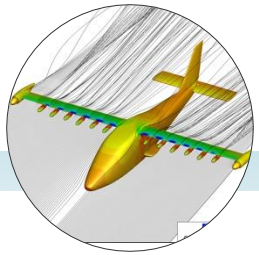
Share technical insights and lessons learned

LEAPTech experiment

Wind-tunnel validation

Motor nacelle design & testing

Structural testing

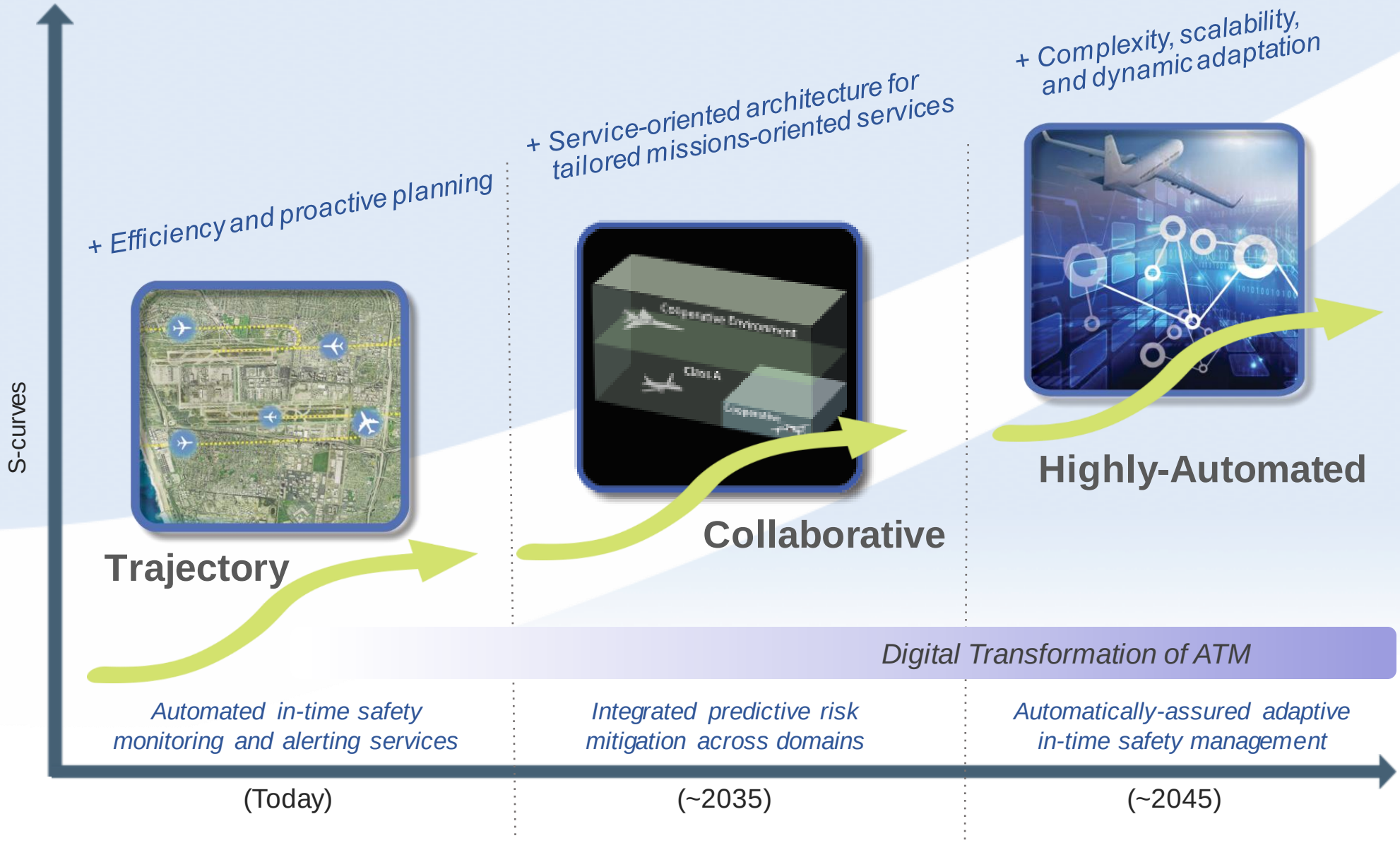


Computational simulations

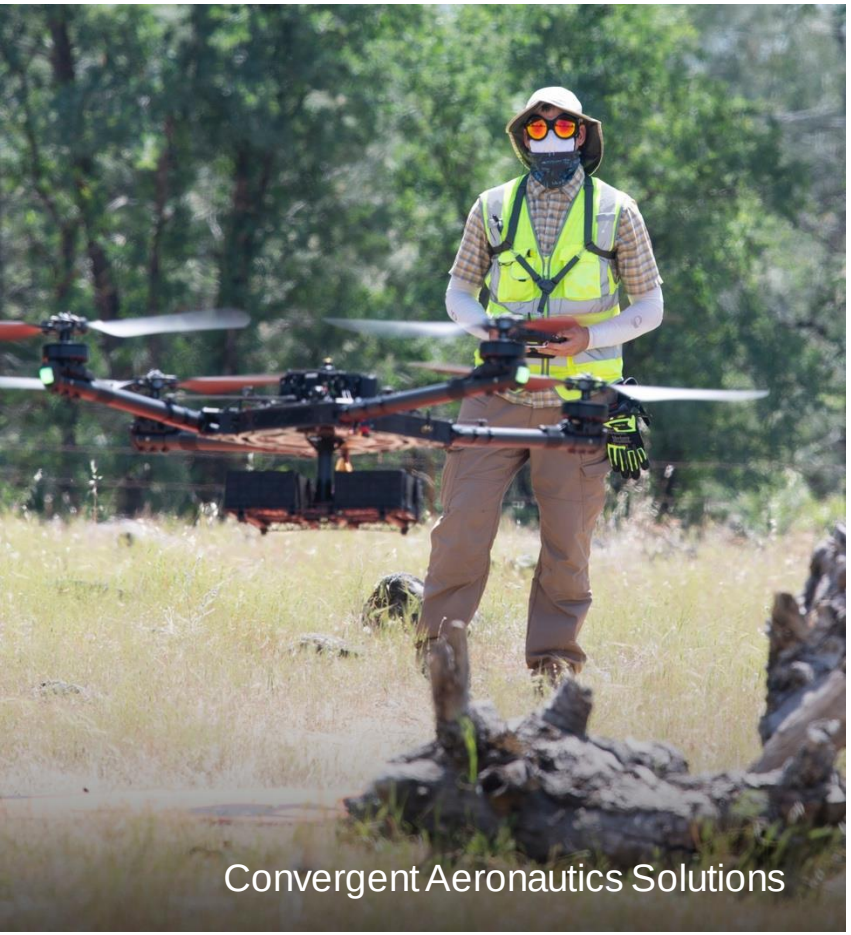
Operational checkouts

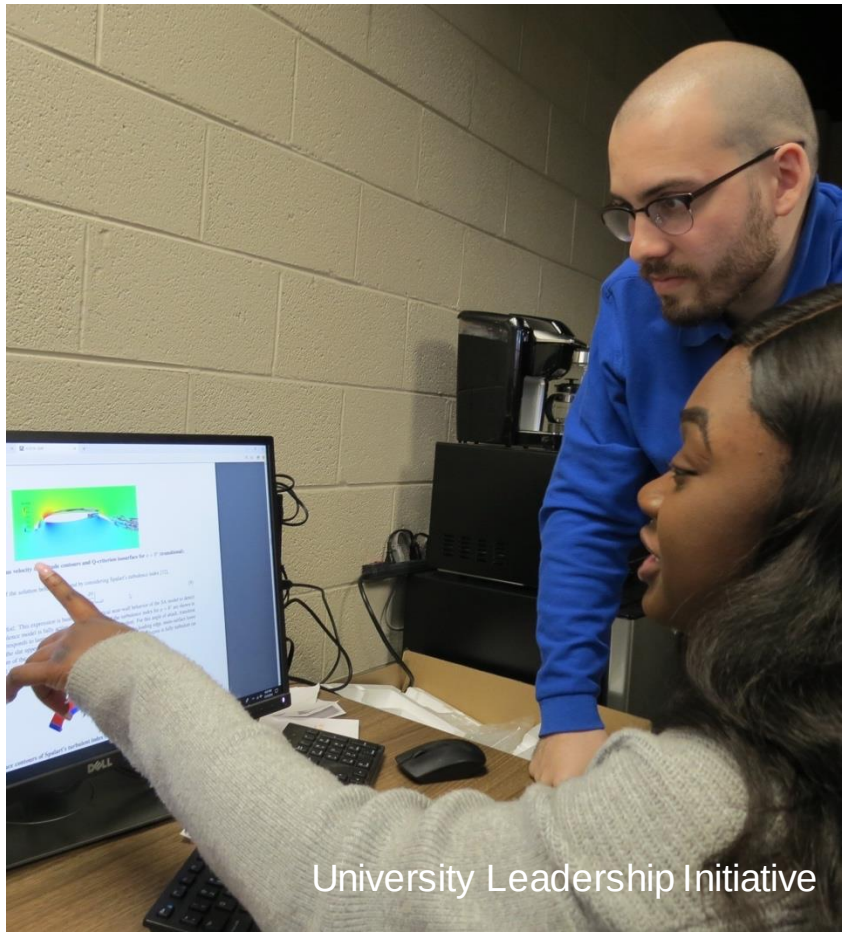
Inform Small Electric Aircraft Propulsion Standards and Certification

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

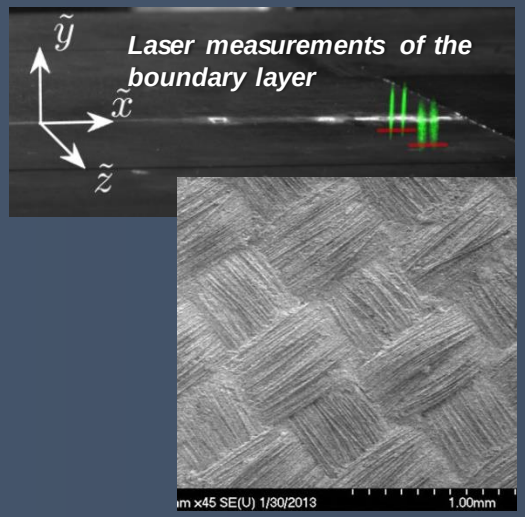
In ULI, the universities take the lead, build their own teams, and set their own research path.

Wildfire Detection/Mitigation Concept of Operations

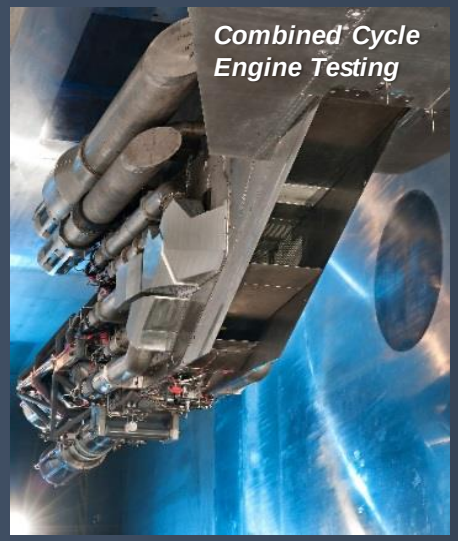
NASA Hypersonic Research

- 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

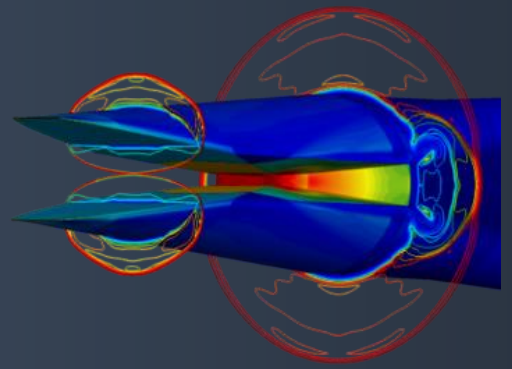
FOCUS AREAS



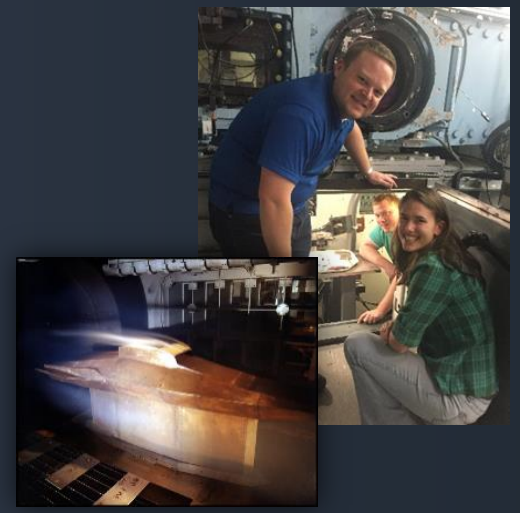
Fundamental Research
Flow Physics & High Temp Materials



Re-usable Hypersonic Propulsion



Design Tools & Uncertainty Quantification



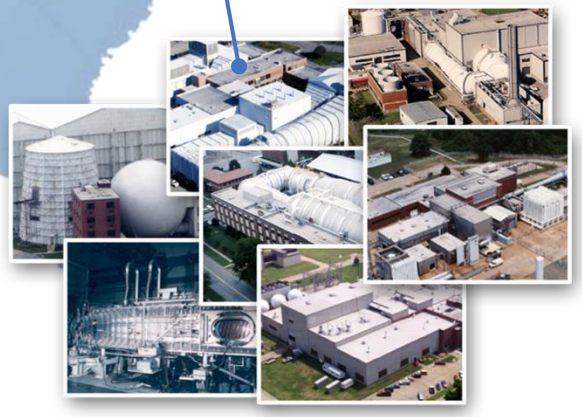
Facility Capabilities and Workforce Development

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

Back Up

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