

# EXPLORE FLIGHT

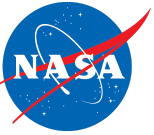
WE'RE WITH YOU WHEN YOU FLY

NASA Aeronautics Research Update

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Associate Administrator  
Aeronautics Research Mission Directorate

May 24, 2021

# 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

### Airspace Operations and Safety Program



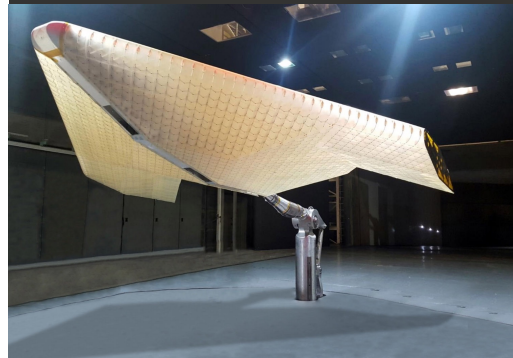
### Advanced Air Vehicles Program



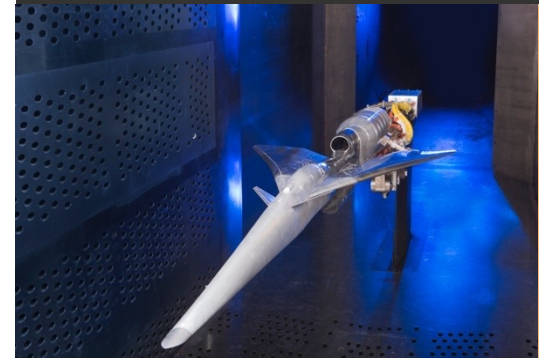
### Integrated Aviation Systems Program



### Transformative Aeronautics Concepts Program

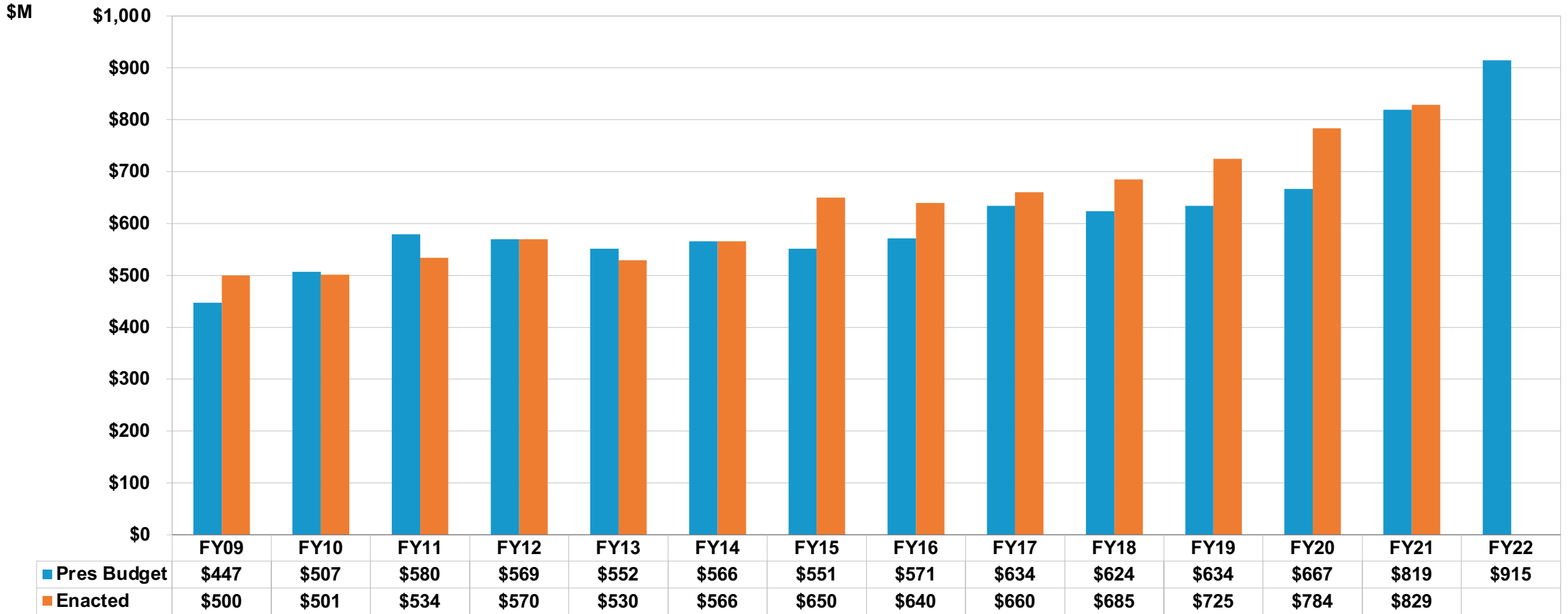
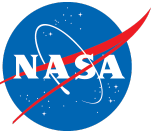


### Aerosciences Evaluation and Test Capabilities Portfolio



# ARMD PROGRAMS

# ARMD Budget FY 2014 to FY 2022

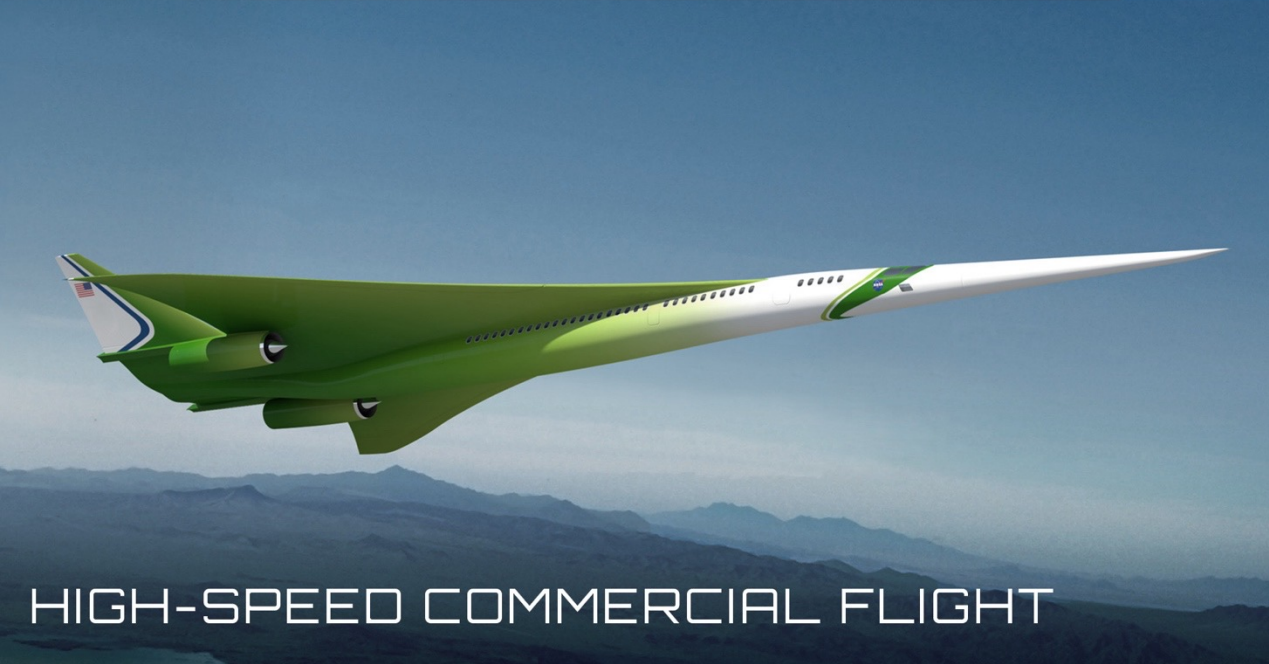




ULTRA-EFFICIENT TRANSPORT



FUTURE AIRSPACE



HIGH-SPEED COMMERCIAL FLIGHT

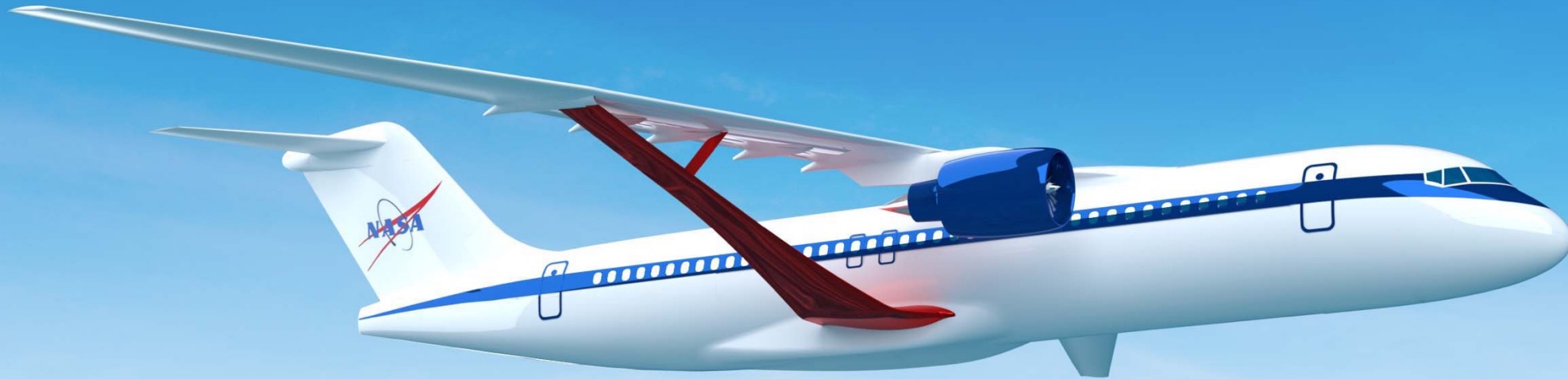


ADVANCED AIR MOBILITY

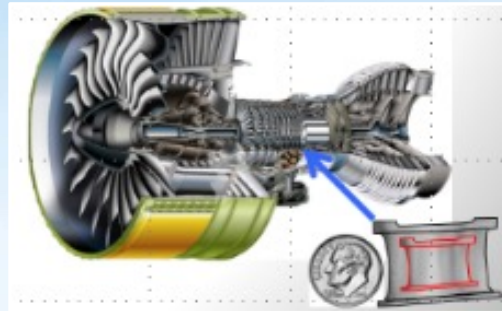
Four Transformations for Sustainability, Greater Mobility, and Economic Growth

# Sustainable Flight National Partnership

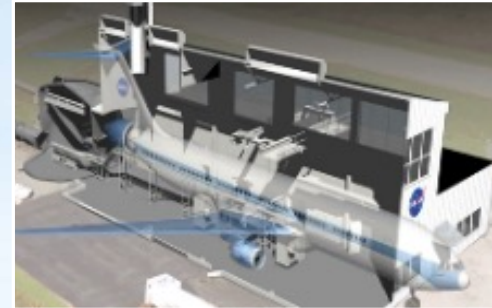
## Subsonic Transport Technologies



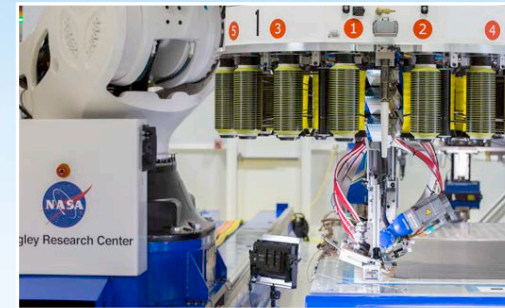
**Transonic Truss-Braced Wing**  
5-10% fuel burn benefit



**Small Core Gas Turbine**  
5-10% fuel burn benefit



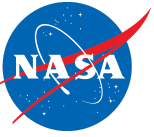
**Electrified Aircraft Propulsion**  
~5% fuel burn and maintenance benefit



**High-Rate Composite Manufacturing**  
4x-6x manufacturing rate increase

# Sustainable Flight National Partnership

## Sustainable Aviation Operations



- Integrated trajectories optimized for environmental benefit
- Advanced flight deck capabilities to operate on those trajectories
- Tailored services that support safe integration of all diverse operations



# High-Speed Commercial Flight

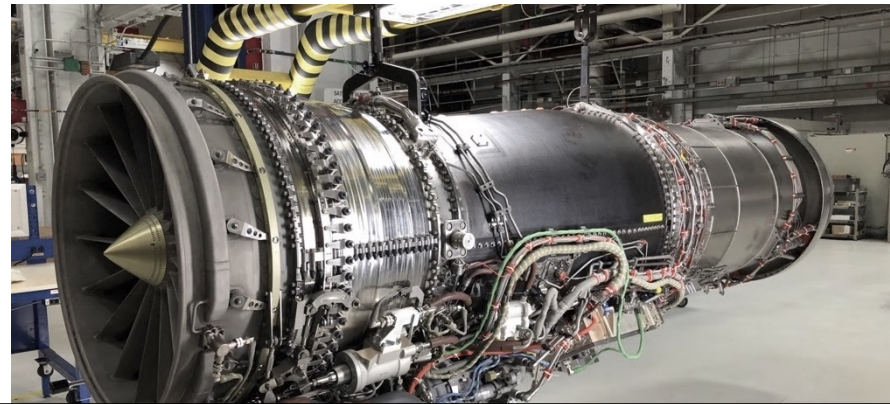
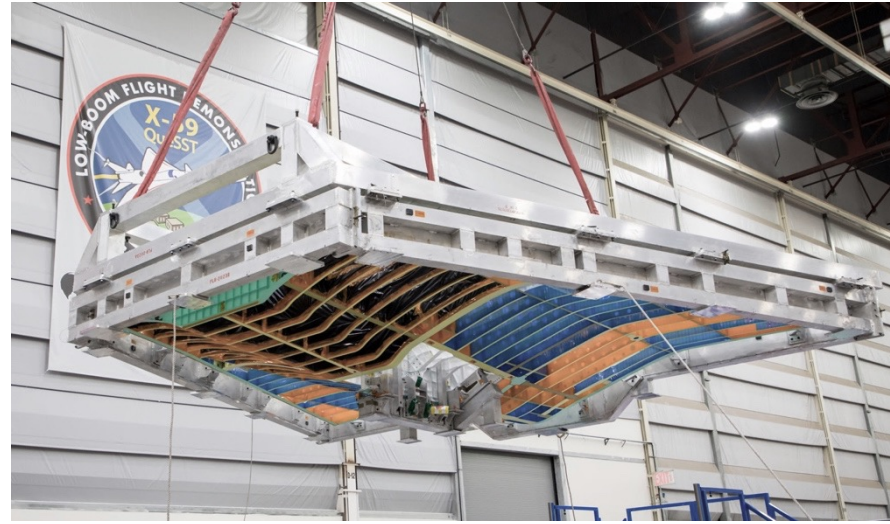
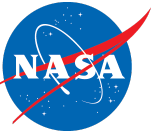
Sustainable transformation of the speed of air travel



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

Generate key data to support development of en route certification standards based on acceptable sound levels

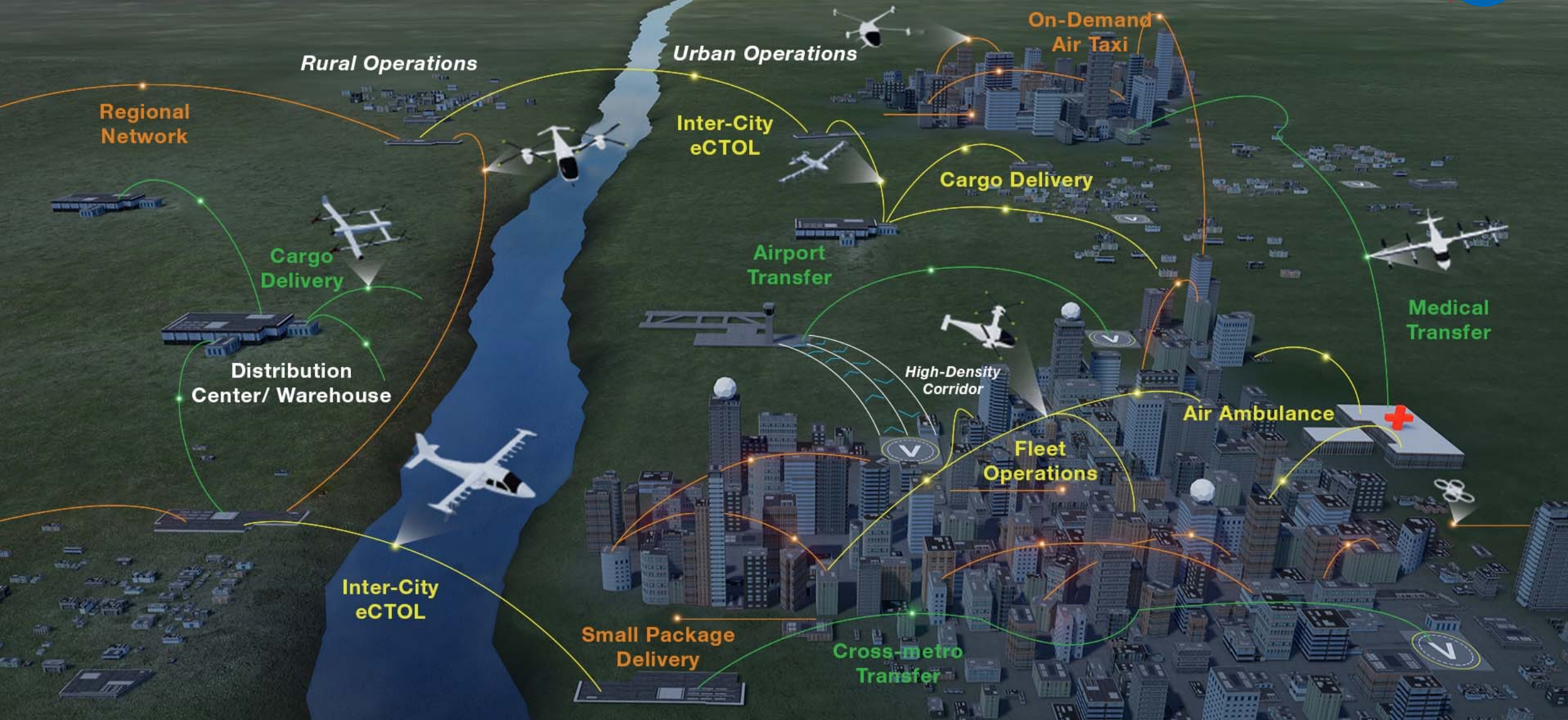
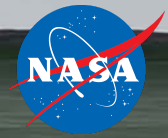
# Recent Scenes of Work on X-59 Construction



Components of NASA's first piloted supersonic X-plane in a generation are under construction by our contract partner Lockheed Martin.

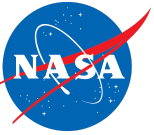
COMPLETE VEHICLE BUILD AND ROLL OUT LATER THIS YEAR  
ACHIEVE FIRST FLIGHT IN 2022

# Advanced Air Mobility Mission



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

# NASA Role to Address AAM Challenges



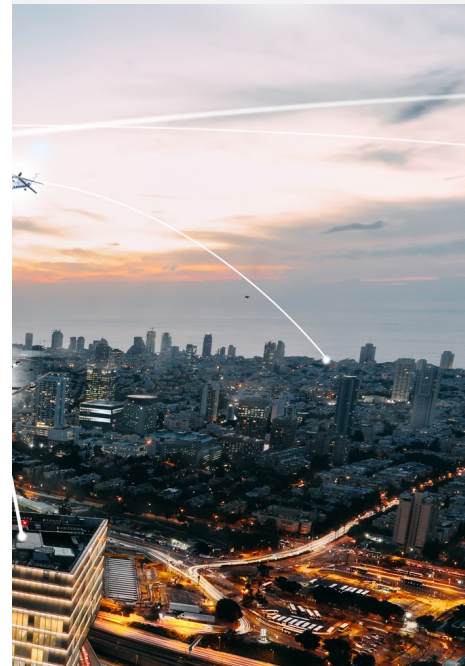
## Vehicle Development and Operations



## Airspace Design and Operations



## Community Integration

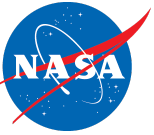


**NASA and key partners are collectively taking on the most difficult mission challenges to enable industry to flourish by 2030**

- **Research and Development Portfolio**
- **Robust Ecosystem Partnerships**
- **AAM National Campaign Series**

NASA to deliver long term technical solutions and architecture requirements for industry, regulatory community

# NASA X-57 Maxwell All-Electric Flight Demonstrator



## Mod II

### Validates Cruise Motors & Subsystems



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

## Mod III

### Achieves High-Speed Objectives



Flight test electric motors relocated to wingtips on newly developed & fabricated distributed electric propulsion wing.

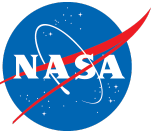
## Mod IV

### Achieves Low-Speed Objectives



Flight test with integrated distributed electric propulsion motors and folding props (cruise motors remain in wing-tips).

# Net Zero Aviation Emissions Innovation



## NASA Distributed Propulsion Concept

- Turbo-Electric with superconducting electric drivetrain
- Over 70% reduction in energy use



Examples of current Research at Low TRL



## University of Illinois, Urbana-Champagne (NASA ULI) fully electric concept

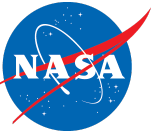
- Hydrogen fuel cell, superconducting electric drivetrain
- Zero carbon emissions

Foster radical aviation technology advancement – new energy sources, aircraft architectures – necessary for large aircraft with extremely low or zero emissions

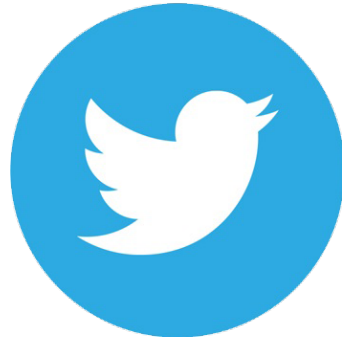
Low TRL concepts can be further conceptualized, researched, developed, ground and flight tested and advanced for late 2030s / early 2040s

Recent University Leadership Initiative solicitation (March 2021) included net-zero emissions topics

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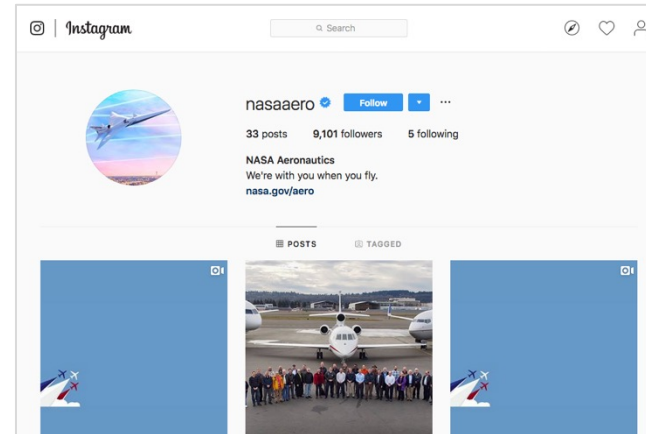
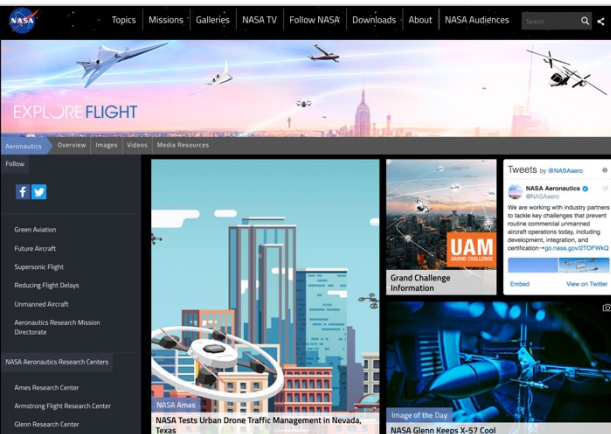
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