NASA Update

FAA REDAC E&E Subcommittee Meeting
July 25-26, 2024

Barbara Esker, Deputy Associate Administrator for Programs
Shivanjli Sharma, Manager, Air Traffic Management Exploration (ATMx) Project
NASA Aeronautics Research Mission Directorate

Outline

- NASA Aeronautics Overview and Top-Level Update
- Focus on 2 of 4 Aeronautics Transformations
  - Future Airspace & Safety Transformation
  - Advanced Air Mobility Transformation
- Wrap up

Four Transformations for Sustainability, Greater Mobility, and Economic Growth

Aeronautics FY 2025 Budget Request

$ Millions	FY 2024 Enacted	FY 2025	FY 2026	FY 2027	FY 2028	FY 2029
Aeronautics	**$935.0**	**$965.8**	**$985.1**	**$1,004.8**	**$1,024.9**	**$1,045.4**
Airspace Operations and Safety		151.2	164.3	174.1	177.7	180.9
Advanced Air Vehicles		278.8	269.6	262.4	248.8	218.7
Integrated Aviation Systems		264.4	277.0	277.6	300.9	342.0
Transformative Aeronautics Concepts		155.3	157.6	171.1	175.2	179.0
Aerosciences Evaluation and Test Capabilities		116.2	116.5	119.5	122.3	124.7

- Supports a robust Sustainable Flight National Partnership
  - Megawatt-class electrified powertrain systems & components
  - Flight test full-scale X-66 sustainable flight demonstrator
  - Advanced small turbine cores ground test - increased engine thermal efficiency & reduced fuel burn
  - Demo - improved rate of composite manufacturing by 4-6 times faster than current production rates with wing & fuselage ground tests.
  - Robust model-based systems analysis & engineering framework at the aircraft system level
  - Field demonstrations with FAA, airline & airport partners of digital departure and oceanic airborne rerouting tools that reduce delays, fuel burn & emissions.
  - Research and study non-CO_2 greenhouse gas emissions such as contrails
- Conducts the first flight X-59 Low Boom Flight Demonstrator & envelope expansion flights to prove airworthiness.
- Enables FAA-adopted Extensible Traffic Management (XTM) concept to create safe airspace access for emerging aviation systems
- 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
- Fosters NASA & University innovation in physics-based tools, novel technologies, & advanced system concepts that supports the future of the entire aerospace industry.

FY25 Budget Request – on the Hill
House mark - $966M
Senate mark - TBD

Status Summary –

Ultra-Efficient Airliners Transformation

- SFNP continues strong progress
  - Sustainable Flight Demonstrator & Transonic Truss-braced Wing Technology – Initiated detailed design of X-66's unique wing structure; Completed low-speed deep stall WT testing.
  - Hybrid Thermally-Efficient Core – Phase 1 technology development efforts are wrapping up; Phase 2 demo efforts underway with GE
  - High-Rate Composite Aircraft Manufacturing – Phase 1 technology development efforts; Phase 2 solicitation under development
  - Electrified Powertrain demonstration & MW-class component development – Completed GE Critical Design Review April 2024; completed magniX's low-power functional testing of magni650 electric power unit; GE electrical power system testing of their fully integrated powertrain at their EPISCenter; partnering with ARPA-e on testing of next generation MW-class components (ASCEND, REEACH)
- NASEM study underway - "*Research Agenda for Reducing the Climate Impact of Aviation-Induced Cloudiness and Persistent Contrails from Commercial Aviation.*" Third meeting held July 12.

High-Speed Commercial Flight Transformation

- Progress continues to be made on X-59 (low boom flight demonstrator). Working towards engine run & first flight.
- Preparations for X-59 acoustic validation and Quesst mission community testing continue. Survey test completed and documented
- New LTO noise models were assessed and the uncertainty in predicting noise of supersonic aircraft was reduced by 5.8 EPNdB.
- Completed Mach 2-5 conceptual design studies to better understand high speed commercial vehicle and market challenges.

Link to the NASEM Study Site
https://www.nationalacademies.org/our-work/research-agenda-for-reducing-the-climate-impact-of-aviation-induced-cloudiness-and-persistent-contrails-from-commercial-aviation

FUTURE AIRSPACE AND SAFETY

Real Progress. Real Value.

Future Airspace and Safety Ecosystem Transformation

FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31

Extensible Traffic Management (xTM)

Demonstrate future complimentary service environment for scalability of operations

Increasingly automated operations in cooperative XTM volumes

Digital Services Environment: Application to SFNP Ops Demonstrations

Demonstrate emission and fuel reductions through use of digital services

Integrated digital information environment for common operating picture and third-party services

In-Time Aviation Safety Management System

Integrate safety assurance capabilities to monitor, assess and mitigate risks in current and future operations

Integrated system-wide safety assurance leveraging digital data

Integration of Highly Automated and Increasingly Autonomous

UAM Midterm Stage

UAM Mature Stage

Planned

Notional

Future airspace and safety transformation will be enabled through novel airspace concepts, digitization of data, and system-wide safety assurance.

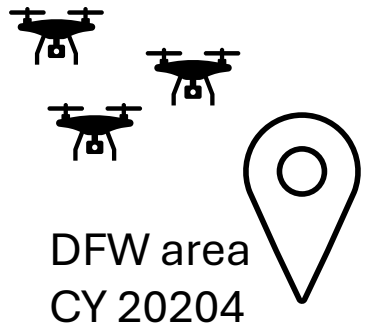
UTM BVLOS Key Site Operational Evaluation

The UTM Key Site Operational Evaluation establishes partnerships with multiple UAS operators and UAS Service Suppliers (USSs) to operate commercial and public beyond visual line-of-sight (BVLOS) operations at a key site using UTM services.

NASA and the FAA will develop processes for validation of services and operations to generate data that informs BVLOS rulemaking and incorporation of USS services into the National Airspace System.

Key Outcomes:

- Informs FAA new BVLOS rulemaking
- Multiple real-world Part 135 and Part 107 operators and operations managing UAS-UAS conflicts via UTM
- Establishes a “leave behind” capability that also informs xTM expansion in the NAS (e.g., AAM)



Advanced Capabilities for Emergency Response Operations

SATELLITE

AIR TACTICAL GROUP SUPERVISOR

AERIAL COMMUNICATION

REMOTE SENSING

DAYTIME OPERATIONS

NIGHTTIME OPERATIONS

Develop, integrate, demonstrate, and transition to operations, NASA and industry aviation technologies to identify, monitor, and mitigate wildland fires and other emergencies, to enhance safety, improve efficiency of operations, and minimize economic loss.

TERRESTRIAL COMMUNICATIONS

TANKER

PILOTED HELICOPTER

REMOTELY PILOTED HELICOPTER

LOGISTICS

AIRCRAFT AUTONOMY

DECISION SUPPORT

AIRSPACE MANAGEMENT

Future Airspace and Safety Ecosystem Transformation

FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31

Extensible Traffic Management (xTM)

Demonstrate future complimentary service environment for scalability of operations

Increasingly automated operations in cooperative XTM volumes

Digital Services Environment: Application to SFNP Ops Demonstrations

Demonstrate emission and fuel reductions through use of digital services

Integrated digital information environment for common operating picture and third-party services

In-Time Aviation Safety Management System

Integrate safety assurance capabilities to monitor, assess and mitigate risks in current and future operations

Integrated system-wide safety assurance leveraging digital data

Integration of Highly Automated and Increasingly Autonomous

UAM Midterm Stage

UAM Mature Stage

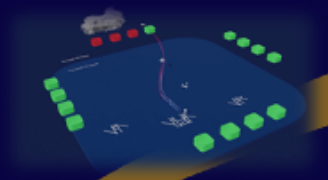
Planned

Notional

Future airspace and safety transformation will be enabled through novel airspace concepts, digitization of data, and system-wide safety assurance.

Sustainable Flight National Partnership Operational (SFNP-Ops) Demo Plan

Operator and ATC digital services in a metroplex and a complex multi-center environment



Digital Departure Rerouting for weather

Pre Departure Rerouting FY22-25

Integrated Pre & Post Departure Rerouting to inform FF-ICE requirements to the FAA

Integrated Airborne Rerouting

Gate to Gate Trajectory Management FY23-27

Fleet-wide rerouting services for intelligent disruption management recovery strategies

Fleet-wide IROP Recovery Management

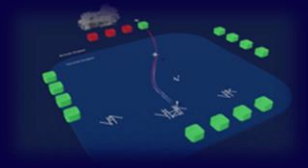
Disruption Management and Recovery FY28 - 30

4D trajectory optimization through an end-to-end digital workflow across NAS users

End to End Digital TBO

Trajectory Based Operations Demo FY30 - 32

Utilizing NASA, FAA, and partner assets to support the SFNP Mission to demonstrate reduction in emissions and fuel for aviation operations



Pre Departure Rerouting

Pre Departure Rerouting Demo

Objective: Pre-departure operator and ATC digital services in metroplex and multi-center environments through a cloud-based digital service architecture

- Operational data collection in North Texas ongoing since January 2023
- Expansion into multi-center complex airspace (Houston) in FY24

SFNP Ops 1
FY22-25

FY24 Focus Areas:

- Field engagement with flight operators and ATC facilities for Ops1b (Houston airspace)
- System wide benefits assessment of CDDR service.
- Tech Transfer plan for CDDR and Fuser
- Participation in AI/ML certification process with FAA

ACTUAL & AVERAGE SAVINGS
For local NTX area (01/23– 04/24)

Fuel Savings

Total Amount Over **84,000 lbs**

The average reroute generates **776 lbs** of savings

Emissions Savings

Total Amount Over **258K** lbs. **CO^2**

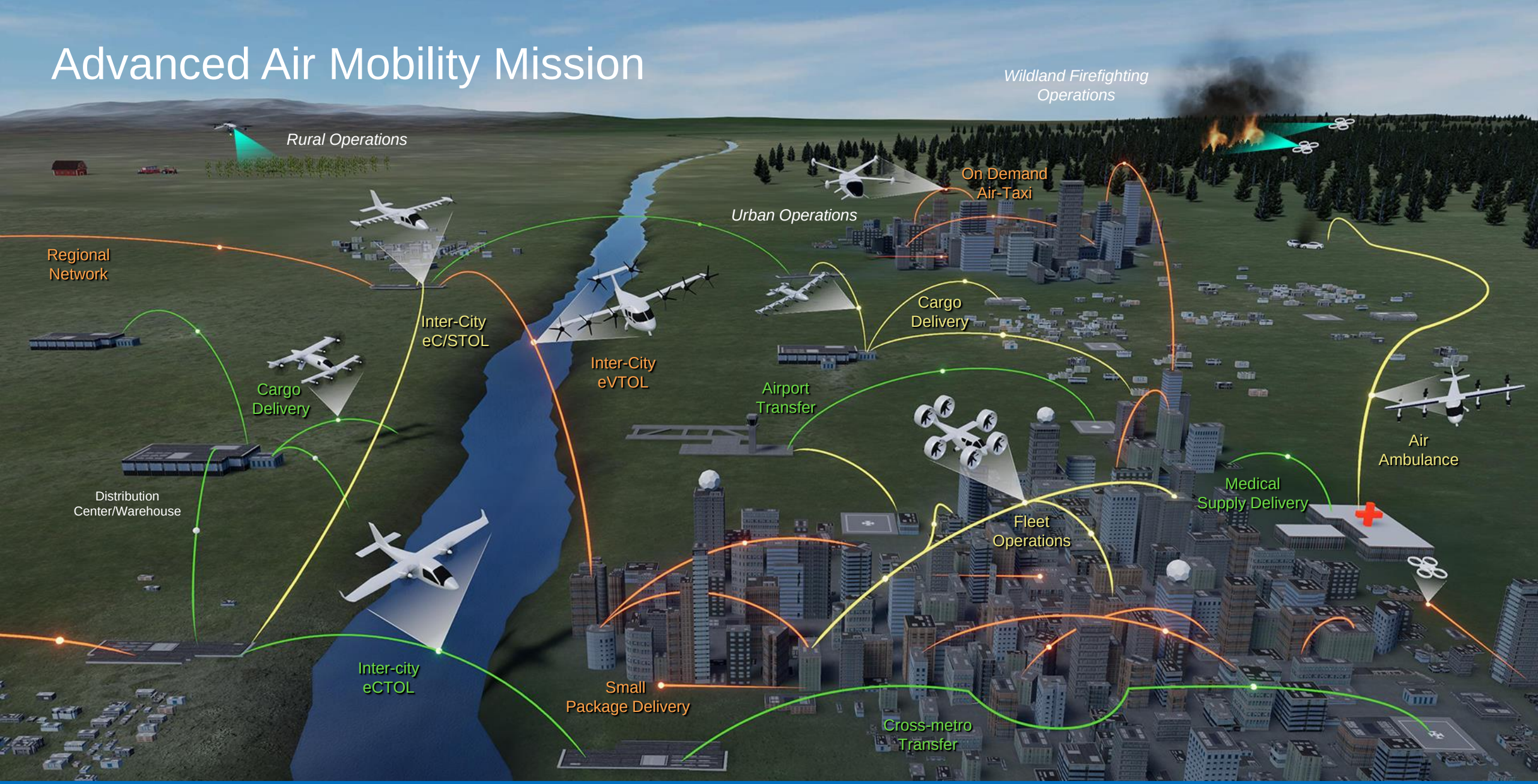
The average reroute provides 2,400 lbs of **CO^2 savings**

Progress towards FAA's Info-Centric NAS by demonstrating digital services on the cloud and reducing the impact of aviation on the climate

ADVANCED AIR MOBILITY

Real Progress. Real Value.

Advanced Air Mobility Mission



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

Integrated Advanced Air Mobility Portfolio

Concepts

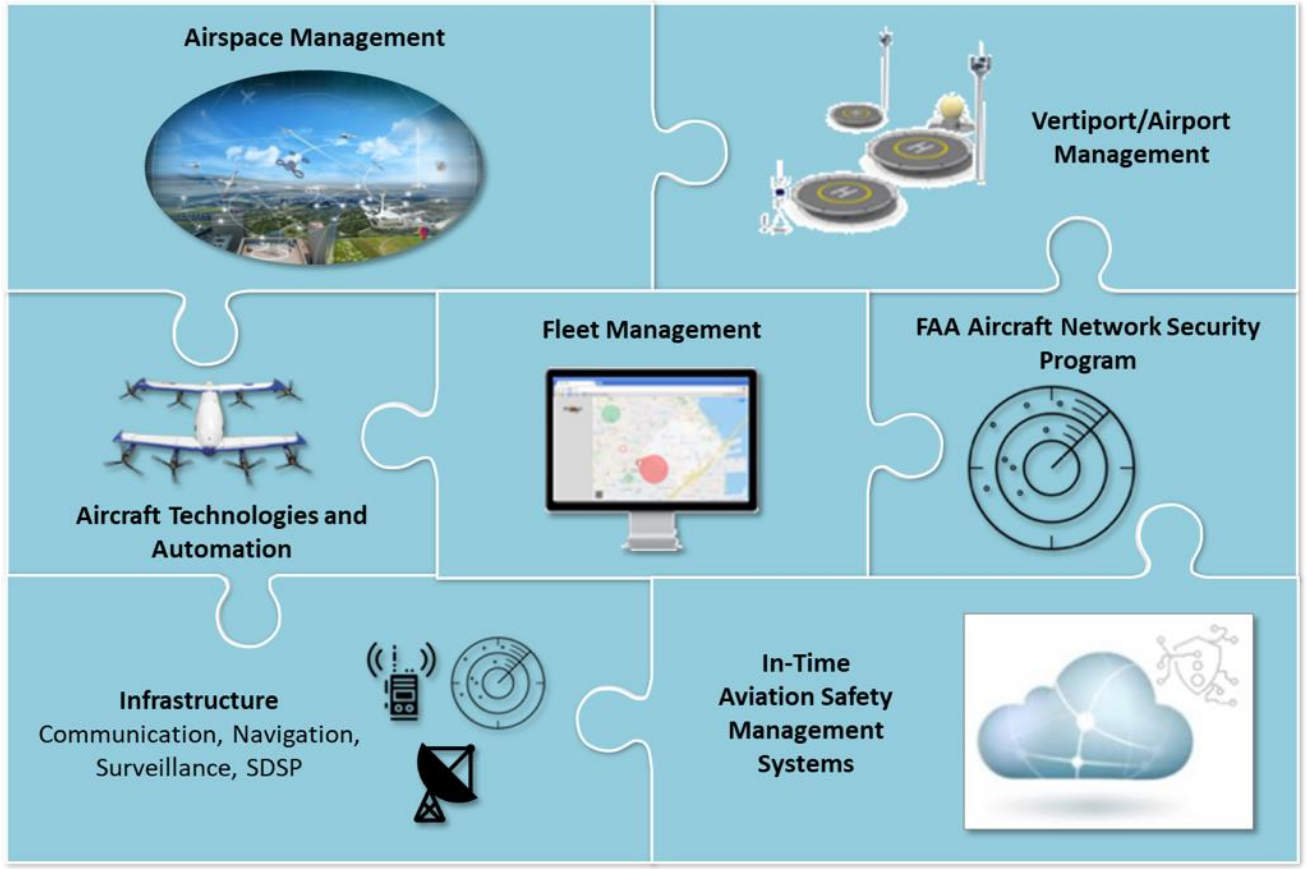
System Engineering & Integration

Deliver **reference architecture(s)**, and **integrated requirements**…

…validated by data from the research, development, and testing of automation prototypes.

Flight Operations

Airspace Operations



Resulting **architecture**(s) will support safe, secure, and scalable UAM operations.

Partnering Approach for AAM Technology Demonstrations

TCL-1: eVTOL pilot on board operations for multiple operators

- Live Virtual Construct with NASA and FAA, including crewed eVTOL aircraft
- Cooperative operating practices
- Airspace automation
- System actor roles & responsibilities

Industry partner engagement

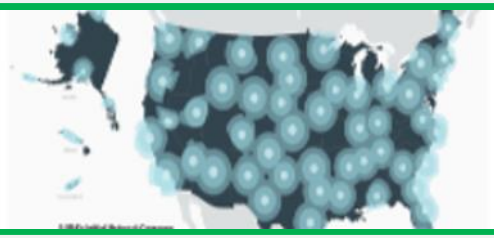
AFWERX / Joby

Focus: Integration of eVTOL aircraft into UAM airspace infrastructure

SKYGRID / wisk

Focus: Uncrewed operations and UAM service provision

AURA



Focus Area: UAM communication digitization needs including command & control

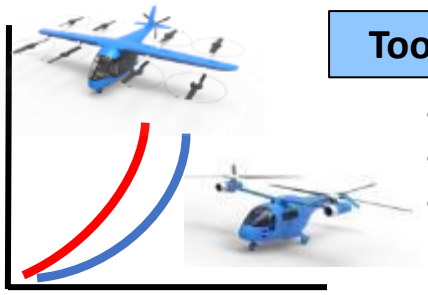
TCL-2 [FY28]: Initial remotely piloted operations

TCL-3 [FY29]: Degraded weather operation

TCL = Technical Capability Level

Revolutionary Vertical Lift Technology Project
Research Focus – Vehicle Noise and Safety; Recent Progress

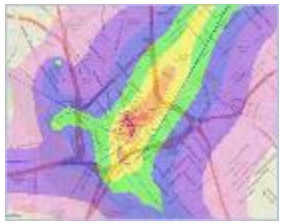
Noise & Performance



Tools to Explore the Noise & Performance of Multi-Rotor UAM Vehicles

- Fabricating semispan tiltwing wind tunnel model for testing in FY25
- Updating the hover validation dataset with additional transition, pressure, and PIV data
- Comprehensive hover validation dataset supports tool validations and improved predictions

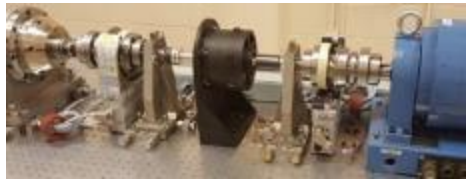
UAM Fleet Noise



UAM Operational Fleet Noise Assessment

- Identified best practices for UAM fleet noise modeling using AEDT
- Developed initial annoyance model for UAM vehicle noise based on results from recent human response tests
- Updated recommendations for AEDT modifications to better support UAM fleet noise assessments and shared with AEE-100 and Volpe.

Electric Powertrain Reliability



Reliable & Efficient Propulsion Components for UAM

- Continued to lead SAE standards committees developing high voltage DC power quality and permanent magnet motor standards
- Developed new methodology to quantify electric motor reliability
- Built and tested an advanced fault-tolerant motor demonstrator.

Occupant Safety

UAM Crashworthiness & Occupant Protection

- Shared phase I battery drop results during FAA community of interest meeting
- Conducted phase II testing of de-energized battery modules
- Developed draft test standard for bird strike impact testing

Handling & Ride Qualities

Acceptable Handling and Ride Qualities for UAM

- Completed verification and validation testing of new Ride Quality Lab
- Preparing for next Vertical Motion Simulator test in collaboration with the Army

Other Important Items

- Overall support from key stakeholders continues to be strong – ARMD research efforts focused on both environmental impact and US economic growth.
- NASA recognizes the challenge of achieving the aggressive 2050 climate goals - requires approaches that complement and go beyond current activities.
- ARMD research efforts continue to be well synchronized with FAA – including coordination on NASA references in 2024 FAA Reauthorization bill.
- Will provide deeper status brief on the Ultra-Efficient Airliners and the High-Speed Commercial Flight Transformations at the winter/spring 2025 E&E REDAC meeting
- Open to feedback on this modified approach to the NASA update brief.

Thank you

UAM Continuum From Initial to Midterm to Mature (per FAA ConOps)

Challenges	Initial Stage	Midterm Stage	Mature Stage
Airspace	Existing NAS rules	Cooperative Areas established & integrated	Tailor flight rules where required
Communications	Voice comms and traditional flight plan	Digital comms for cooperative areas	Digital comms that leverage extensible traffic flow
Pilot Modality	Crewed	Initial Uncrewed	Mix pilot modality increasingly common
Demand	Low demand akin to current day helicopters	Medium demand. Several vertiports & landing pads	High demand. Distributed vertiports and operations
Weather Conditions	Limited robustness. Visual conditions. Current WX tools.	Early weather robustness and associated tools	Robust to all weather while enabling high demand
Safety	Current day NAS safety tools & processes	Deterministic automation that improves safety	Prognostics and autonomy improve diverse ops safety
	Innovate 28 Focus	**AMP Focus Through 2030**	**AMP Focus Beyond 2030**

AMP Addresses Extensibility & Evolution to Next Stage