NASA Update

FAA ASCENT Advisory Committee Meeting
Oct. 26, 2021

Barbara Esker, Deputy Director, Advanced Air Vehicles Program
NASA Aeronautics Research Mission Directorate

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

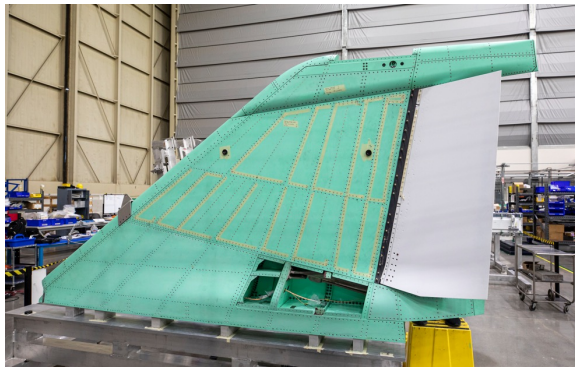
- Safe, Efficient Growth in Global Operations
- Safe, Quiet, and Affordable Vertical Lift Air Vehicles
- Innovation in Commercial Supersonic Aircraft
- In-Time System-Wide Safety Assurance
- Ultra-Efficient Subsonic Transports
- Assured Autonomy for Aviation Transformation

U.S. leadership for a new era of flight

Low-Boom Flight Demonstrator (LBFD) Build

Phase 1 – Aircraft Development - X-59 Aircraft Build Progressing

- Good progress being made, with some challenges encountered
  - Parts manufacturing and procurement
  - COVID-19
- Working to schedule as implemented in August 2020
  - Integrated ground testing targeted to start this fall
  - First flight targeted for summer 2022



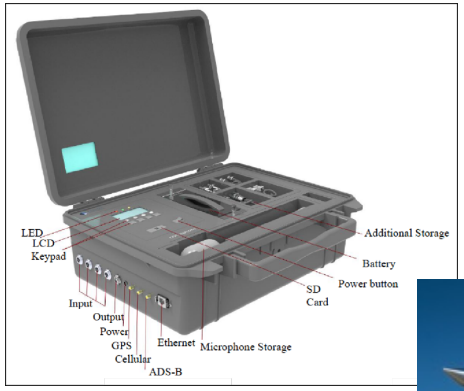
Vertical Tail / Rudder Assembly May 2021

Major Assembly Mate Complete May 2021

Low-Boom Flight Demonstrator (LBFD)
Acoustic Validation & Community Response Preparations

Acoustic Measurement

- Ground Recording System being developed by Crystal Instruments, Inc
  - New system meets challenging requirements for X-59 mission
  - Phased delivery of 125+ units to support Phase 2 & 3 measurement
- Progress continues on airborne acoustic measurement systems
  - CoVID-19 is slowing effort, but not yet impacting major milestones



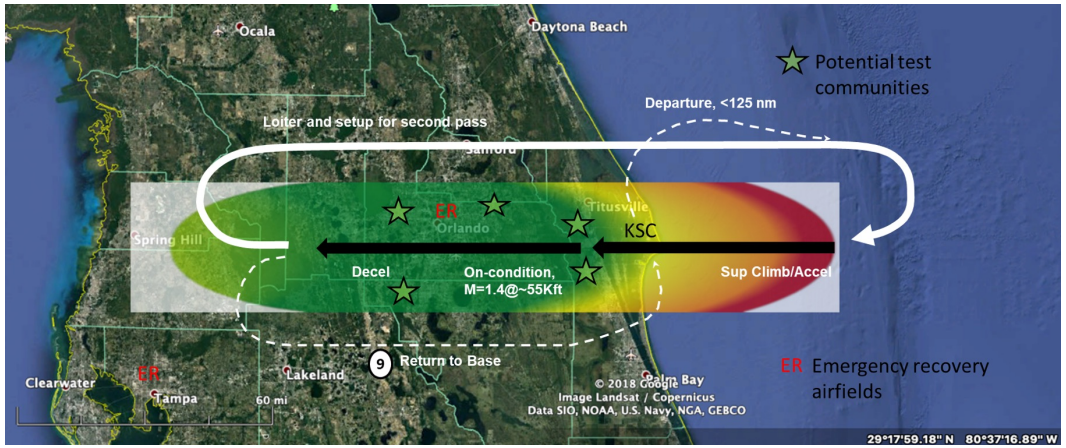
Community Test Planning & Execution

- Community Response Testing support contract awarded to HMMH
- Test and survey plans in development
- Airfield and community selection process ongoing

International Standards Development

- Continued engagement with FAA/AEE, ICAO/CAEP & international research community
- Second virtual International Workshop planned for later this year

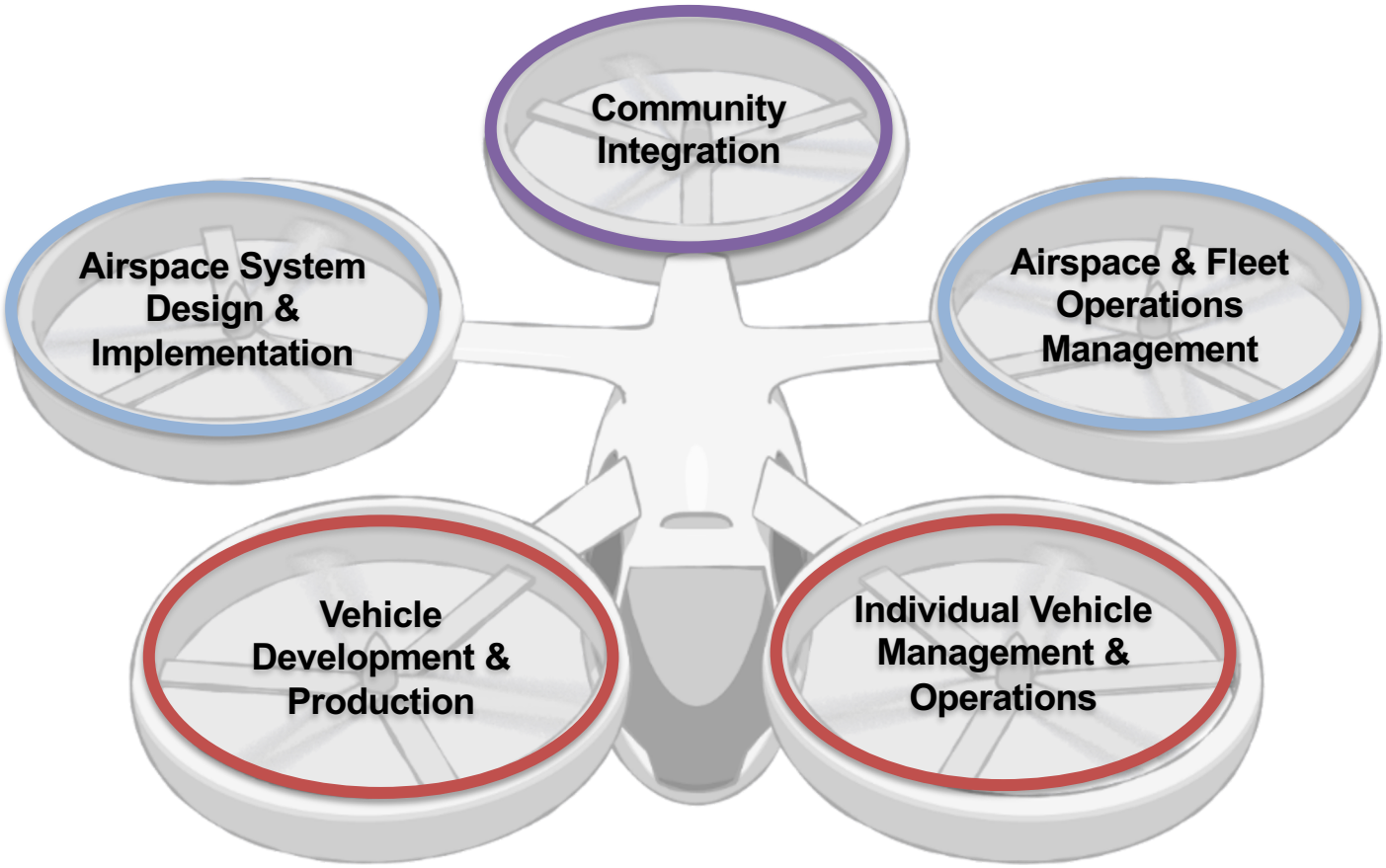
For more information, see the Aug. 2021 video newsletter: https://youtu.be/HHeS7-xgois



Representative Mission for Potential Airfield/Community Selection Studies

Advanced Air Mobility Mission

Safe, Quiet, and Affordable Vertical Lift Air Vehicles



Community Integration

Airspace Design & Operations

Vehicle Development & Operations

AAM Critical Commitment

Deliver a validated
1) system architecture with
2) corresponding requirements and guidelines

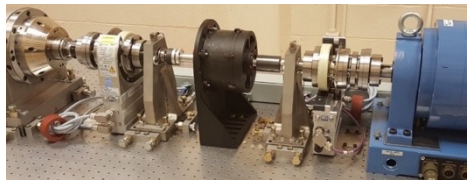
for a safe and scalable AAM transportation system.

Advanced Air Mobility (AAM) Vision

Revolutionize mobility in and around metropolitan areas by enabling a safe, efficient, convenient, affordable, and accessible air transportation system for passengers and cargo

Revolutionary Vertical Lift Technologies Project
FY21-23 Research Focus

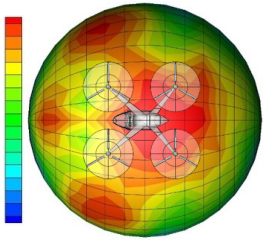
Vehicle Propulsion Reliability



Reliable & Efficient Propulsion Components for UAM

- Re-configure labs for electric propulsion testing
- Conduct initial single string tests
- Develop tools to assess motor reliability & high reliability conceptual motor design

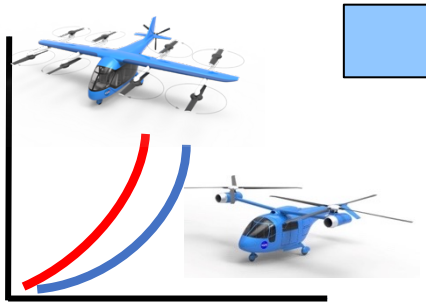
UAM Fleet Noise



UAM Operational Fleet Noise Assessment

- Generate Noise Power Distance (NPD) database for several UAM ref. configurations & trajectories
- Conduct Fleet Noise assessments
- Initiate psychoacoustic testing to assess human response to UAM vehicles

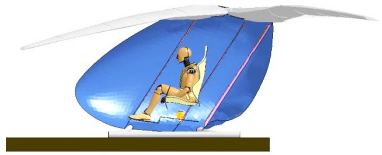
Noise and Performance



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

- Plan/conduct validation experiments
- Improve efficiency & accuracy of conceptual design tools
- Conduct high-fidelity configuration CFD for validation/reference
- Improve community transition & training for analysis tools

Safety and Acceptability

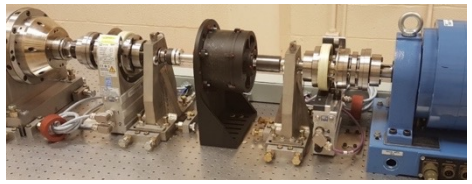


Targeted Research Areas

- Occupant protection & survivability
- Acceptable handling/ride qualities
- Ice accretion and shedding

Revolutionary Vertical Lift Technologies Project
FY21-23 Research Focus; Recent Technical Progress

Vehicle Propulsion Reliability

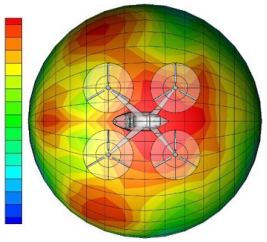


Reliable & Efficient Propulsion Components for UAM

- Re-configure labs for electr
- Conduct initial single string
- Develop tools to assess motor reliability & high reliability conceptual motor design

Completed two advanced motor conceptual designs and reliability assessment (Balcones, Univ of Wisconsin)

UAM Fleet Noise

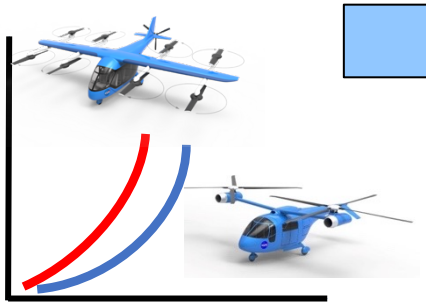


UAM Operational Fleet Noise Assessment

- Generate Noise Power Distance (NPD) databas
- Conduct Fleet Noise assessments
- Initiate psychoacoustic testing to assess humar

Completed Gen 2 Fleet Noise Assessment - including impact of broadband noise & further refined for better determination of noise exposure in vicinity of vertiports

Noise and Performance

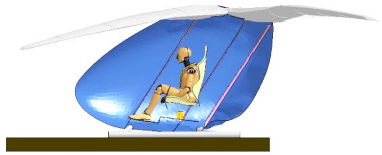


Tools to Explore the Noise & Performance of Multi-Rotor UAM Vehicles

- Plan/conduct validation experiments
- Improve efficiency & accuracy of co
- Conduct high-fidelity configuration C
- Improve community transition & trai

Completed conceptual design & sizing trade studies for Vertical Take Off and Landing (VTOL) UAM configurations. Paper: Practical Conceptual Design of Quieter Urban VTOL Aircraft (ref #20210014173, NASA Technical Reports Server)

Safety and Acceptability



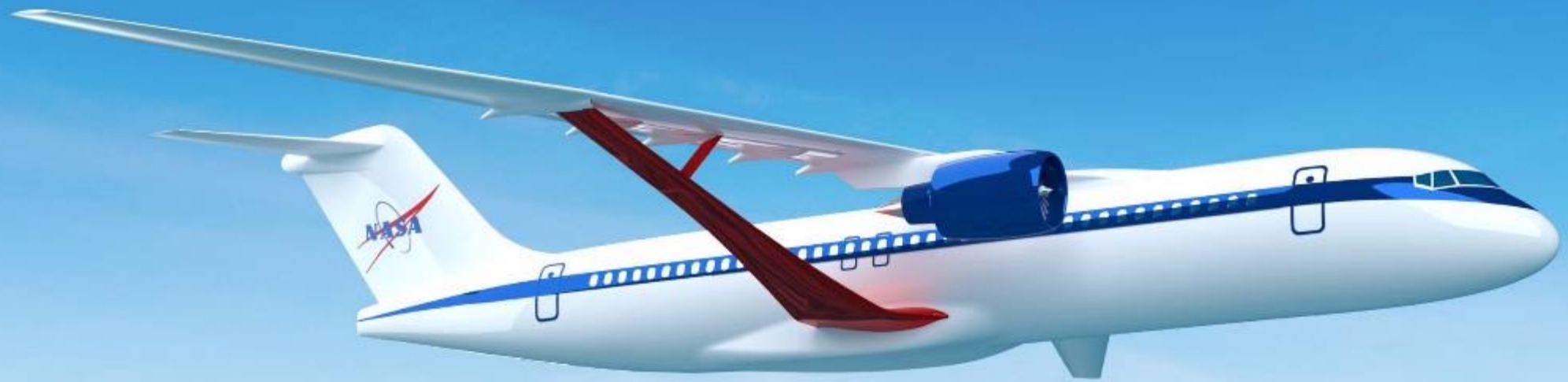
Targeted Research Areas

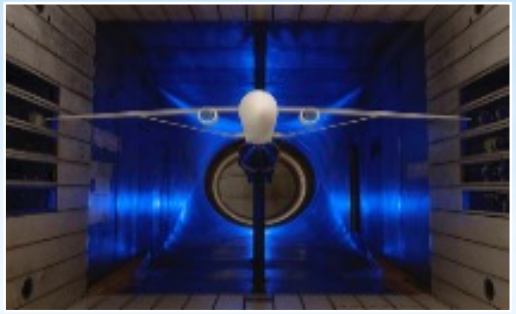
- Occupant protection & survivability
- Acceptable handling/ride qualities
- Ice accretion and shedding

List of FAA & standard-setting organization engagements available upon request.

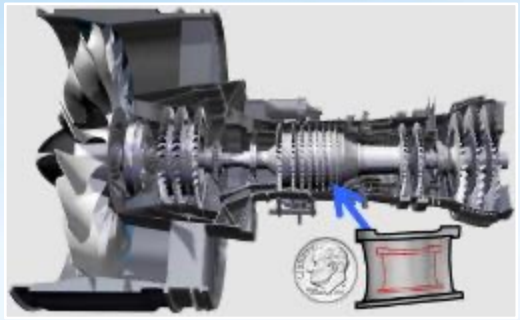
Subsonic Transport Technologies

Ensure U.S. industry is the first to establish the new “S Curve” for the next 50 years of transports

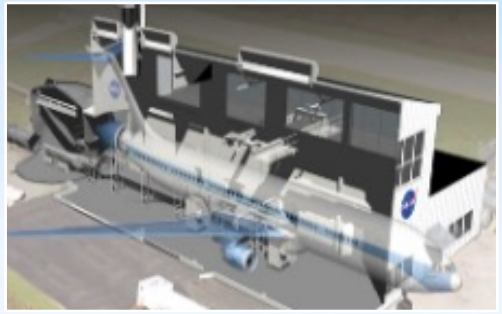




Transonic Truss-Braced Wing
5-10% fuel burn benefit



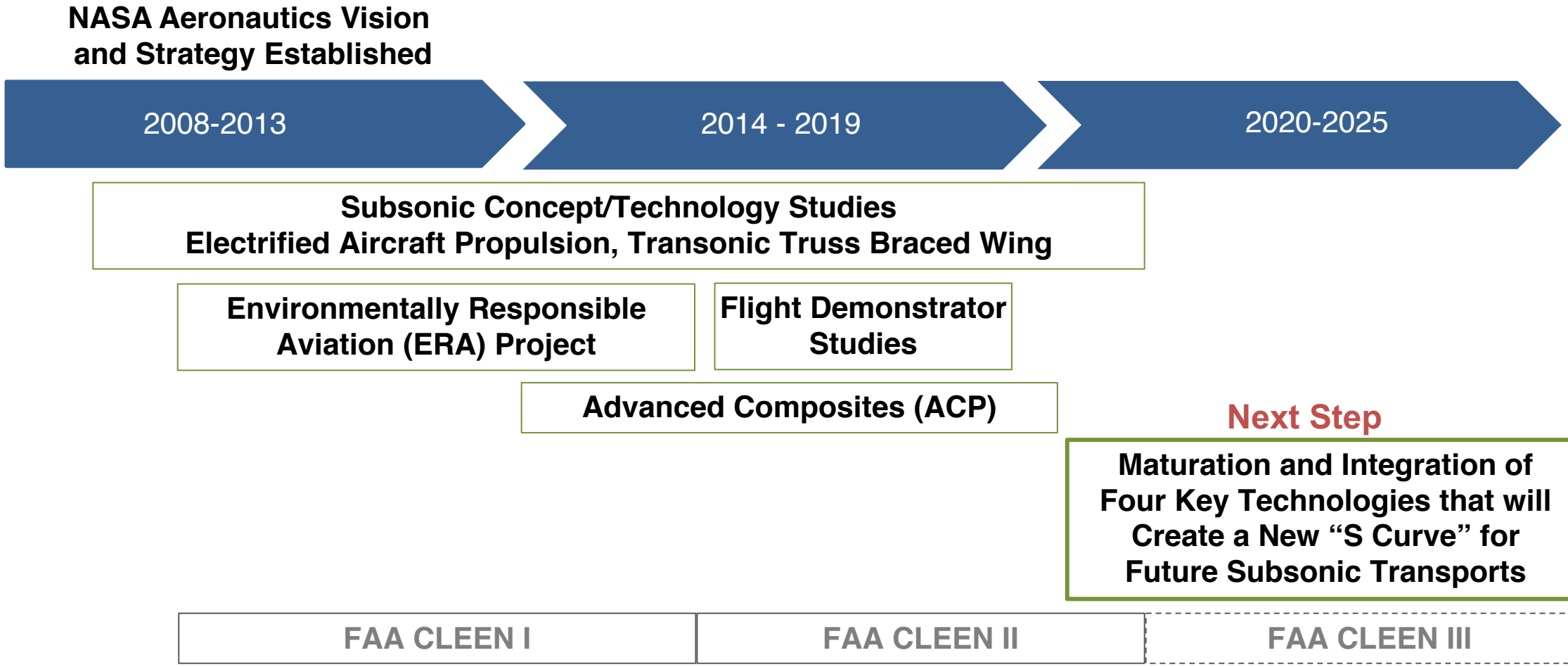
Small Core Gas Turbine
5-10% fuel burn benefit



Electrified Aircraft Propulsion
~5% fuel burn and maintenance benefit

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

Subsonic Transport Technology Prioritization



ARMD Subsonic Transport Strategy Based on over a Decade of Research, Concept and Technology Development, and NASA-Industry Partnership

Next Gen Transports: Integrated Technology Development

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

Technology Readiness Target

Model Based System Analysis & Engineering

Sustainable Flight Demonstrator

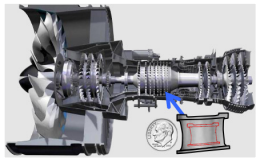
Flight Test

AATT – Ultra Efficient Wing (TTBW)

Leverage the Asset – Future Spirals

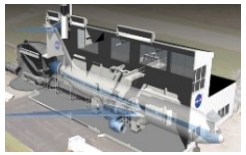
Hi-Rate Composite Aircraft Manufacturing (HiCAM)

Mfg Demo & Structural Test



Hybrid Thermally Efficient Core (HyTEC)

Core Demonstration & Test



Electrified Powertrain Flight Demonstration

Flight Test

AATT - Electrified Aircraft Propulsion

Planned

Notional

Oct. 2021

Achieve TRL 6 in time for Industry Product Decision-Making

Next Gen Transports: Integrated Technology Development

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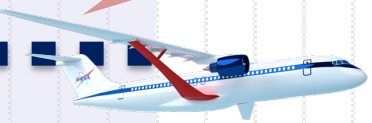


Sustainable Flight Demonstrator

Flight Test

Leverage the Asset – Future Spirals

AATT – Ultra Efficient Wing (TTBW)

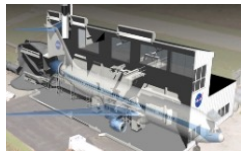
EPFD: Recently awarded two industry teams (General Electric & MagniX) to accelerate integrated megawatt-class powertrain system maturation and transition to the global fleet. Efforts to help identify/address gaps in regulations/standards and acquire ground/flight test data to advance design/modeling tools.

(HiCAM)

AATT/Electrified Aircraft Propulsion: Testing underway at the NEAT Facility with industry partners in MW-class components and powertrains – advancing MW-class powertrain components to TRL 6 and powertrains to TRL 4 for further maturation in flight.

Core (HyTEC)

Notional



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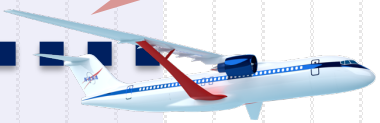


Sustainable Flight Demonstrator

Flight Test

Leverage the Asset

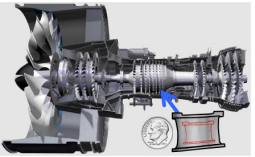
AATT – Ultra Effi

- Recently awarded six contracts for small-core turbofan technologies to TRL 4/5 by 2023 – targeting single-aisle class aircraft.
- Another NRA solicitation being formulated – for small core combustor design/operability using 100% SAF
- In partnership with GE Aviation: Testing underway to advance CMC turbine blade durability & design work on-going preparing for FY23/24 Turbofan Power Extraction Demo

Hi-Rate Composi

Manufacturing

(HiCAM)



Hybrid Thermally Efficient Core (HyTEC)

Core Demonstration & Test

Planned

Notional

Electrified Powertrain Flight Demonstration

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Next Gen Transports: Integrated Technology Development

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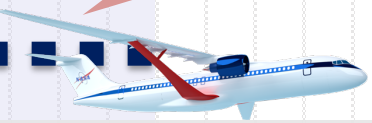
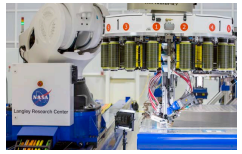


Sustainable Flight Demonstrator

Flight Test

Leverage the Asset – Future Spirals

AATT – Ultra Efficient Wing (TTBW)



Hi-Rate Composite Aircraft Manufacturing (HiCAM)

Mfg Demo & Structural Test

Hybrid Thermally Efficient Core (HyTEC)

Core Demonstration & Test

Planned

Notional

Electr

AATT - Electrified Aircraft Propulsion

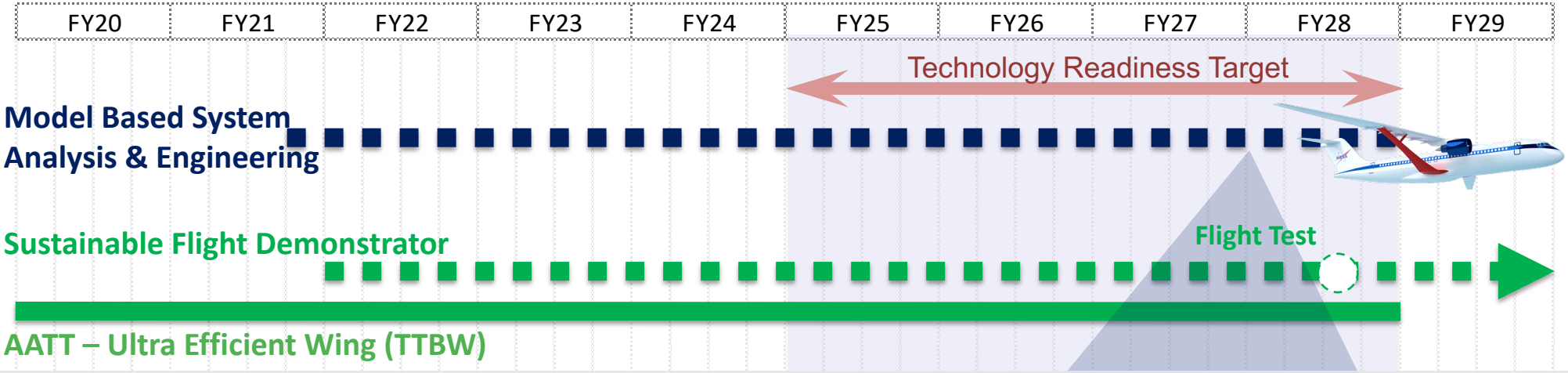
Formulation activities underway – 12 teams leveraging Advanced Composites Consortium

- System Requirements and Baseline Definition
- Technology Assessments & Roadmaps

Formal project approval meeting set for January 2022

Achieve TRL 6 in time for Industry Product Decision-Making

Next Gen Transports: Integrated Technology Development



Sustainable Flight Demonstrator: Early-stage planning underway. Risk reduction contracts in place.

Ultra Efficient Wing (TTBW): High-lift model recently completed low-speed tests in the NASA Langley 14x22 wind tunnel. Data analysis underway. Buffet & high-speed tests planned for near future.

Other Key Takeaways

- Overall support from key stakeholders continues to be strong – ARMD research efforts well synchronized with FAA and are consistent with Administration environmental sustainability priorities.
- Four new projects in various stages of ramp up in FY22
  - Hybrid Thermally-Efficient Core (HyTEC) Project – in full implementation
  - Hi-Rate Composite Aircraft Manufacturing (HiCAM) Project – in final stages of implementation planning
  - Electrified Powertrain Flight Demonstration (EPFD) Project - recent source selections for maturing MW-class electrified aircraft powertrain technology through ground and flight tests (General Electric & MagniX USA)
  - Sustainable Flight Demonstrator (SFD) Project – in early-stage planning
- NASA Research Centers safely restarting key, mission-critical test facilities and research efforts on-site. Progress is being made – Centers are up to the 25-50% onsite workforce limits.
- Continuing to strengthen coordination efforts with the FAA
  - Office of Environment & Energy (AEE) – technical personnel engagement & insights, programmatic reviews & assessments
  - Office of Policy & Innovation (AIR-600) – coordination framework in development & review engagement
  - Tech Center – technical interfaces & working groups

Thank you