



Advanced Aircraft Concepts for Environmental Sustainability (AACES) 2050: Overview

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NASA Aeronautics Mission Directorate
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Agenda



- Background
- Solicitation Overview
- Funded Awards
- Questions and Reflections





Background

U.S. Aviation Climate Action Plan

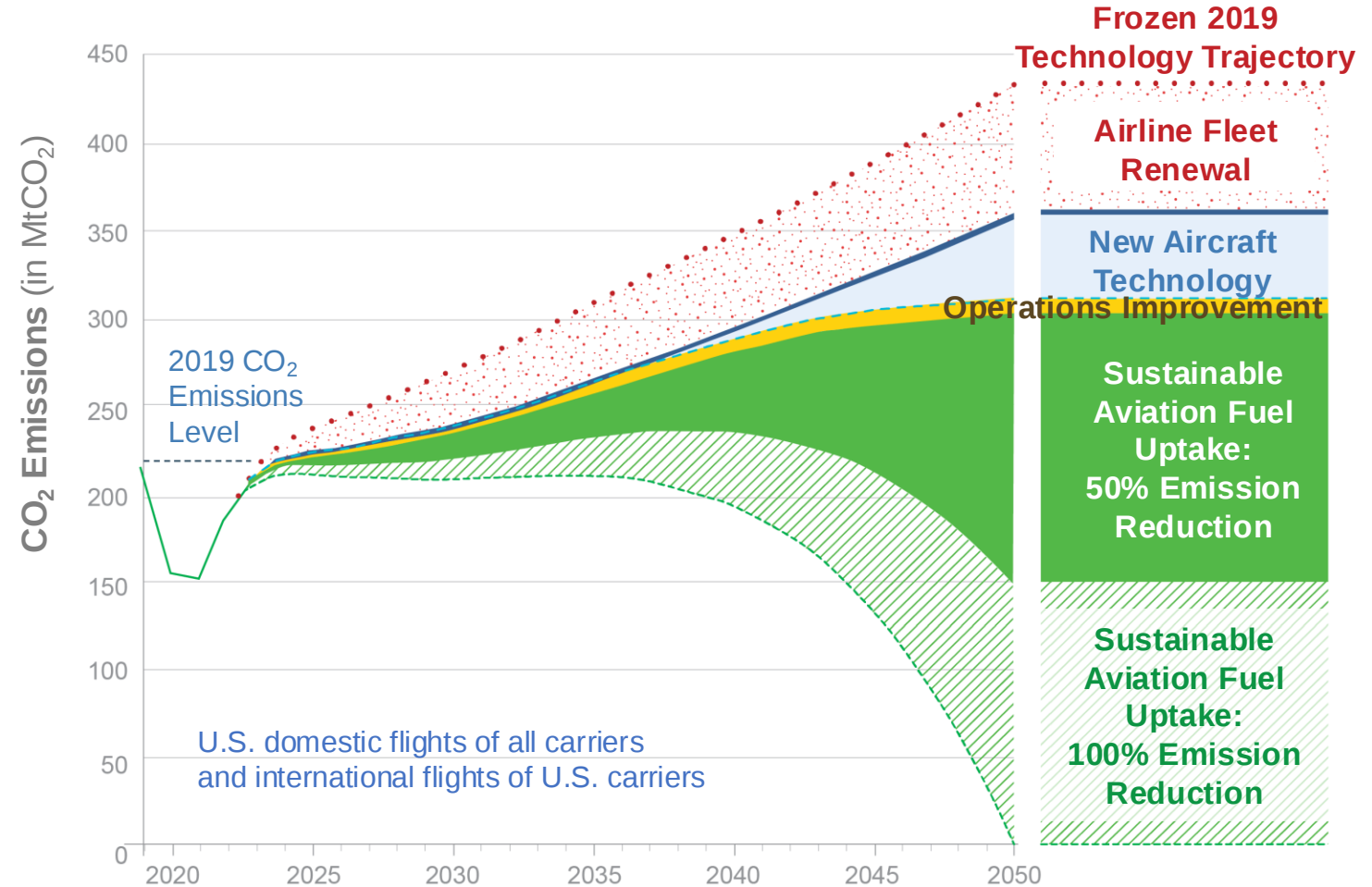
Global Context for Sustainable Aviation

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

U.S. Aviation Climate Action Plan is aligned with

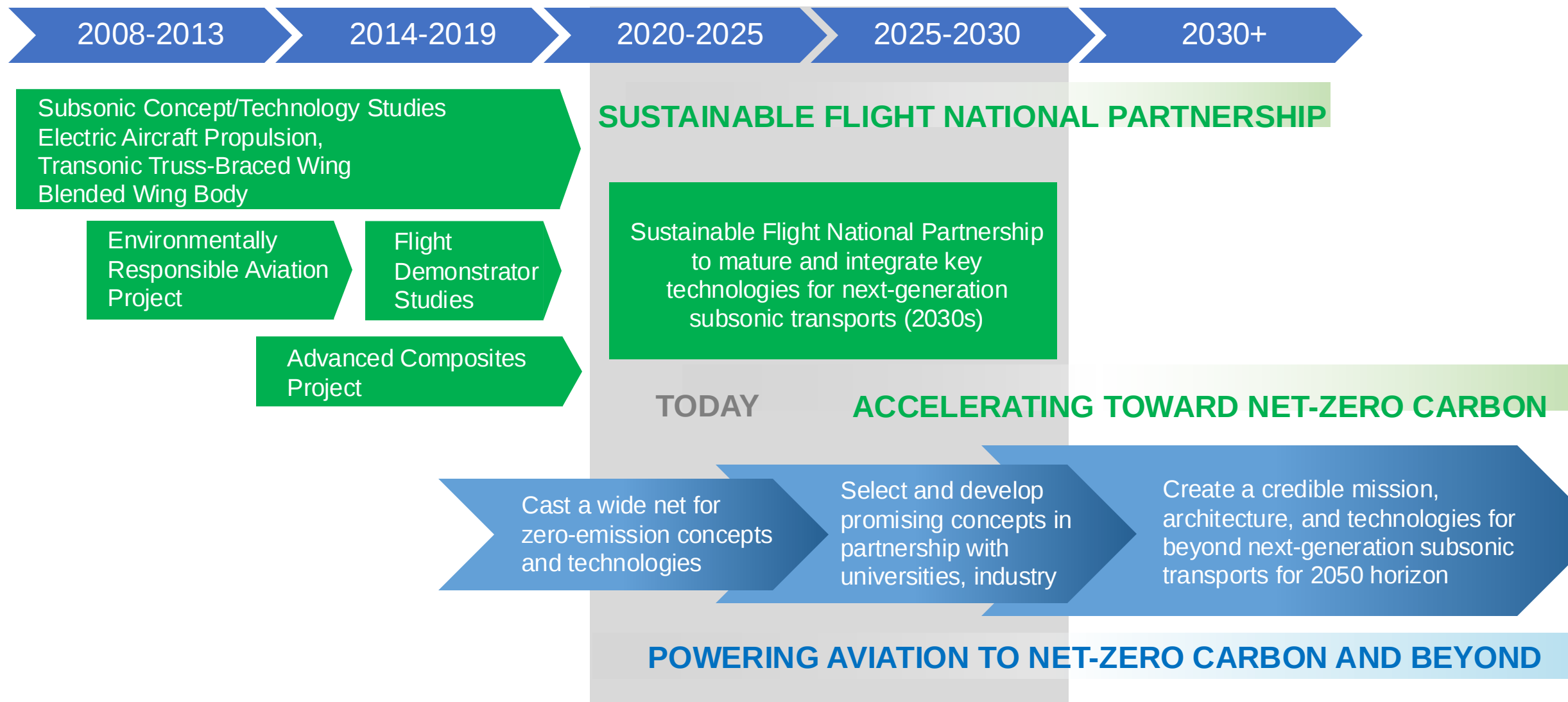
- U.S. economy-wide goal
- International Civil Aviation Organization
- Air Transport Action Group

https://www.faa.gov/sites/faa.gov/files/2021-11/Aviation_Climate_Action_Plan.pdf



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

NASA Sustainable Aviation Strategy



Investment in innovation today paves the way to a net-zero carbon and beyond aviation future.

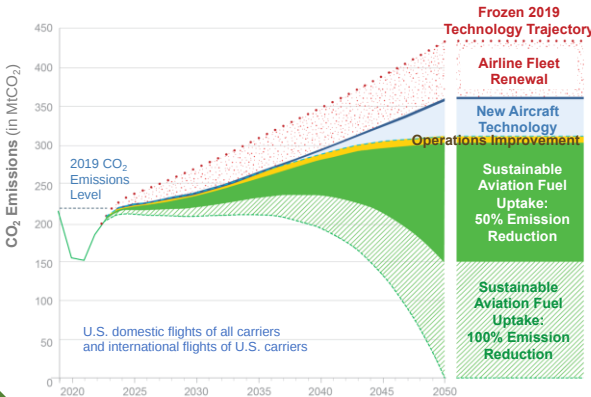
The Long Game: Aviation Eras on the Path Toward Sustainability



Net-Zero GHG, 2050



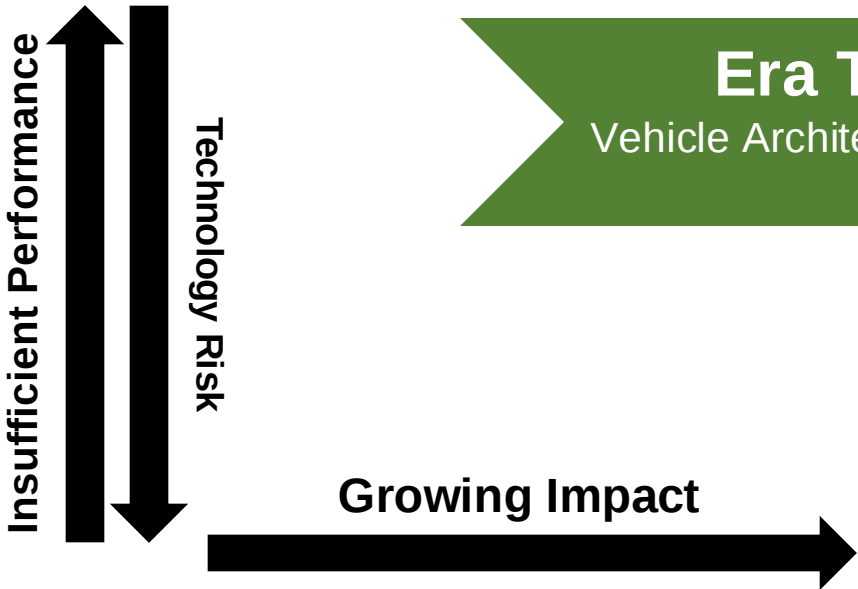
Era One: Evolution (*Change is Coming*)
Tube-and-Wing, Existing Infrastructure, Transition to Drop-In SAF, Increasing Electrification



Era Two: Revolution (*SFNP Realized*)
Vehicle Architecture Change, Major SAF Adoption, Mild Hybrid EAP, Minor Infrastructure Change

Era Three: Transformation (*Paradigm Shift*)
Major Vehicle Architecture Change, Non-Drop-In Fuel Adoption, Many-MW EAP, Major Infrastructure Change

Exploration!



Data-Driven Strategy Development



Recent ARMD Strategy Studies:

- *Long-Term Propulsion Strategy Plan*
- *Materials, Structures, and Manufacturing (MSM) Strategy Plan*
- *EAP Strategy Refinement Study*
- *Future Flight Demonstrations and Experimentations Study*
- *High-Speed Strategy Plan*

NASA Concept/Technology Studies and Workshops:

Vision Vehicle Integrated Design for Sustainability (Ongoing, ISAT)
TACP Studies (Ongoing, CAS/TTT/UI)
Cryo Fuels Workshop (2022)

AACES Phase One Awards:

Public announcement imminent

Stakeholder Engagements:

Technical Interchange Meetings
Industry Days
RFIs

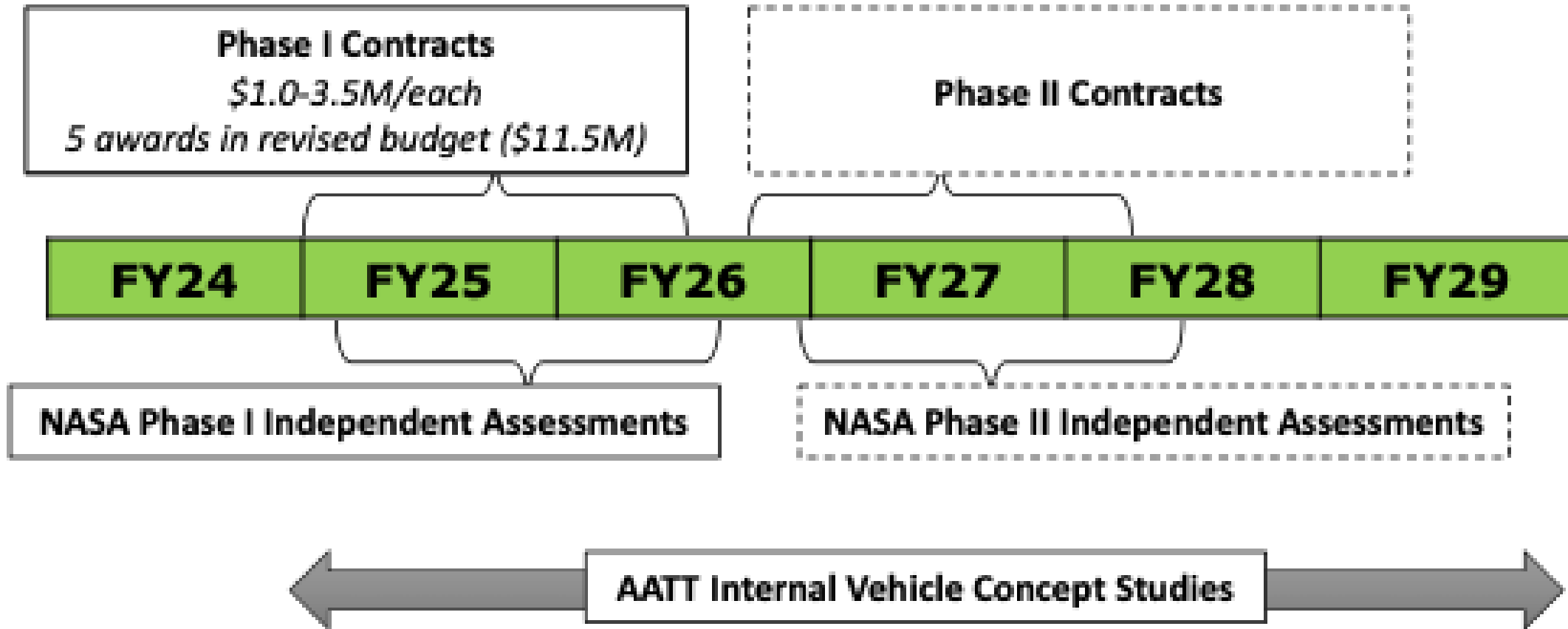
Studies, Papers, and Reports:

OGA Strategy Reports
ICAO LTAG Reports
Technical Papers

+

***Transforming Aviation Beyond SFNP (TABS):
Integrated Technical Strategy Development***

AACES 2050 Planning and Approach



The AACES 2050 study is an important investment for NASA to identify promising aircraft concepts and enabling technologies, which will continue to reduce aviation's environmental impact beyond the SFNP

Data-Driven Strategy Development



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***Transforming Aviation Beyond SFNP (TABS):
Integrated Technical Strategy Development***



Phase I Solicitation Overview



Phase I Goals

- Develop or identify a future scenario(s) that supports adoption of advanced technologies, subsystems, and aircraft concepts
- Identify critical technologies, subsystems, and aircraft concepts for mid-century sustainable aviation
- Evaluate the technologies, subsystems, and aircraft concepts against metrics
- Develop technology roadmaps with associated risks for enabling technologies and concepts not currently used in commercial aviation

NRA Solicitation



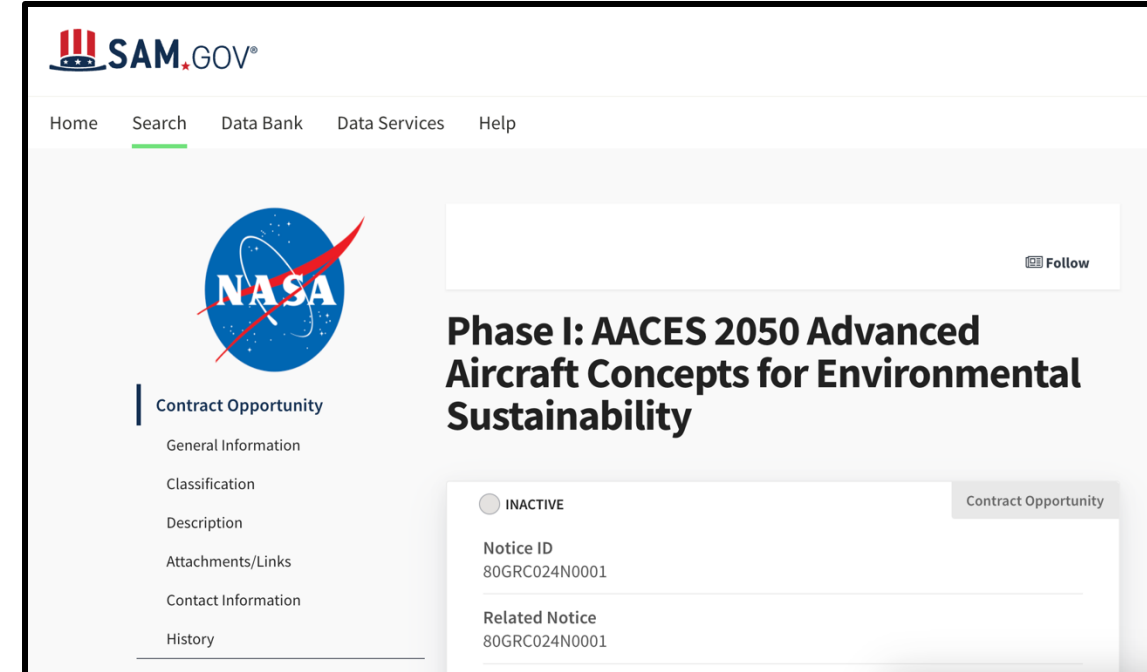
5.1 Future Scenarios Development (required)

5.2 Technology and Subsystem Exploration (required)

- Technology and Subsystem Exploration Trade Study Task
- Detailed Technology or Subsystem Description Task
- Technology Development Roadmaps Task

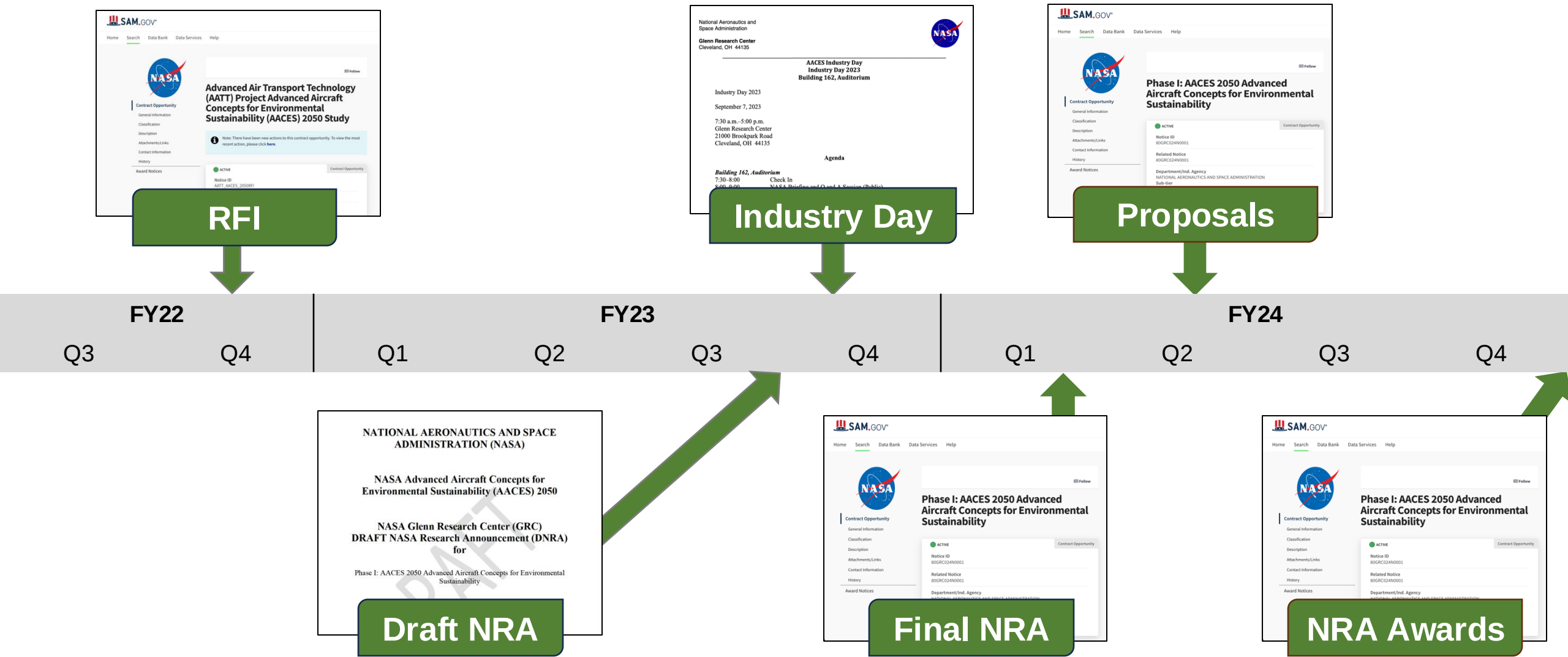
5.3 Aircraft Concept Exploration (optional)

- Aircraft Exploration Trade Study Task
- Detailed Aircraft Description Task
- Aircraft Concept Development Roadmaps Task



<https://sam.gov/opp/8aee2665a3964bec98fa032f97348680/view>

Timeline to First Award



The final AACES 2050 NRA RFP builds on a foundation of stakeholder engagement, including robust RFI response, well-attended Industry Day, and sustained partner Q&A through the procurement. ¹³



Phase I Funded Awards Overview

AACES 2050 NRA Awards



A Boeing Company



JetZero



Scenario Development, Technology and Subsystem Exploration, Advanced Concept Exploration

Partners:

Boeing, MIT, Penn State, University of Michigan

PoP: 18-months

Award: \$3.302M



(Image Credit: Aurora Flight Science, Used with Permission)

“Aurora Flight Sciences, a Boeing Company, whose team will perform a comprehensive, “open-aperture” exploration of technologies and aircraft concepts for the 2050 timeframe. This will include examining new alternative aviation fuels, propulsion systems, aerodynamic technologies, and aircraft configurations along with other technology areas that arise throughout the study.”

NASA Web Release, Nov 12, 2024

Scenario Development, Technology and Subsystem Exploration, Advanced Concept Exploration

Partners:

Honeywell, University of Michigan, MIT, Lockheed Martin

PoP: 18-months

Award: \$3.485M



(Image Credit: Electra, Used with Permission)

“The **Electra**-led team will explore extending Electra’s novel distributed electric propulsion and its unique aerodynamic design capabilities to develop innovative wing and fuselage integrations that deliver sustainable aviation focused on enabling community-friendly emission reduction, noise reduction, and improved air travel access. The company’s existing small aircraft prototype has been flying for over a year, demonstrating Electra’s technology that aims to transform air travel with reduced environmental impact and improved operational efficiency.”

NASA Web Release, Nov 12, 2024



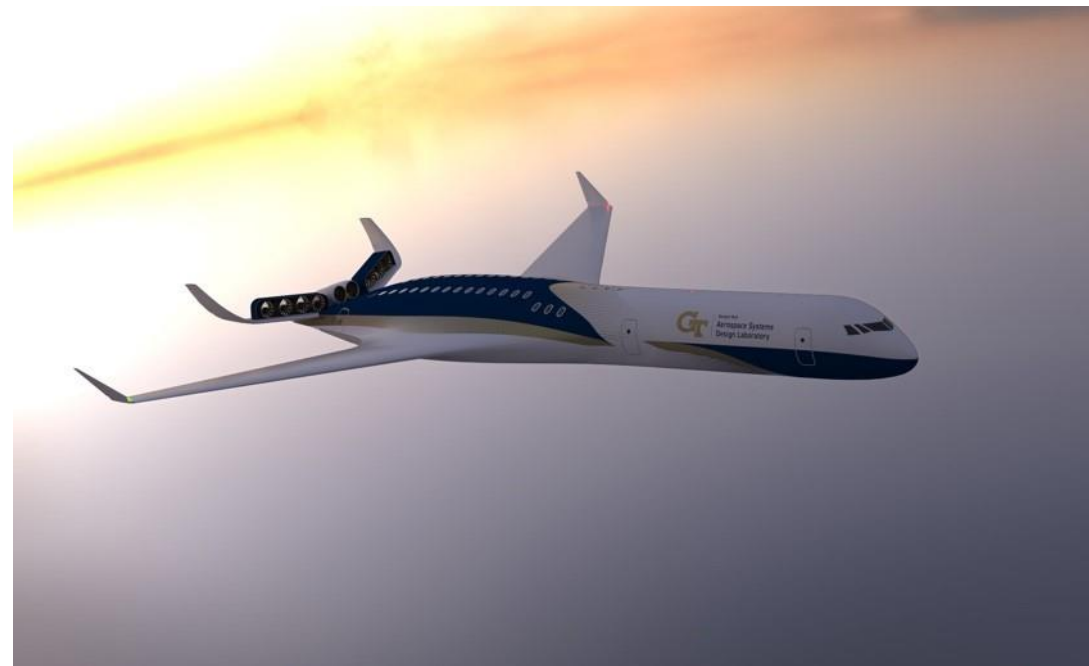
Scenario Development, Technology and Subsystem Exploration, Advanced Concept Exploration

Partners:

None

PoP: 18-months

Award: \$1.368M



(Image Credit: Georgia Institute of Technology, Used with Permission)

“Georgia Institute of Technology will perform a comprehensive exploration of sustainability technologies, including alternative fuels, propulsion systems, and aircraft configurations. The institute’s team will then explore new aircraft concepts incorporating the selected technologies with their Advanced Technology Hydrogen Electric Novel Aircraft (ATH2ENA) as a starting point.”

NASA Web Release, Nov 12, 2024

Scenario Development, Technology and Subsystem Exploration, Advanced Concept Exploration

Partners:

University of Illinois Urbana-Champaign, Northrop
Grumman

PoP: 18-months

Award: \$2.152M



(Image Credit: JetZero, Used with Permission)

“JetZero will explore technologies that enable cryogenic, liquid hydrogen to be used as a fuel for commercial aviation to reduce greenhouse gas emissions. These technologies will be evaluated on both tube-and wing and JetZero’s blended wing body – an airplane shape that provides more options for larger hydrogen fuel tanks within the aircraft.”

NASA Web Release, Nov 12, 2024



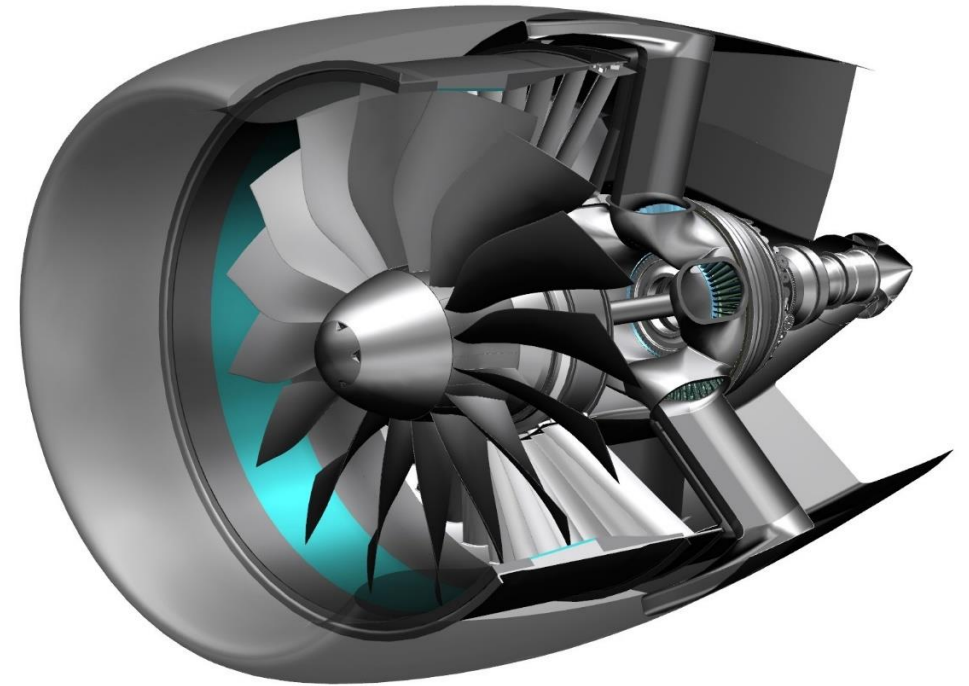
Scenario Development, Technology and Subsystem Exploration

Partners:

None

PoP: 12 months

Award: \$1.200M



(Image Credit: Pratt & Whitney, Used with Permission)

“Pratt and Whitney a division of RTX Corporation, will explore a broad suite of commercial aviation propulsion technologies targeting thermal and propulsive efficiency improvements to reduce fuel consumption and greenhouse gas emissions. The Pratt & Whitney team will then down-select high-priority and alternative propulsion concepts for potential integration studies with various airframe concepts for aircraft in 2050 and beyond.”

NASA Web Release, Nov 12, 2024

Exploring a Broad State Space of Far Term Technologies



Energy Carriers

- Jet-A/SAF
- Hydrogen
- Methane/Natural Gas
- Ammonia
- Batteries
- Etc.

Powertrains & Propulsors

- Gas Turbines
- Electric Systems
- Hybrid Systems
- Fuel Cells
- Ducted Fans
- Open Fans
- Etc.

Aerodynamic Technologies

- Distributed Propulsion
- Boundary Layer Ingestion
- Blown Lift
- Over Wing Nacelle
- Etc.

Airframe Configurations

- Tube and Wing
- Transonic Truss-Braced Wing
- Blended Wing Body
- Etc.

Aircraft Size Classes

- Small Narrow Body
- Large Narrow Body
- Small Wide Body
- Large Wide Body

With five funded awards, ARMD is exploring a diverse and expansive state space of potential technologies for mid-century aviation EIS impact.



Reflections and Discussion

Reflections and Next Steps



- Interviews with N+3 organizers provided significant value and guidance to solicitation formulation, approach, and independent assessment planning
- An after-action review will be used to explore ways the solicitation process, and especially timeline, could be improved
- Far term Ultra Efficient Airlines Transformation strategy and portfolio development hinges on successful performance of AACES phase one awards, but not without several additional ongoing and planned internal studies and stakeholder engagement activities
- Independent assessment of contractor concepts and technologies will not wait; NASA internal configurators and systems analysts will be working alongside phase one partners to ensure results of these studies can be leveraged as soon as possible
- Kickoff meetings with all five contractors will be completed soon

Discussion Topics



AACES phase one awards are designed to leave no 'stone unturned,' ideally exploring vision concepts and technologies across the wide state space of possibility.

- Are the phase one awards complete in this way? Are we missing any areas exploration?

AACES phase one awards, including partners and subcontractors, represent an especially diverse collection thought across industry/academia.

- Are the phase one awards missing any critical group representation across industry/academia?

AACES may uncover compelling technologies or concepts beyond ARMD's future budget or risk tolerance, but that nonetheless could revolutionize aviation.

- How to identify opportunities for investment outside of NASA for these technologies or concepts? How to begin planning for this possibility with stakeholders across the USGOV?

The scope of AACES Phase One is necessarily limited by budget.

- How should NASA consider partnership across the USGOV to maximize the return on investment for these awards?

