

Environment & Energy Research & Development Portfolio Overview

Prepared for: REDAC E&E Subcommittee

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Office of Environment and Energy
Federal Aviation Administration

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Federal Aviation
Administration

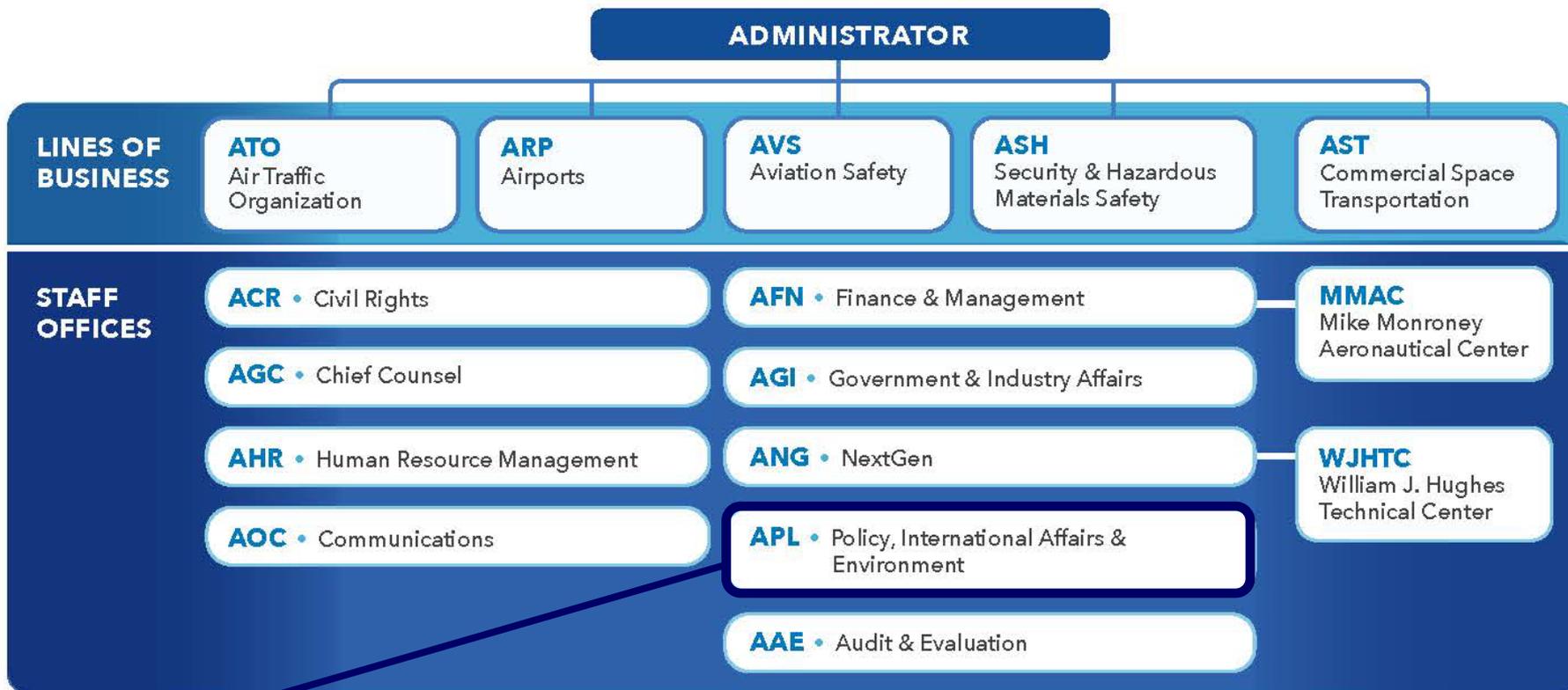


Presentation Outline

- **Office of Environment and Energy – Background & E&E Strategy Overview**
- **ASCENT COE Summary**
- **Highlights of R&D Program**
- **Discussion on Noise, Climate Change and the Direction of the E&E Portfolio**
- **Budget Profile for E&E Portfolio**
- **Summary**
- **Background - Budget and ASCENT COE**



FAA Organizational Structure



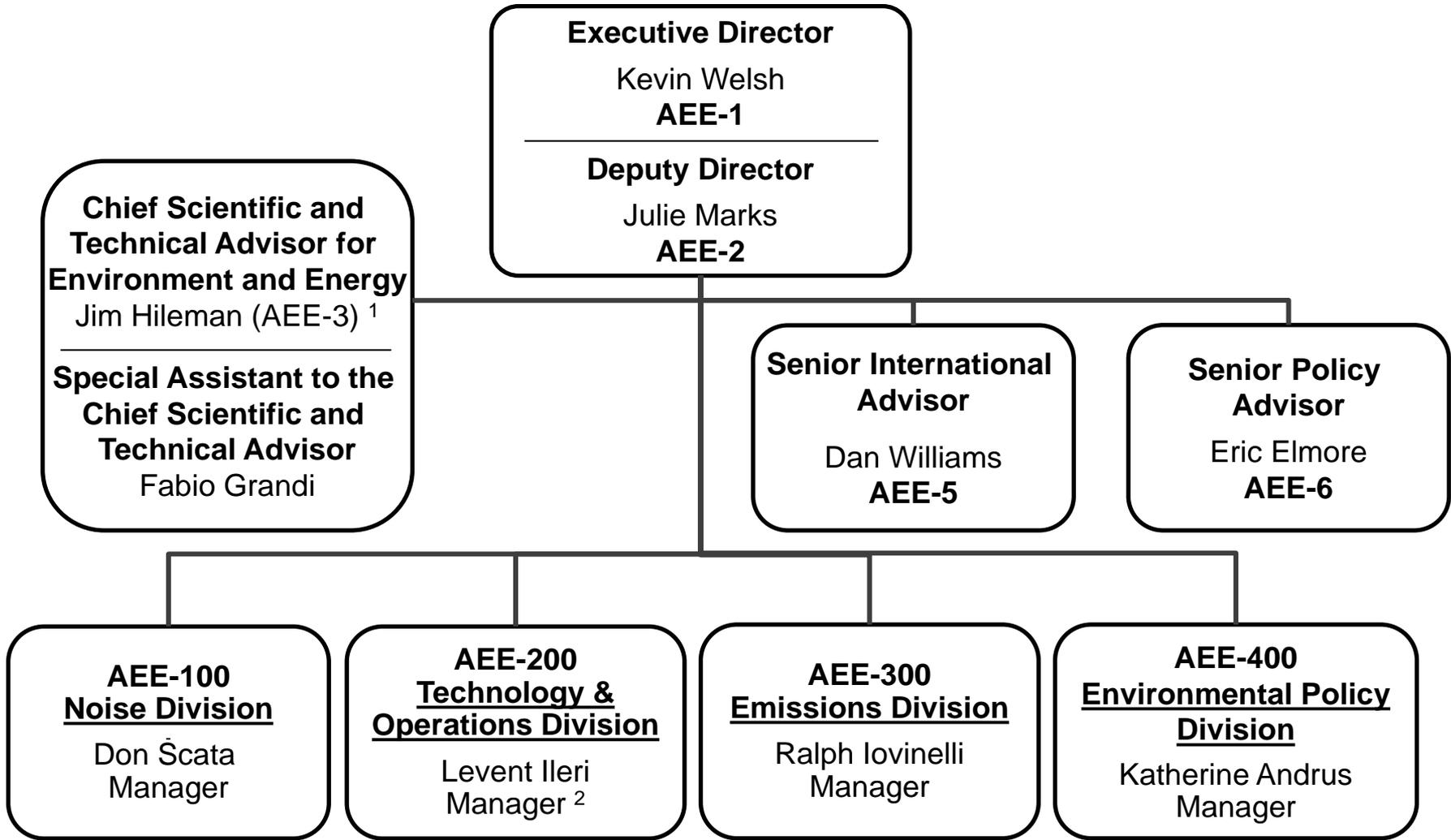
Office of Environment and Energy (AEE)

- Office within APL, responsible for broad range of environmental policies
- Roughly 45 staff members
- Responsible for roughly one-fourth of FAA RE&D Budget



AEE Organizational Structure

Effective 3/28/2021



¹ ASCENT Program Manager, as a subset of his Chief Scientist duties

² CLEEN Program Manager, as a subset of his Division Manager duties

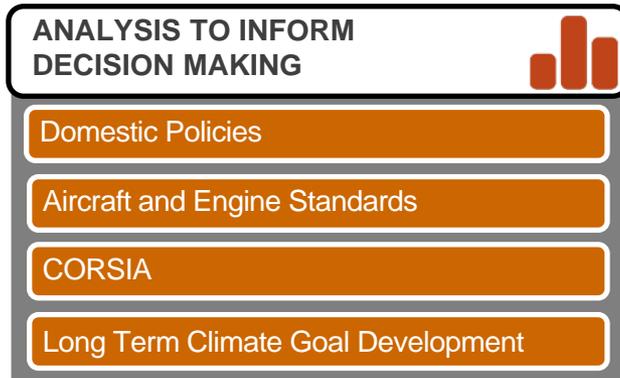
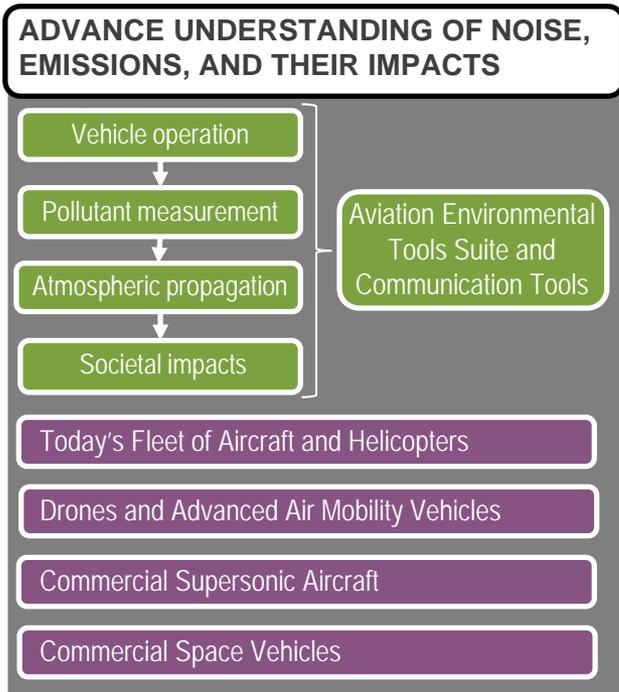


Environmental & Energy (E&E) Strategy

E&E Mission: *To understand, manage, and reduce the environmental impacts of global aviation through research, technological innovation, policy, and outreach to benefit the public*

E&E Vision: *Remove environmental constraints on aviation growth by achieving quiet, clean, and efficient air transportation*

E&E R&D Portfolio Activities & Programs



www.faa.gov/go/cleen/



ASCENT COE Update



ASCENT Research Portfolio

Portfolio covers broad range of topics on Alternative Jet Fuels, Emissions, Noise, Operations, and Analytical Tools

Over last few years have stood up many projects to advance aircraft technology innovation and supersonic flight

Projects listed by topic: <https://ascent.aero/projects-by-topic/>

ASCENT Leadership

- Mike Wolcott of WSU - Director
- John Hansman of MIT - Co-Director
- Carol Sim of WSU - Assistant Director

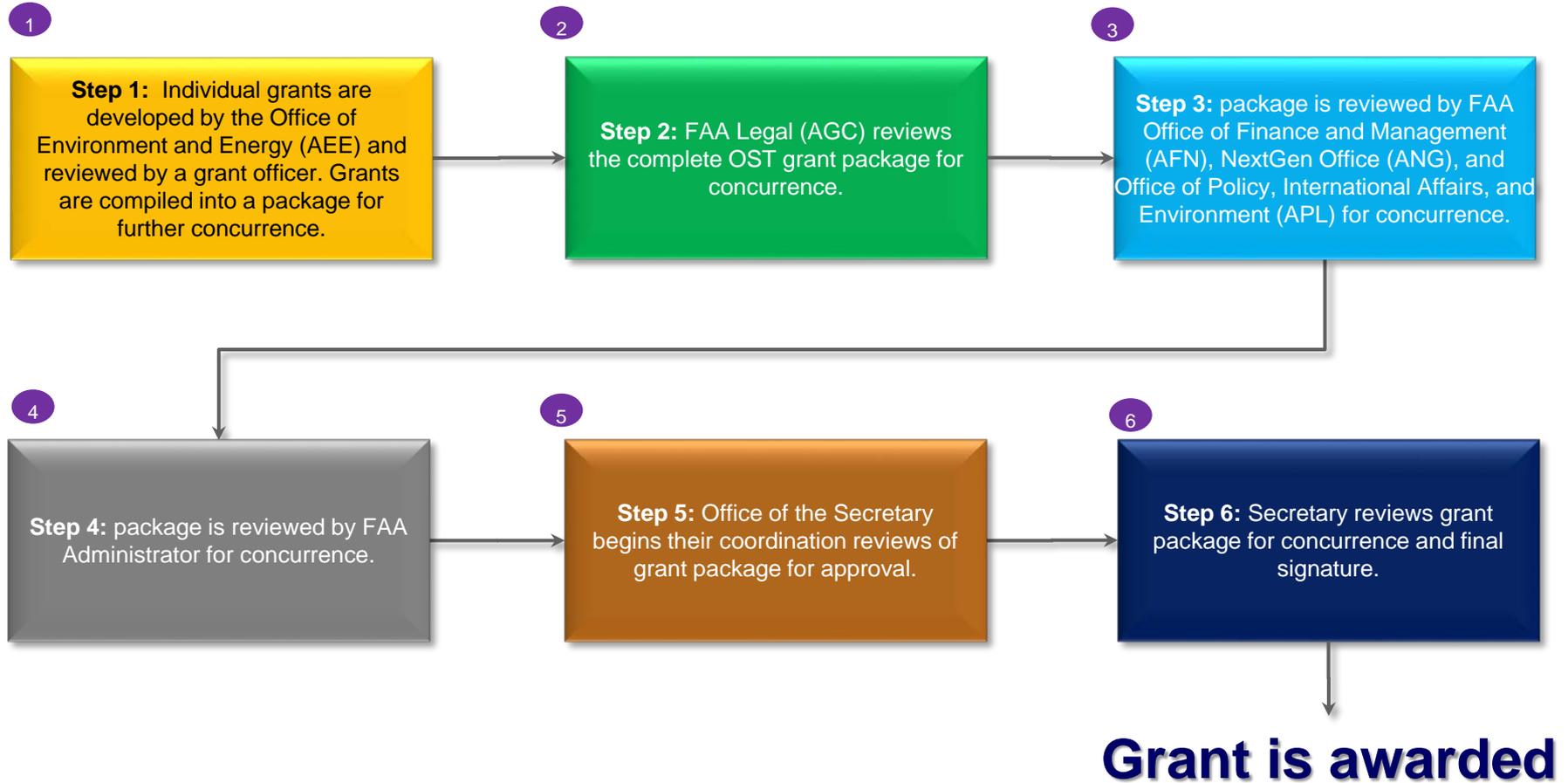
ASCENT Annual Technical Report Summaries*

	Report 1	Report 2	Report 3	Report 4	Report 5	Report 6
Time period	9/2013 – 9/2015	10/2015 – 9/2016	10/2016 – 9/2017	10/2017 – 9/2018	10/2018 – 9/2019	10/2019 – 9/2020
Research Projects	50	54	43	32	30	60
Publications, Reports, and Presentations	137	119	110	179	166	125
Students involved	131	112	105	116	236	186
Industry partners	63	70	72	72	76	57

* ASCENT Annual Tech Reports available for download at: <https://ascent.aero/resources>



COE Grant Approval Process

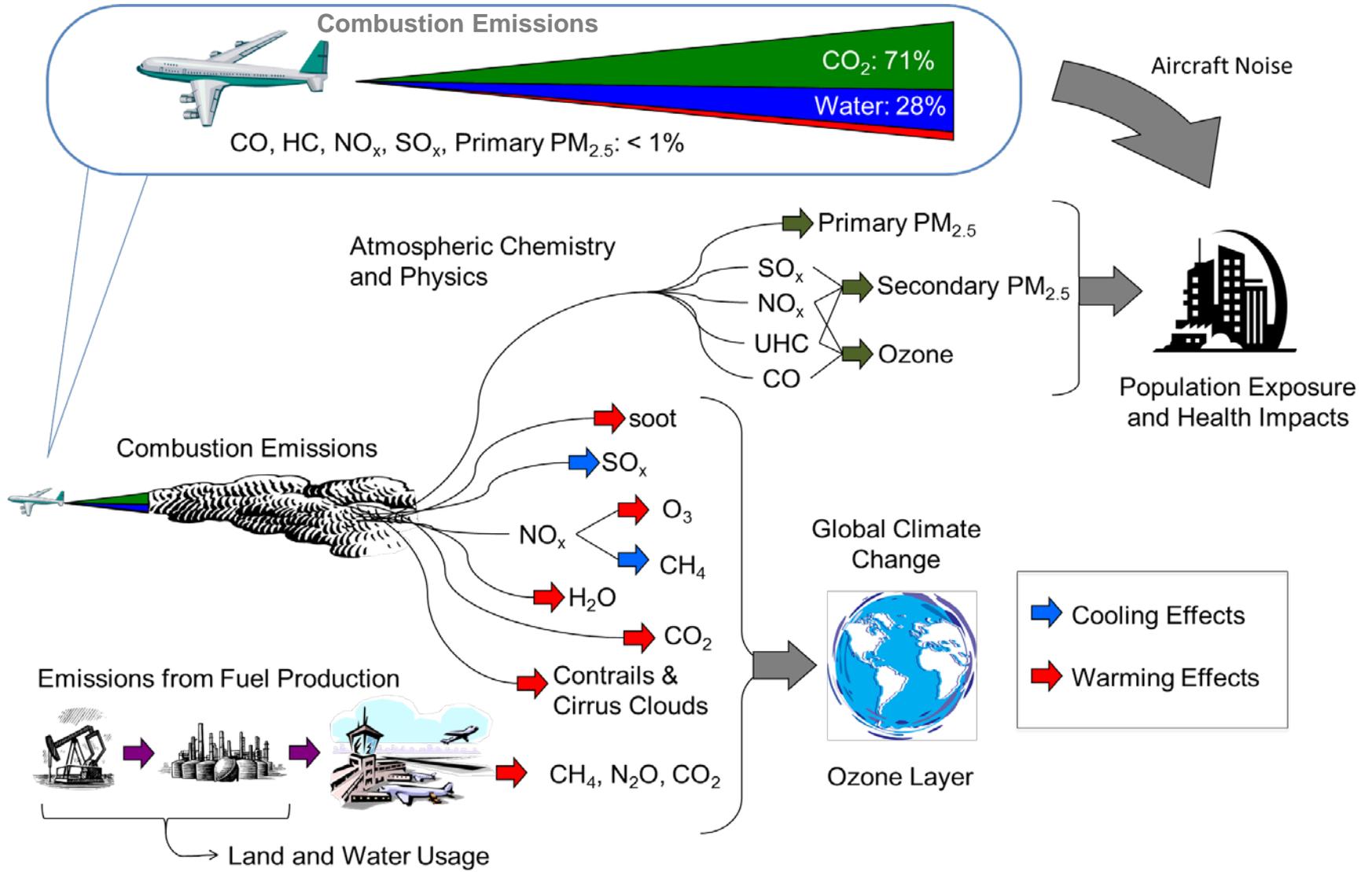


Highlights of Ongoing R&D Efforts (E&E Portfolio)

- Research efforts continue to inform decision making
- Developed innovation portfolio within ASCENT
- Sustainable aviation fuels: CORSIA, CAAFI, and ASTM
- Technology maturation in CLEEN continues and we are close to making awards for 3rd Phase of CLEEN
- Renewed efforts on impacts evaluation within ASCENT
- Exploring low noise operational procedures and means to improve communication among affected communities
- Released AEDT3c - executing long term vision for AEDT
- Have ASCENT projects on drones and advanced air mobility
- Work on helicopter noise is making good progress
- Have wide-ranging portfolio on supersonic aircraft



Environmental Impacts of Aviation



Community Noise from Aircraft

Aircraft Noise

Engine Fan & Jet Exhaust



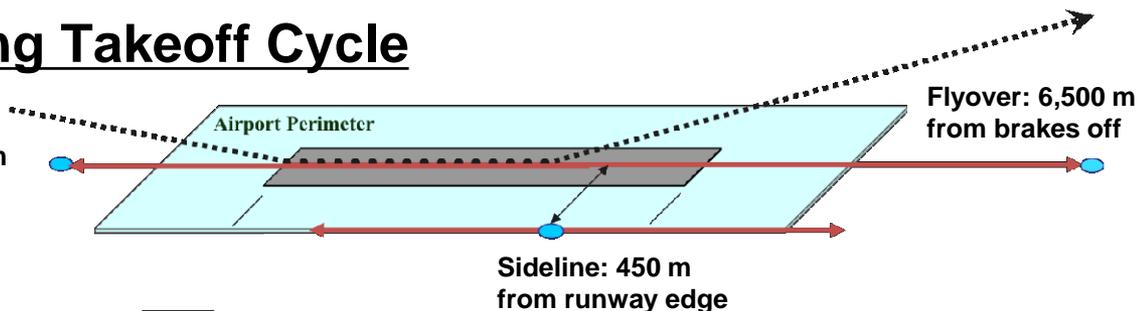
High lift system

Landing Gear

All noise sources contribute to acoustic signature – both at takeoff and during landing

Landing Takeoff Cycle

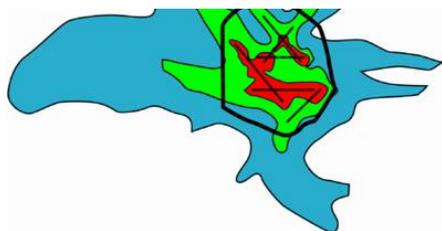
Approach: 2,000 m from threshold



Flyover: 6,500 m from brakes off

Sideline: 450 m from runway edge

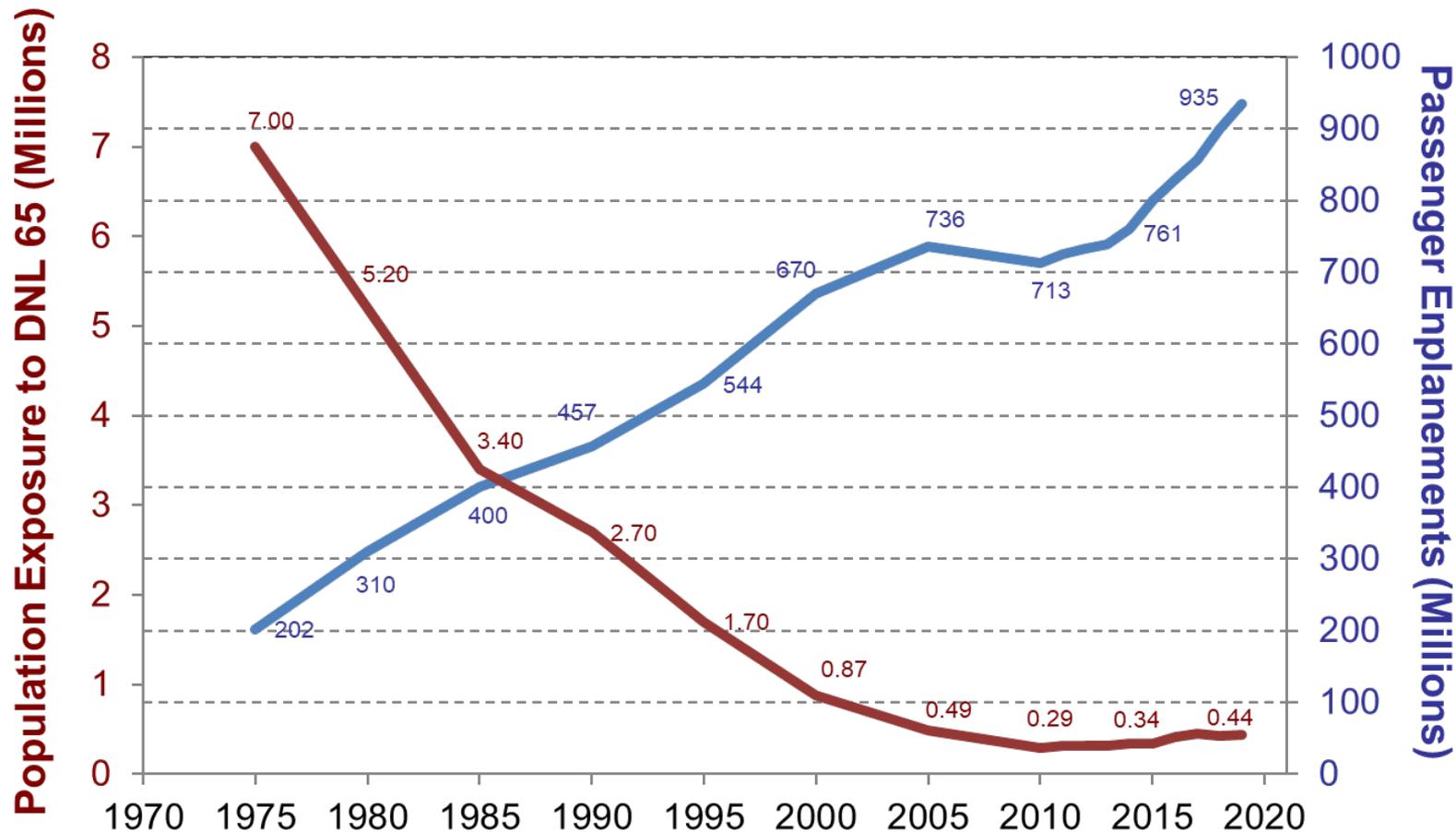
Community Exposure



Community exposure set by aircraft types, operational tempo over day and night, and where people live.



Historical Trends in Noise Exposure and Enplanements



Over a ninety percent decrease in community noise exposure while increasing enplanements by nearly a factor of five; however, the noise experience is different than it was in decades past

Aircraft Noise in the Last Decade (1 of 2)

- Aircraft noise from 1970s is different than aircraft noise today.
- A single aircraft from the 1970s produced the same acoustic energy as 10 to 30 aircraft operations today.
- A few, but relatively loud, operations in the 1970s would result in DNL 65 dB. Many, relatively quiet operations today would also result in DNL 65 dB. However, the noise experience is very different.

EQUIVALENT OPERATIONS FOR DNL = 65

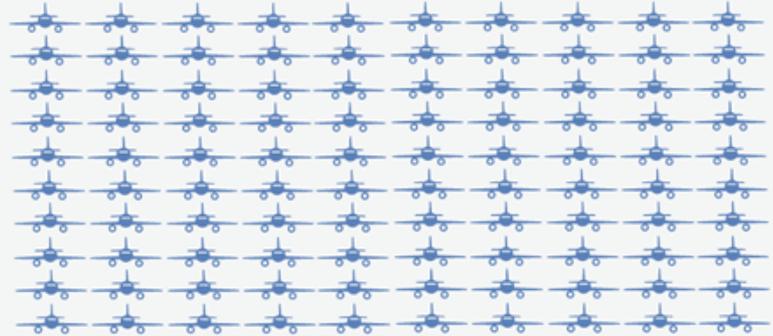
1 EVENT/DAY SEL 114.4 dBA = DNL 65



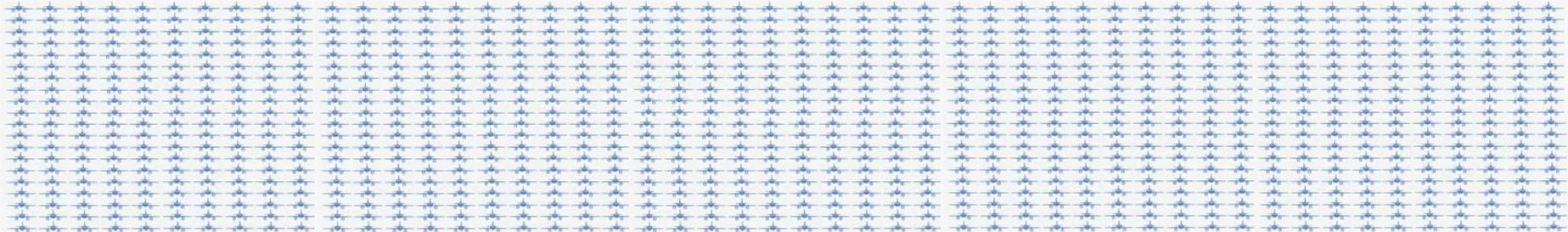
10 EVENTS/DAY SEL 104.4 dBA = DNL 65



100 EVENTS/DAY SEL 94.4 dBA = DNL 65

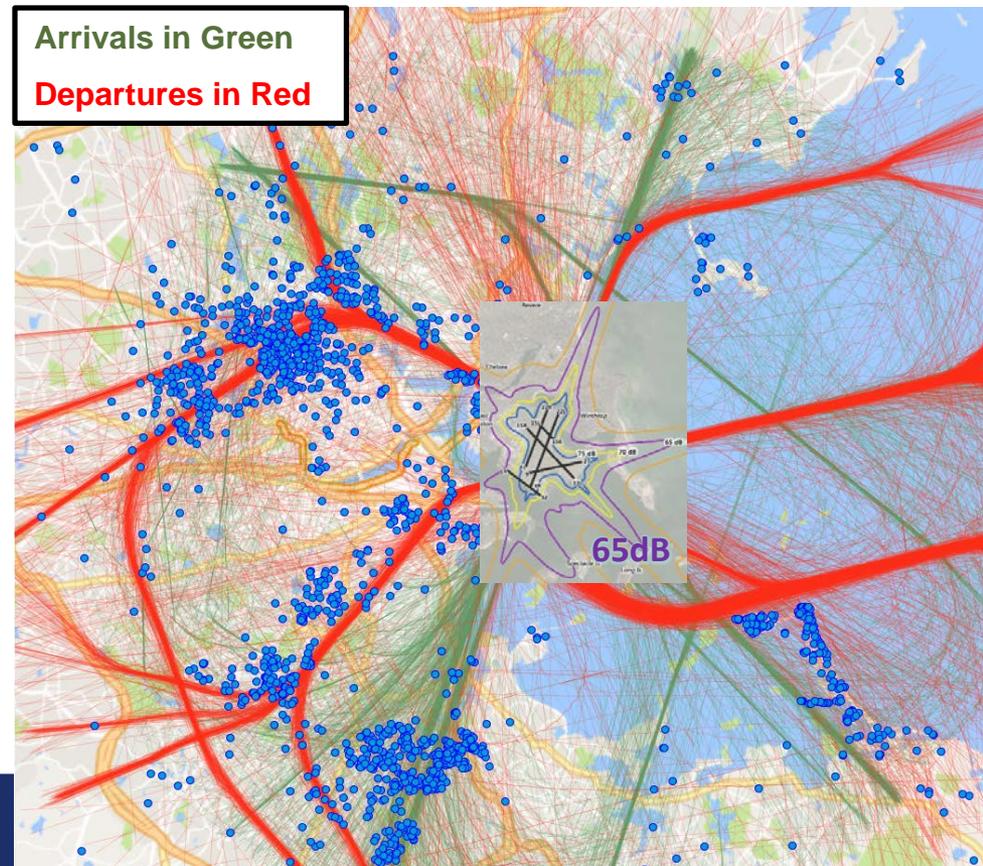
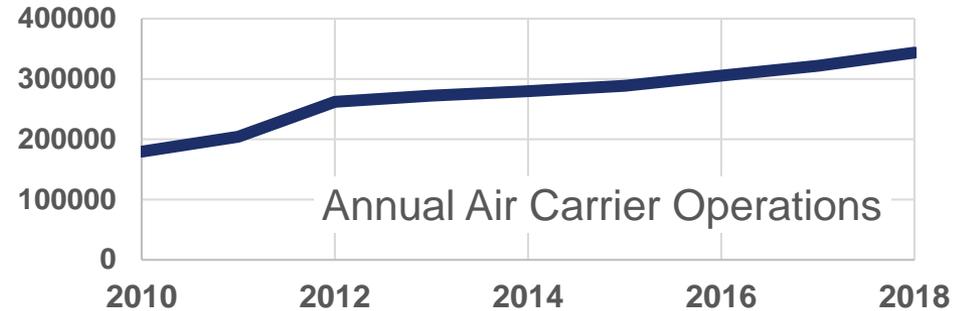


1,000 Events/Day SEL 84.4 dBA = DNL 65



Aircraft Noise in the Last Decade (2 of 2)

- Recent efforts to modernize the national air transportation system have required changes in aircraft operational patterns
- While modernization is needed to increase public safety and system efficiency, the changes in operational patterns have also led to increased concern about aircraft noise
- While air space redesigns have been taking place, operations by air carriers have also increased
- Airport communities that are outside the DNL 65 dB contour are expressing concerns about aircraft noise



Each marker represents a unique complaint address

Data Sources:

Brenner, M., Hansman, R. J., "Comparison of Methods for Evaluating Impacts of Aviation Noise on Communities," 2017

FAA Data on Annual Air Carrier Operations for Boston Logan International Airport

Noise R&D Update

Federal Register Notice

Provides comprehensive overview of FAA R&D efforts on noise

- Effects of Aircraft Noise on Individuals and Communities
- Noise Modeling, Noise Metrics and Environmental Data Visualization
- Reduction, Abatement and Mitigation of Aviation Noise

Includes neighborhood environmental survey results with a link to the full study

Expanded the aviation noise website to include details on the noise survey

https://www.faa.gov/regulations_policies/policy_guidance/noise/survey/

Have had extensive outreach on FRN including a public webinar on the Neighborhood Environmental Survey and Noise Research Portfolio on February 22, 2021.

Webinar link <https://www.youtube.com/watch?v=Mku13gLOxGc>

www.faa.gov/go/aviationnoise

Aviation Noise

 FAA conducted a nationwide survey regarding annoyance related to aircraft noise and seeks public comment. Please review the survey introduction, read the survey report, and provide your comments.



FEDERAL REGISTER

The Daily Journal of the United States Government



Notice

Overview of FAA Aircraft Noise Policy and Research Efforts:
Request for Input on Research Activities To Inform Aircraft Noise Policy

A Notice by the [Federal Aviation Administration](#) on 01/13/2021

This document has a comment period that ends in 10 days. (03/15/2021)

[SUBMIT A FORMAL COMMENT](#)

[Read the 480 public comments](#)

PUBLISHED DOCUMENT

AGENCY:

Federal Aviation Administration (FAA), Department of Transportation (DOT).

ACTION:

Notice of research programs and request for comments.

SUMMARY:

The FAA is releasing a summary to the public of the research programs it sponsors on civil aircraft noise that could potentially inform future aircraft noise policy. The FAA invites public comment on the scope and applicability of these research initiatives to address aircraft noise.

The FAA will not make any determinations based on the findings of these research programs for the FAA's noise policies, including any potential revised use of the Day-Night Average Sound Level (DNL) noise metric, until it has carefully considered public and other stakeholder input along with any additional research needed to improve the understanding of the effects of aircraft noise exposure on communities.

DOCUMENT DETAILS

Printed version:

[PDF](#)

Publication Date:

01/13/2021

Agencies:

[Federal Aviation Administration](#)

Dates:

Comments on this notice must identify the docket number and be received on or before March 15, 2021.

Comments Close:

03/15/2021

Document Type:

Notice

Document Citation:

86 FR 2722

Page:

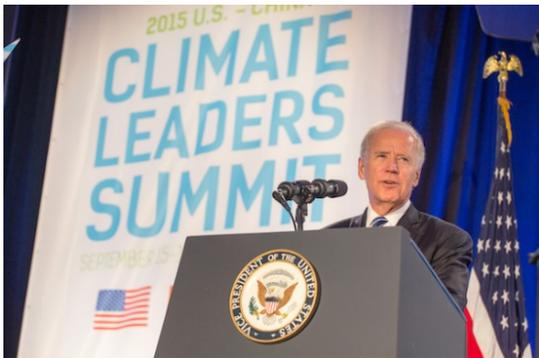
2722-2728 (7 pages)

Agency/Docket Number:

Docket No. FAA-2021-0037

Biden Administration Commitment on Climate Change

- **Day One:** Took action to re-join the Paris Agreement (took effect on February 19)
- **Executive Order 14008 on Tackling the Climate Crisis**
 - *“put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050”*
- **Joint Statement of Sec Buttigieg and Minister Alhabra of Transport Canada**
 - *“shared vision toward reducing the (aviation) sector’s emissions in a manner consistent with the goal of net zero emissions for our economies by 2050”*
 - *“building on existing partnerships, such as through ASCENT”*
- **Leaders Summit & Climate Pledge:** President Biden will host a leaders summit on April 22 and announce a new climate pledge.



Action on Aviation

- The United States will build on a strong track record of aviation climate action
- Will develop an aviation climate action plan and vision for 2050

Climate Change - Direction of the R&D Portfolio

Background on Aviation and Climate Change

- Aviation has three primary contributors to climate change: CO₂ emissions, NO_x emissions, and aviation-induced cloudiness
- Need to take a holistic approach to de-carbonizing aviation (SAF, technology, operations, policy) and ensure international leadership from the U.S. on aviation climate issues

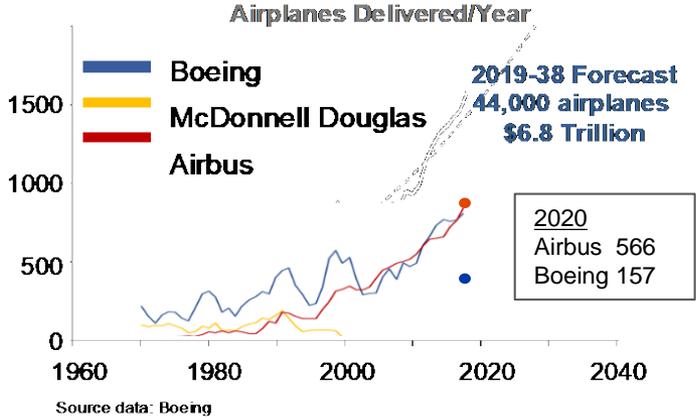
Climate Research Portfolio Direction

- Technology Development: long term solution to climate challenge (and noise challenge)
- Sustainable Aviation Fuels: most promising near to medium-term means to reduce aviation CO₂ emissions
- Operational Procedures: seeking opportunities to reduce fuel use and laying ground work to develop decision support tools to address aviation induced cloudiness
- International leadership: R&D program provides the scientific data and analyses that are required for the U.S. to lead direction of international aviation climate negotiations
- Advancing Understanding: conducting research to better understand the impacts of non-CO₂ combustion emissions from all flight vehicles
- Analytical Tools: providing the models that are used across the globe to quantify aviation fuel burn and emissions
- Emerging Technologies and Energy Sources: need to give appropriate consideration to emerging technologies and concepts, but avoid looking for a “silver bullet”



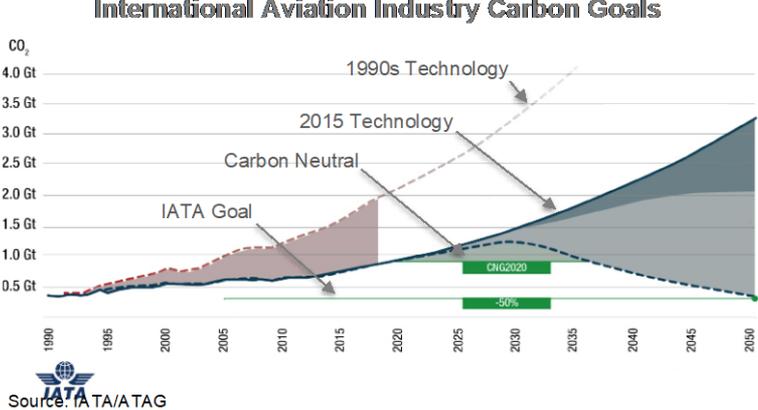
Global Competition and Environmental Pressure Increasing

Economic Perspective



- Airline industry particularly hard hit by COVID-19**
 - U.S. passenger airline traffic fell 60.1% in 2020 (lowest since 1984)
 - The nine biggest US carriers lost \$46 billion before taxes in 2020
- Global competition among manufacturers is growing
 - Airbus backlog exceeds Boeing by 2500 aircraft in 200 Pax class*
 - New competitors in key Asia-Pacific growth market
- Limited industry funding for needed R&D investments

Environmental Context



- Societal pressure growing on climate globally
- Primary contributors to climate change: CO₂ emissions, NO_x emissions, and aviation-induced cloudiness
- Broad community concerns in U.S. about aircraft noise
- Air quality continues to be a challenge in select areas
- Need to address environmental justice concerns

Technological innovation will be required to enable sustainable growth & to maintain U.S. global leadership

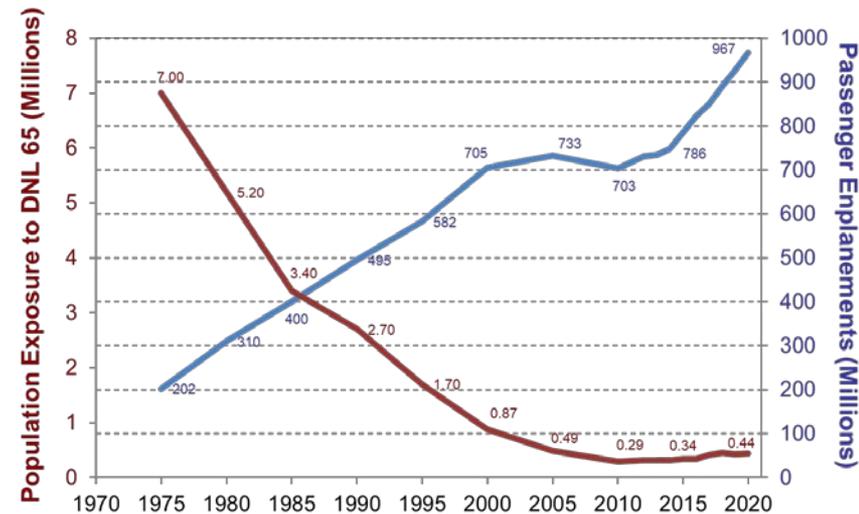
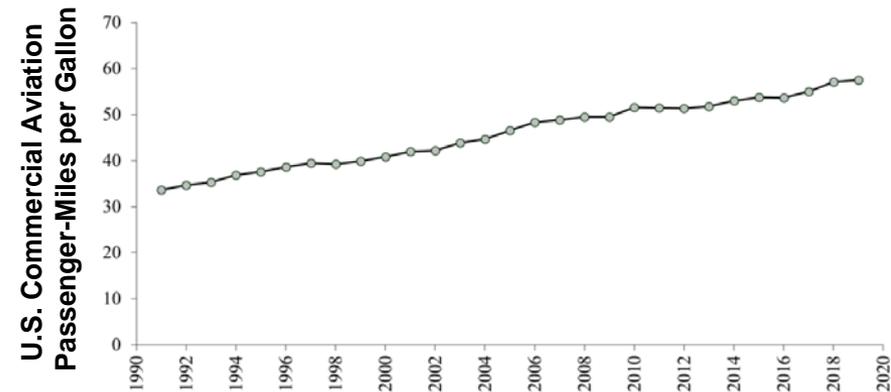
- Environmental performance provides competitive edge
- National economy-wide carbon neutral goals: 2045 in Sweden; 2050 in Denmark, France, Hungary, Japan, New Zealand, South Korea, UK, and United States; 2060 in China
- CO₂ goals publicly stated by: American Airlines, Delta Airlines, FedEx, JetBlue, United Airlines
- *Environmental challenges must be addressed if U.S. industry is to remain competitive in the global marketplace*

* <https://aviationweek.com/air-transport/aircraft-propulsion/opinion-will-boeing-become-next-mcdonnell-douglas>

** <https://www.reuters.com/article/us-health-coronavirus-usa-airlines/us-airline-passenger-traffic-fell-601-in-2020-dot-id>

Rationale for Investing in Aircraft Technology

- Historically, advances in aircraft technology have been the main factor in reducing aviation's environmental impact
- Continued improvements come with large technological risk
- Manufacturers have limited financial incentive to develop technologies to reduce noise and emissions
- COVID-19 pandemic has hit the aerospace sector particularly hard and the industry has considerably reduced ability to undertake research to advance new technologies
- Government resources help mitigate technological risk and incentivize aviation manufacturers to invest in and develop cleaner, quieter technology



Efforts Relating to Aircraft Technology

Continuous Lower Energy, Emissions & Noise (CLEEN) Program

- FAA partnership with industry - 100% industry cost share
- Focus on aircraft and engine technologies (CLEEN Phases I-III) and development of high performance fuels (CLEEN Phase III)
- Conducting ground and/or flight test demonstrations to accelerate maturation of certifiable aircraft and engine technologies
- Mature technologies from TRL 3-5 to TRL 5-7
- Individual companies use knowledge gained to improve their design methods

ASCENT COE Efforts on Innovation and Technology

- FAA partnership with academia - 100% in-kind cost share*
- Focus on broad range of innovation solutions (technology, fuels, ops, etc.)
- Conducting ground and/or flight test demonstrations to accelerate maturation of certifiable aircraft and engine technologies
- Advance technologies at any TRL, but with understanding that FAA has a focus on applied R&D
- Universities use knowledge gained to improve knowledge broadly, but there are opportunities to examine specific technologies under Non Disclosure Agreements (NDAs)



For more information:

ASCENT: www.ascent.aero/

CLEEN: www.faa.gov/go/cleem/



Federal Aviation
Administration

* Universities can apply for a cost share reduction to a 25/75 split instead of 50/50

Aircraft Technology Innovation Portfolio

<https://ascent.aero/topic/Aircraft-Technology/>

ASCENT's aircraft technology innovation research advances the industry state-of-the-art and expands the technical knowledge base.

ASCENT Aircraft Technology Innovation Projects

- 010- Aircraft Technology Modeling and Assessment
- 037 - CLEEN II System Level Assessment
- 047 - Clean Sheet Supersonic Aircraft Engine Design and Performance
- 050 (NEW) - Over-Wing Engine Placement Evaluation
- 051 (NEW) - Combustion concepts for next-generation aircraft engines to reduce fuel burn and emissions
- 052 (NEW) - Comparative Assessment of Electrification Strategies for Aviation
- 055 (NEW) - Noise Generation and Propagation from Advanced Combustors
- 056 (NEW) - Turbine Cooling Through Additive Manufacturing
- 059 (NEW) - Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development
- 063 (NEW) - Parametric Noise Modeling For Boundary Layer Ingesting Propulsors
- 064 (NEW) - Alternative Design Configurations to Meet Future Demand
- 066 (NEW) - Evaluation of High Thermal Stability Fuels
- 067 (NEW) - Impact of Fuel Heating on Combustion and Emissions
- 068 (NEW) - Combustor Wall Cooling Concepts for Dirt Mitigation
- 070 (NEW) - Reduction of nvPM emissions via innovation in aero-engine fuel injector design
- 071 (NEW) - Predictive Simulation of Soot Emission in Aircraft combustors
- 074 (NEW) - Low Emissions Pre-Mixed Combustion Technology for Supersonic Civil Transport
- 075 (NEW) - Improved Engine Fan Broadband Noise Prediction Capabilities
- 076 (NEW) - Improved Open Rotor Noise Prediction Capabilities
- 077 (NEW) - Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities



Benefits of CLEEN Technology Introduction

Analytical Evaluation:

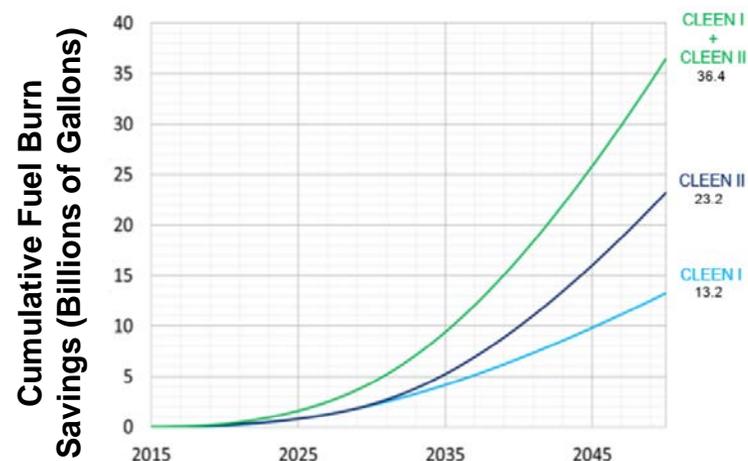
- Conducted by Georgia Tech through ASCENT COE
- Evaluating impact on fuel burn and noise out to 2050
- Have completed modeling of CLEEN Phase I technologies and all CLEEN Phase II fuel burn reduction technologies

Fuel Burn Benefit

- 36.4 billion gallons of fuel saved cumulative by 2050 from CLEEN Phase I and II
- CO2 emissions reduced by 424 million metric tons over this time period – the equivalent to removing 3.05 million cars from the road from 2020 to 2050

Noise Benefit

- CLEEN Phase I Contributes to 14% decrease in the land area exposed to DNL 65 dB and greater
- CLEEN Phase II noise benefits assessment ongoing



R&D Direction on Sustainable Aviation Fuels



Testing

accelerate SAF development

- Test fuels
- Improve testing methods
- Conduct evaluation
- Streamline approval



Analysis

environmental and economic sustainability

- Lifecycle emissions
- Cost reduction
- Supply potential
- Supply chain opportunities



Coordination

support SAF deployment

- Public-private partnership – *CAAFI*
- U.S. interagency cooperation
- International cooperation – *ICAO*

Considerable energy going to support efforts at ICAO via FTG and LTAG

Looking to utilize R&D to go beyond 50% to higher SAF blend levels

Want to establish the development of SAF as a key DOT and U.S. climate priority



Environmental & Energy R&D Portfolio

RE&D Environment & Energy

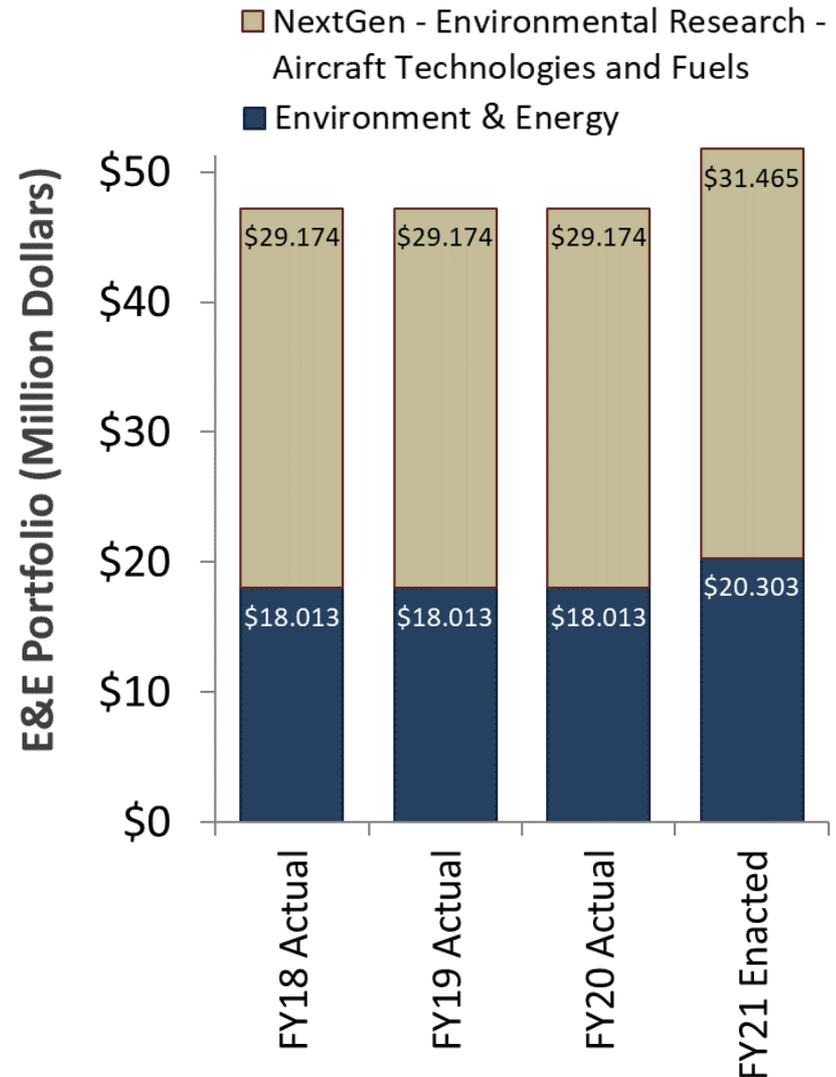
Budget Line Item*

- Advance understanding of noise and emissions
- Analysis to inform decision making

RE&D NextGen – Environmental Research – Aircraft Technology and Fuels

Budget Line Item**

- Develop innovative solutions to reduce noise and emissions



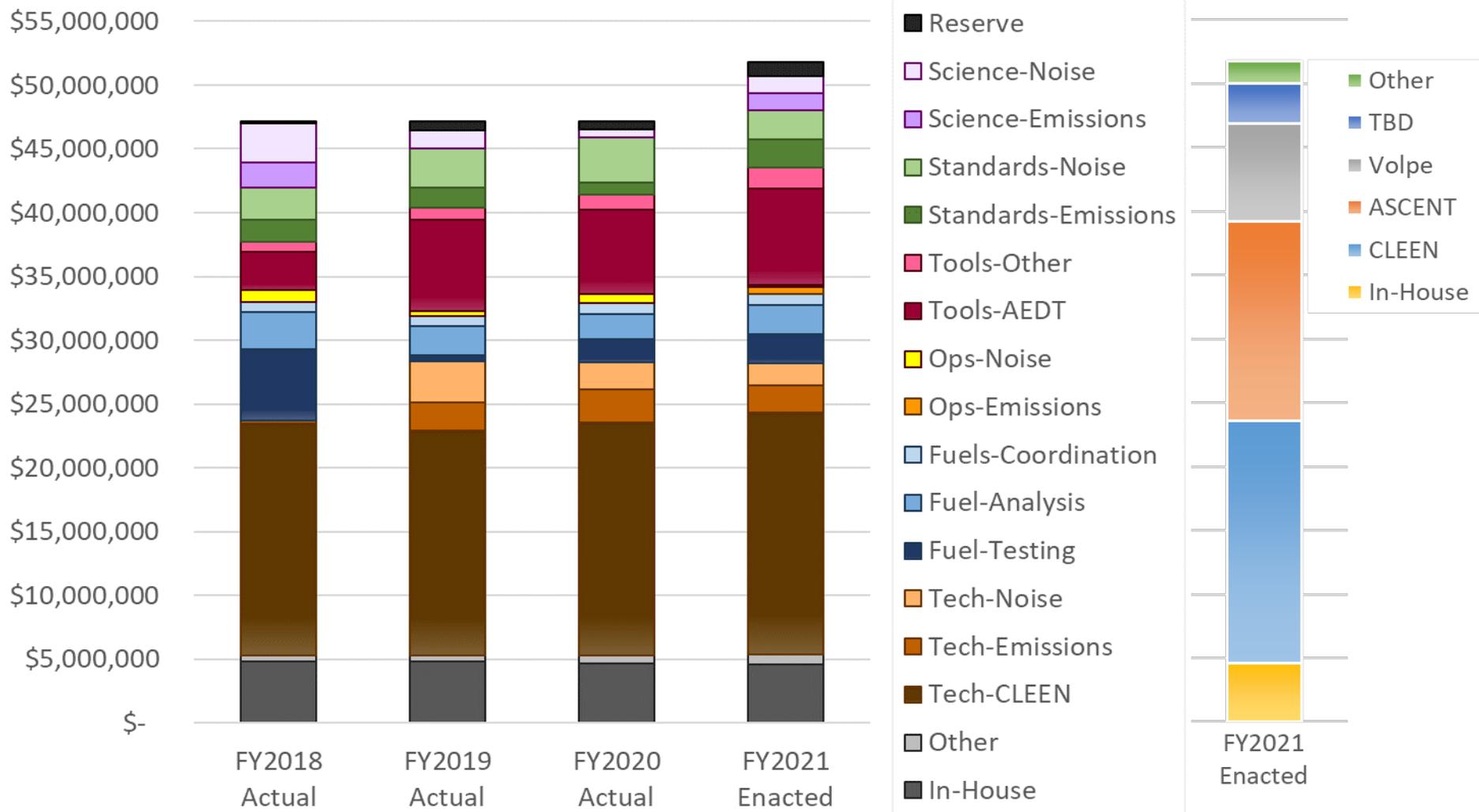
*Budget Line Items: A13.a (FY18 & FY19), A12.a (FY20), A.T (FY21)

** Budget Line Items: A13.b (FY18 & FY19), A12.b (FY20), A.U (FY21)



Environment and Energy R&D Portfolio

Broken out by Research Area & Funding Vehicle



Recent Successes - Capabilities and Solutions Helping Today

Informing Decision Making to Support U.S. Leadership on International Aviation Climate Issues

- Research team at forefront of informing the development of a *long term aspirational goal for international aviation CO₂ emissions* within International Civil Aviation Organization (ICAO).
- Provided critical support to development of *Carbon Offsetting and Reduction Scheme for International Aviation (CORSI A)*.
- Analytical tools and data provided foundation for ICAO CAEP *Aircraft CO₂ Standard* being promulgated domestically.
- Measurement technique and data provided foundation for new ICAO CAEP *non-volatile particular matter engine standard* that will replace the existing smoke number standard in 2023.

Supporting the Development of Sustainable Aviation Fuels

- *Certification of eight alternative jet fuel pathways* enabling multiple airlines to buy and use sustainable aviation fuels in LAX, SFO, and elsewhere. Efforts have also *significantly reduced fuel volumes required for new approvals*.
- Research efforts were critical for the *inclusion of sustainable aviation fuels within CORSIA*.

Accelerating Technological Innovation and the Development of Improved Operational Procedures

- *CLEEN aircraft and engine technologies appearing in new aircraft* with some technologies retrofitted into today's fleet. These technologies and knowledge gained by industry will reduce noise, emissions, and fuel use for decades to come.
- Research efforts are supporting the *introduction of unmanned aircraft systems, advanced air mobility vehicles, and supersonic aircraft* into the air space.
- Developing operational procedure concepts and communication tools at Boston Logan that could *help address noise concerns nationwide*.

Advancing Our Understanding of Noise, Emissions, and their Impacts

- Released *Federal Register Notice on noise research portfolio* with comprehensive community noise annoyance survey quantifying community perceptions on noise. Work is ongoing to understand *impacts of noise on sleep and health*.
- Researchers are advancing our understanding of the impacts of aviation emissions on human health and welfare via *air quality, global climate change, and changes to the ozone layer*.
- Aviation Environmental Design Tool (AEDT) is being used extensively globally to quantify aviation noise and emissions.



Backup Slides

- **Environment & Energy RE&D Budget Line Items**
- ASCENT Center of Excellence



RE&D A.s: Environment & Energy

Major Activities and Accomplishments Planned in FY 2021 Include:

- Using advances in scientific understanding, enhance the aviation environmental tool suite to improve our ability to calculate environmental consequences and impacts of aviation.
- Develop innovative, cost-effective solutions to reduce noise, fuel use, and emissions for both fixed wing and vertical takeoff and landing vehicles through technology and operational procedure concepts.
- Conduct analyses to inform decision making on operational procedure concepts, policy measures, and standards that could reduce noise, fuel use, and emissions.
- Develop improved measurement capabilities and airworthiness certification methods for both noise and emissions, for both existing air vehicles and new entrants.
- Conduct analyses and gather data to inform the development of noise and emissions standards to enable the introduction of new entrants, such as Unmanned Aerial Systems, Urban Air Mobility vehicles, and civil supersonic aircraft.



RE&D A.s: Environment & Energy

Goals for FY 2021 Funding:

- By 2022, complete analyses to quantify the potential health impacts of aircraft noise.
- By 2023, release AEDT Version 4 with improved characterization at lower noise levels where some communities are expressing concerns as well as to include supersonic aircraft.*
- By 2022, release noise screening tool to streamline environmental approval process and improve communication on noise matters with communities.
- By 2022, conduct measurements and complete analyses to inform the development of noise standards for unmanned aerial systems and urban air mobility vehicles.
- Through 2025, complete analyses to support the development of new international standards for supersonic transport aircraft and engines in ICAO CAEP.



RE&D A.t: NextGen – Environmental Research – Aircraft Technology and Fuels

Major Activities and Accomplishments Planned in FY 2021 Include:

- Develop aircraft and engine technologies, as well as novel drop-in fuels, for both subsonic and supersonic aircraft, that reduce noise and emissions while increasing fuel efficiency through the CLEEN Program.
- Evaluate innovative technological solutions to reduce noise, emissions and fuel burn from both subsonic and supersonic aircraft through ASCENT.
- Support the approval of novel jet fuel pathways within the American Society of Testing and Materials (ASTM) International certification process via testing and coordination to ensure these fuels are safe for use.
- Support the inclusion of sustainable aviation fuels, created from waste and biomass feedstocks, and lower carbon aviation fuels, created from fossil feedstocks, within the International Civil Aviation Organization (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).



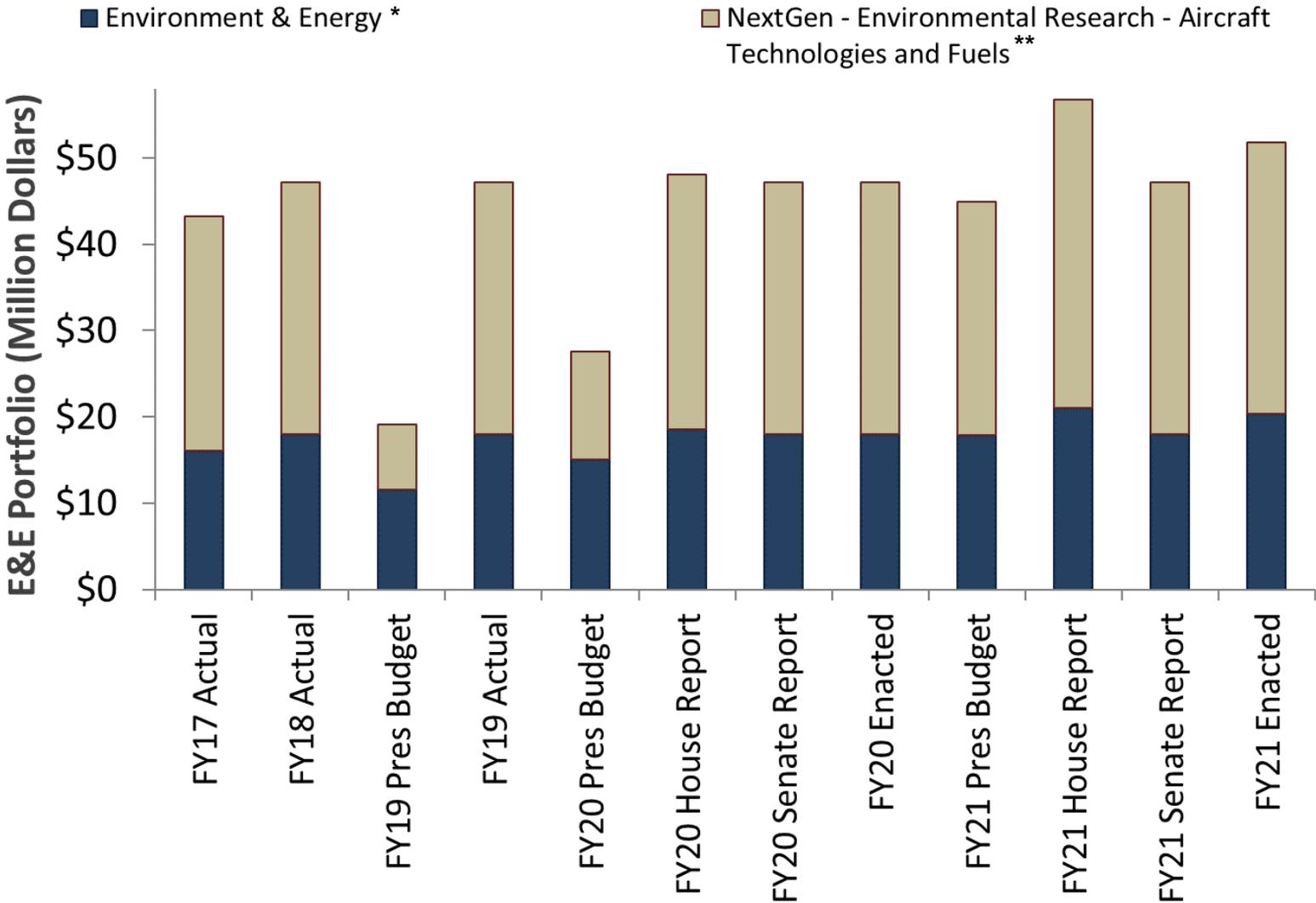
RE&D A.t: NextGen – Environmental Research – Aircraft Technology and Fuels

Goals for FY 2021 Funding:

- By 2022, develop lifecycle greenhouse gas emissions values and sustainability criteria for use in CORSIA.
- By 2022, identify innovative solutions to reduce noise, emissions, and fuel burn through the university research of ASCENT.
- Through 2025, continue activities within the third phase of CLEEN to demonstrate technologies that can reduce energy use, emissions, and noise for both subsonic and supersonic aircraft.
- Through 2025, conduct testing to support the approval of at least one alternative jet fuel type per year and to streamline the ASTM certification process to reduce the time and cost of certification.
- By 2025, assess the benefits of the technologies matured under the third phase of the CLEEN Program.



Recent Trends in E&E R&D Portfolio Budget

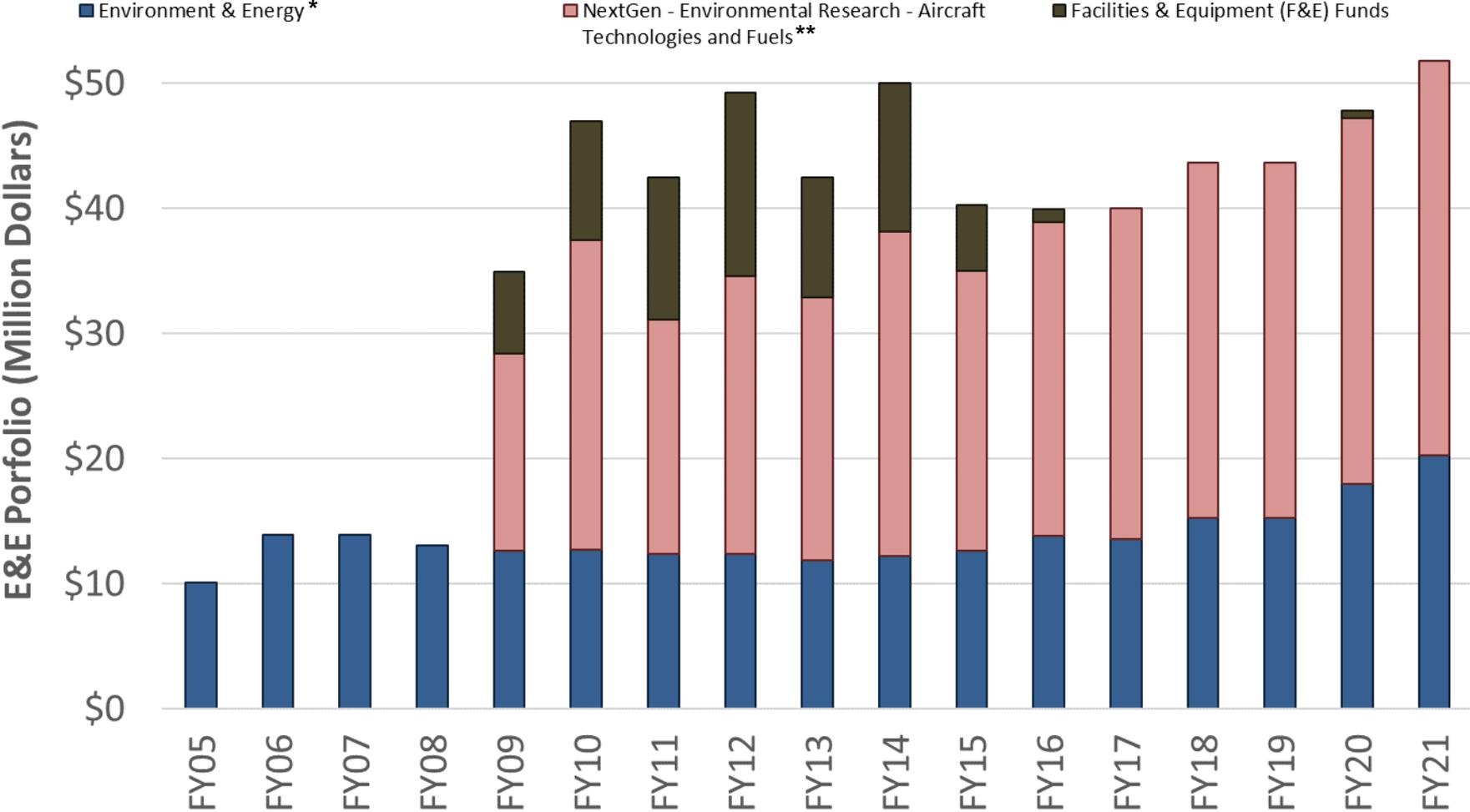


* Budget Line Items: A13.a (FY18 & FY19), A12.a (FY20), A.T (FY21)

** Budget Line Items: A13.b (FY18 & FY19), A12.b (FY20), A.U (FY21)



Long Term Trends in E&E R&D Portfolio Budget



* Budget Line Items: A13.a (FY18 & FY19), A12.a (FY20), A.T (FY21)

** Budget Line Items: A13.b (FY18 & FY19), A12.b (FY20), A.U (FY21)



Backup Slides

- Environment & Energy RE&D Budget Line Items
- **ASCENT Center of Excellence**



FAA Centers of Excellence (COE)

For 16 years, FAA Office of Environment and Energy has relied on university centers of excellence to:

- Provide knowledge to inform decision making on environment and energy matters;
- Enable the introduction of innovative solutions to cost-effectively mitigate the environmental impacts of aviation; and
- Support the instruction of hundreds of professionals with knowledge of the environmental challenges facing aviation.

Timeline:

- In 2004, FAA established PARTNER Center of Excellence
- In 2013, FAA established Center of Excellence for Alternative Jet Fuels and Environment, a.k.a. Aviation Sustainability Center or ASCENT, that continues work of PARTNER with expanded efforts on alternative jet fuels R&D
- In 2015, FAA sunsets PARTNER Center of Excellence, which had 48 projects (research efforts shifted to ASCENT)
- **Have funded 77 ASCENT Projects. Stood up 30 new projects in the last year with an emphasis on innovation to reduce environmental impacts**



ASCENT Center of Excellence (COE)



Lead Universities:

Washington State University (WSU)

Massachusetts Institute of Technology (MIT)*

Core Universities:

Boston University (BU)*

Georgia Institute of Technology (Ga Tech)*

Missouri University of Science and Technology (MS&T)*

Oregon State University (OSU)

Pennsylvania State University (PSU)*

Purdue University (PU)*

Stanford University (SU)*

University of Dayton (UD)

University of Hawaii (UH)

University of Illinois at Urbana-Champaign (UIUC)*

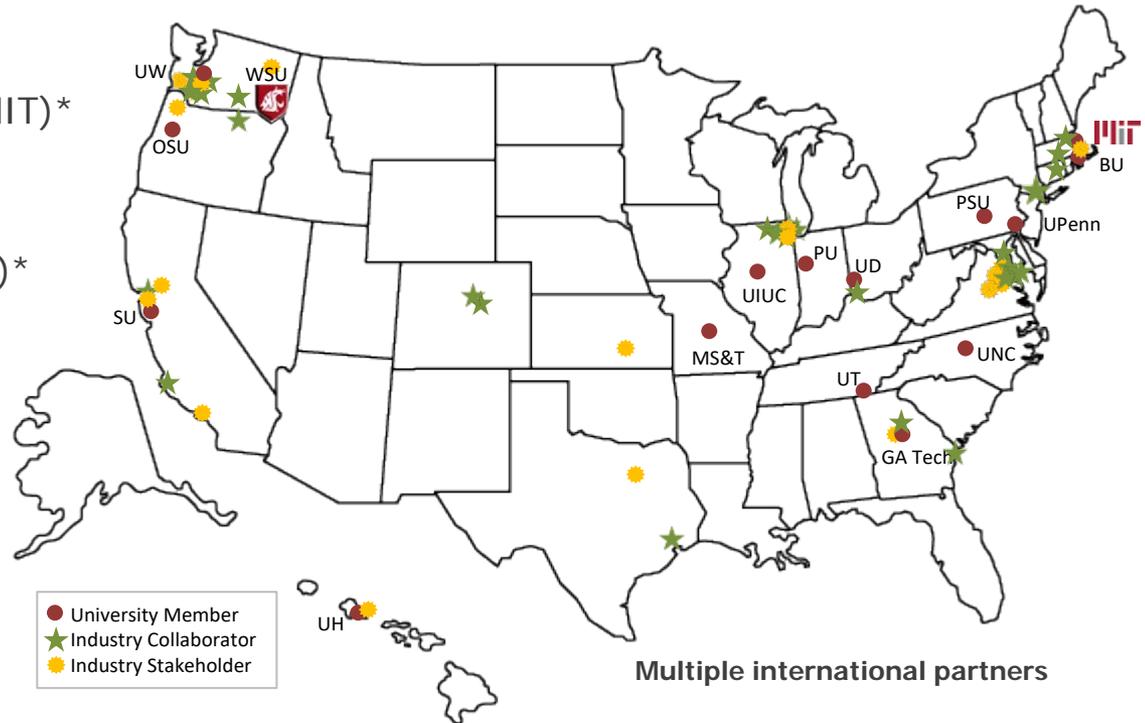
University of North Carolina at Chapel Hill (UNC)*

University of Pennsylvania (UPenn)*

University of Tennessee (UT)

University of Washington (UW)

* Indicates university was also a member of PARTNER COE



Advisory Committee - 57 organizations:

- 5 airports
- 4 airlines
- 9 NGO/advocacy
- 8 aviation manufacturers
- 10 feedstock/fuel manufacturers
- 21 R&D, service to aviation sector



ASCENT / PARTNER Support



Federal Aviation Administration



Transport
Canada



NASA



Environmental
Protection
Agency



Defense Logistics
Agency - Energy



U.S. Dep't
of Energy



U.S. Dep't of
Agriculture



Air Force Research
Laboratory

ASCENT COE:

- In operation: 2013 to present
- \$15M+ annual funding level
- \$81.6M funding to date

PARTNER COE:

- In operation: 2004 to 2015
- \$62.8M over 10 years

FAA COE research requires 100% cost share. This has led to significant collaboration among universities, industry, and international research programs



ASCENT COE Details



ASCENT Research Portfolio

Portfolio covers broad range of topics on Alternative Jet Fuels, Emissions, Noise, Operations, and Analytical Tools

Over last few years have stood up many projects to advance aircraft technology innovation and supersonic flight

Projects listed by topic: <https://ascent.aero/projects-by-topic/>

ASCENT Leadership

- Mike Wolcott of WSU - Director
- John Hansman of MIT - Co-Director
- Carol Sim of WSU - Assistant Director

ASCENT Annual Technical Report Summaries*

	Report 1	Report 2	Report 3	Report 4	Report 5	Report 6
Time period	9/2013 – 9/2015	10/2015 – 9/2016	10/2016 – 9/2017	10/2017 – 9/2018	10/2018 – 9/2019	10/2019 – 9/2020
Research Projects	50	54	43	32	30	60
Publications, Reports, and Presentations	137	119	110	179	166	125
Students involved	131	112	105	116	236	186
Industry partners	63	70	72	72	76	57

* ASCENT Annual Tech Reports available for download at: <https://ascent.aero/resources>



A Cross-Cutting Example:

Aircraft Technology Innovation

<https://ascent.aero/topic/Aircraft-Technology/>

ASCENT's aircraft technology innovation research advances the industry state-of-the-art and expands the technical knowledge base.

ASCENT Aircraft Technology Innovation Projects

- 010- Aircraft Technology Modeling and Assessment
- 037 - CLEEN II System Level Assessment
- 047 - Clean Sheet Supersonic Aircraft Engine Design and Performance
- 050 (NEW) - Over-Wing Engine Placement Evaluation
- 051 (NEW) - Combustion concepts for next-generation aircraft engines to reduce fuel burn and emissions
- 052 (NEW) - Comparative Assessment of Electrification Strategies for Aviation
- 055 (NEW) - Noise Generation and Propagation from Advanced Combustors
- 056 (NEW) - Turbine Cooling Through Additive Manufacturing
- 059 (NEW) - Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development
- 063 (NEW) - Parametric Noise Modeling For Boundary Layer Ingesting Propulsors
- 064 (NEW) - Alternative Design Configurations to Meet Future Demand
- 066 (NEW) - Evaluation of High Thermal Stability Fuels
- 067 (NEW) - Impact of Fuel Heating on Combustion and Emissions
- 068 (NEW) - Combustor Wall Cooling Concepts for Dirt Mitigation
- 070 (NEW) - Reduction of nvPM emissions via innovation in aero-engine fuel injector design
- 071 (NEW) - Predictive Simulation of Soot Emission in Aircraft combustors
- 074 (NEW) - Low Emissions Pre-Mixed Combustion Technology for Supersonic Civil Transport
- 075 (NEW) - Improved Engine Fan Broadband Noise Prediction Capabilities
- 076 (NEW) - Improved Open Rotor Noise Prediction Capabilities
- 077 (NEW) - Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities



ASCENT Alternative Jet Fuels Research Portfolio

<https://ascent.aero/topic/alternative-fuels/>

Alternative jet fuels have the potential to provide benefits to the aviation industry in terms of energy security and reduction in greenhouse gases. Their production can support rural economic growth and job creation through the development of economically valuable feedstocks and fuel processing facilities.

ASCENT Alternative Jet Fuels Projects

- 001 - Alternative Jet Fuel Supply Chain Analysis
- 025-030 & 034 - National Jet Fuel Combustion Program
- 031 - Alternative Jet Fuels Test and Evaluation
- 032 (COMPLETE) - Worldwide LCA of GHG Emissions from Petroleum Jet Fuel
- 033 - Alternative Fuels Test Database Library
- 052 (NEW) - Comparative Assessment of Electrification Strategies for Aviation
- 065 (NEW) - Fuel Testing Approaches for Rapid Jet Fuel Prescreening
- 066 (NEW) - Evaluation of High Thermal Stability Fuels
- 067 (NEW) - Impact of Fuel Heating on Combustion and Emissions
- 073 (NEW) - Combustor Durability with Alternative Fuel Use



ASCENT Emissions Research Portfolio

<https://ascent.aero/topic/emissions/>

Demand for air transportation, both for passenger and cargo service, has been increasing and airports are expanding to accommodate it. This growth is accompanied by an increase of emissions from aircraft, ground services equipment and vehicle traffic on and near airports. All this activity impacts the local air quality around airports and human health.

ASCENT Emissions Projects

- 002 - Ambient Conditions Corrections for Non-Volatile PM Emissions Measurements
- 013 (COMPLETE) - Micro-Physical Modeling & Analysis of ACCESS 2 Aviation Exhaust Observations
- 014 (COMPLETE) - Analysis to Support the Development of an Aircraft CO2 Standard
- 018 - Community Measurement of Aviation Emission Contribution of Ambient Air Quality
- 019 - Development of Improved Aviation Emissions Dispersion Capabilities for AEDT
- 020 (COMPLETE) - Development of NAS wide and Global Rapid Aviation Air Quality
- 021 (COMPLETE) - Improving Climate Policy Analysis Tools
- 024 (COMPLETE) - Emissions Data Analysis for CLEEN, ACCESS, and Other Recent Tests
- 022 - Evaluation of FAA Climate Tools
- 039 - Naphthalene Removal Assessment
- 047 - Clean Sheet Supersonic Aircraft Engine Design and Performance
- 048 - Analysis to Support the Development of an Engine nvPM Emissions Standard
- 051 (NEW) - Combustion concepts for next-generation aircraft engines to reduce fuel burn and emissions
- 052 (NEW) - Comparative Assessment of Electrification Strategies for Aviation
- 058 (NEW) - Improving Policy Analysis Tools to Evaluate Aircraft Operations in the Stratosphere
- 064 (NEW) - Alternative Design Configurations to Meet Future Demand
- 067 (NEW) - Impact of Fuel Heating on Combustion and Emissions
- 068 (NEW) - Combustor Wall Cooling Concepts for Dirt Mitigation
- 069 (NEW) - Transitioning a research nvPM mass calibration procedure to operations
- 070 (NEW) - Reduction of nvPM emissions via innovation in aero-engine fuel injector design
- 071 (NEW) - Predictive Simulation of Soot Emission in Aircraft combustors
- 074 (NEW) - Low Emissions Pre-Mixed Combustion Technology for Supersonic Civil Transport



ASCENT Noise Research Portfolio

<https://ascent.aero/topic/noise/>

The growth in demand for passenger and cargo air transportation has pushed operators to increase the number and frequency of their scheduled flights. The expansion in operations and the changes to the airspace aimed at accommodating it have resulted in renewed public concern.

ASCENT Noise Projects

- 003 - Cardiovascular Disease and Aircraft Noise Exposure
- 004 (COMPLETE) - Estimate of Noise Level Reduction
- 005 (COMPLETE) - Noise Emission and Propagation Modeling
- 007 (COMPLETE) - Civil, Supersonic Over Flight, Sonic Boom (Noise) Standards Development
- 008 - Noise Outreach
- 009 (NEW) - Geospatially driven noise estimation module
- 017 - Pilot Study on Aircraft Noise and Sleep Disturbance
- 038 – Rotorcraft Noise Abatement Procedures Development
- 040 (COMPLETE) – Quantifying Uncertainties in Predicting Noise in Real-world Situations
- 041 - Identification of Noise Acceptance Onset for Noise Certification Standards of Supersonic Airplanes
- 042 - Acoustical Model of Mach Cut-off
- 043 – Noise Power Distance Re-Evaluation
- 044 - Aircraft Noise Abatement Procedure Modeling and Validation
- 049 (NEW) - Urban Air Mobility Noise Reduction Modeling
- 050 (NEW) - Over-Wing Engine Placement Evaluation
- 053 (NEW) - Validation of Low-Exposure Noise Modeling by Open-Source Data Mgmt and Visualization Systems Integrated w/ AEDT
- 055 (NEW) - Noise Generation and Propagation from Advanced Combustors
- 057 (NEW) - Support for Supersonic Aircraft Noise Efforts in ICAO CAEP
- 059 (NEW) - Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development
- 061 (NEW) - Noise Certification Streamlining
- 062 (NEW) - Noise Model Validation for AEDT
- 063 (NEW) - Parametric Noise Modeling For Boundary Layer Ingesting Propulsors
- 072 (NEW) - Aircraft noise exposure and market outcomes in the US
- 075 (NEW) - Improved Engine Fan Broadband Noise Prediction Capabilities
- 076 (NEW) - Improved Open Rotor Noise Prediction Capabilities
- 077 (NEW) - Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities



ASCENT Operations Research Portfolio

<https://ascent.aero/topic/operations/>

Aviation operations at an airport can affect local communities in ways that are dependent on how and where aircraft are flown. Aviation operations can be optimized to reduce the amount of noise and emissions generated by these operations while still maintaining the efficiency of the airport system.

ASCENT Operations Projects

- 006 (COMPLETE) - Rotorcraft Noise Abatement Operating Conditions Modeling
- 015 (COMPLETE) - Cruise Altitude and Speed Optimization
- 016 (COMPLETE) - Airport Surface Movement Optimization
- 023 - Analytical Approach for Quantifying Noise from Advanced Operational Procedures
- 038 - Rotorcraft Noise Abatement Procedures Development
- 044 - Aircraft Noise Abatement Procedure Modeling and Validation
- 053 (NEW) - Validation of Low-Exposure Noise Modeling by Open-Source Data Management and Visualization Systems Integrated with AEDT



ASCENT Tools Research Portfolio

<https://ascent.aero/topic/tools/>

The aviation system operation involves the complex interactions between many different components and understanding how to optimize its activities requires advanced modeling tools. The FAA suite of tools has been developed to provide the ability to characterize and quantify the interdependences of aviation-related noise and emissions, impacts on health and welfare, and industry and consumer costs under different policy, technology, operational and market scenarios.

ASCENT Tools Projects

- 009 (NEW) - Geospatially driven noise estimation module
- 010 - Aircraft Technology Modeling and Assessment
- 011 (COMPLETE) - Rapid Fleet-wide Environmental Assessment Capability
- 012 (COMPLETE) - Aircraft Design and Performance Assessment Tool Enhancement
- 035 (COMPLETE) - Airline Flight Data Examination to Improve flight Performance Modeling
- 036 (COMPLETE) - Parametric Uncertainty Assessment for AEDT2b
- 037 - CLEEN II System Level Assessment
- 040 (COMPLETE) - Quantifying Uncertainties in Predicting Aircraft Noise in Real-world Situations
- 043 - Noise Power Distance Re-Evaluation (NPD+C) to Include Airframe Noise in AEDT
- 045 - Takeoff/Climb Analysis to Support AEDT APM Development
- 046 - Surface Analysis to support AEDT APM Development
- 049 (NEW) - Urban Air Mobility Noise Reduction Modeling
- 053 (NEW) - Validation of low exposure noise modeling by open source data management and visualization systems integrated with AEDT
- 054 (NEW) - AEDT Evaluation and Development Support
- 058 (NEW) - Improving Policy Analysis Tools to Evaluate Aircraft Operations in the Stratosphere
- 060 (NEW) - Analytical Methods for Expanding the AEDT Aircraft Fleet Database
- 062 (NEW) - Noise Model Validation for AEDT
- 064 (NEW) - Alternative Design Configurations to meet Future Demand

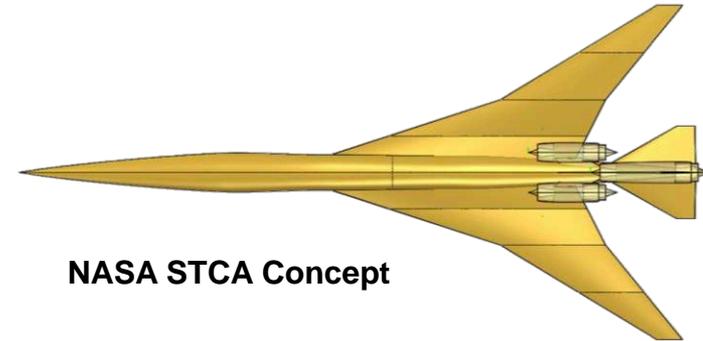


A Cross-Cutting Research Example:

Supersonic Civil Aircraft

<https://ascent.aero/topic/supersonics/>

Multiple ASCENT Projects support technology analysis for ICAO/CAEP rulemaking activity and development of new technologies for the next generation of supersonic aircraft.



ASCENT Supersonics Related Projects

- 007 (COMPLETE) - Civil, Supersonic Over Flight, Sonic Boom (Noise) Standards Development
- 010- Aircraft Technology Modeling and Assessment
- 022 - Evaluation of FAA Climate Tools
- 041 - Identification of Noise Acceptance Onset for Noise Certification Standards of Supersonic Airplanes
- 042 - Acoustical Model of Mach Cut-off
- 047 - Clean Sheet Supersonic Aircraft Engine Design and Performance
- 057 (NEW) - Support for Supersonic Aircraft Noise Efforts in ICAO CAEP
- 058 (NEW) - Improving Policy Analysis Tools to Evaluate Aircraft Operations in the Stratosphere
- 059 (NEW) - Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development
- 074 (NEW) - Low Emissions Pre-Mixed Combustion Technology for Supersonic Civil Transport

