Environment & Energy Research Portfolio Overview

Presented to: REDAC E&E Subcommittee

By: Dr. James I. Hileman
Chief Scientific and Technical Advisor for Environment and Energy
Office of Environment and Energy
Federal Aviation Administration

Date: March 17, 2020

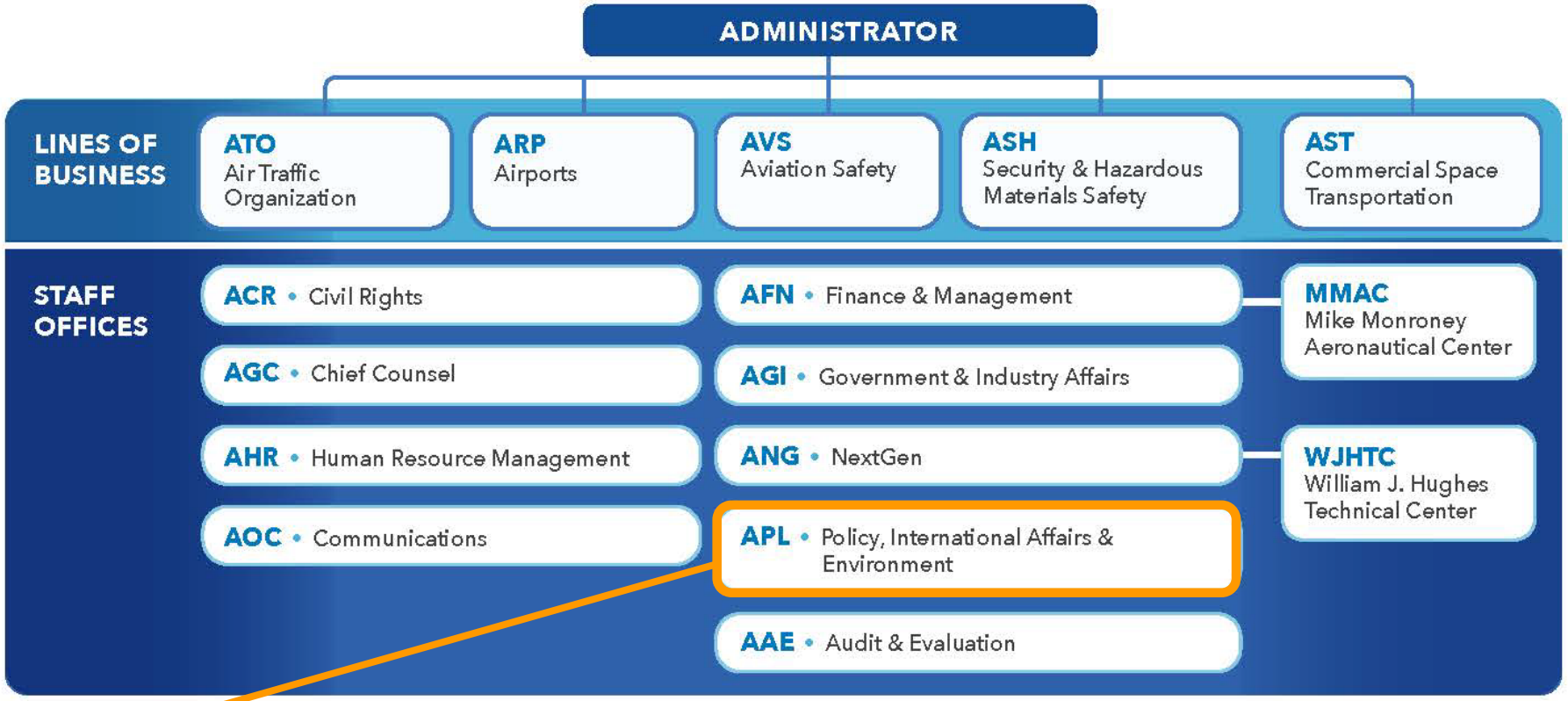
Presentation Outline

- **Office of Environment and Energy – Background**
- **E&E Research Portfolio – Overview**
- **ASCENT COE Summary**
- **Budget Profile for E&E Portfolio**
- **Summary**

Presentation Outline

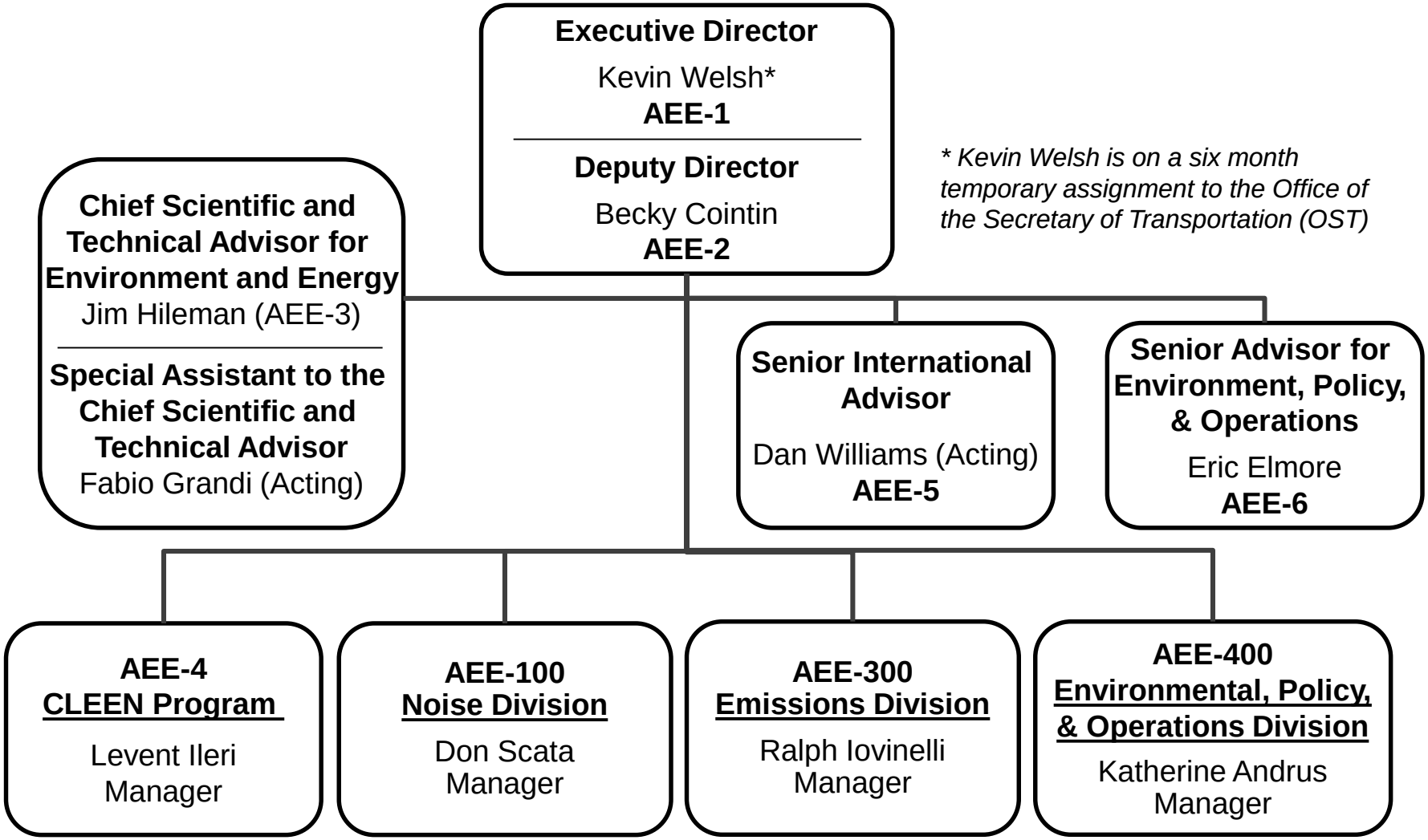
- **Office of Environment and Energy – Background**
- **E&E Research Portfolio – Overview**
- **ASCENT COE Summary**
- **Budget Profile for E&E Portfolio**
- **Summary**

FAA Organizational Structure



Office of Environment and Energy (AEE)

Office of Environment and Energy (AEE)



Economic Benefits of Aviation

5.1% of U.S. GDP

10.6 Million
U.S. jobs

$1.6 Trillion
in U.S. economic activity annually

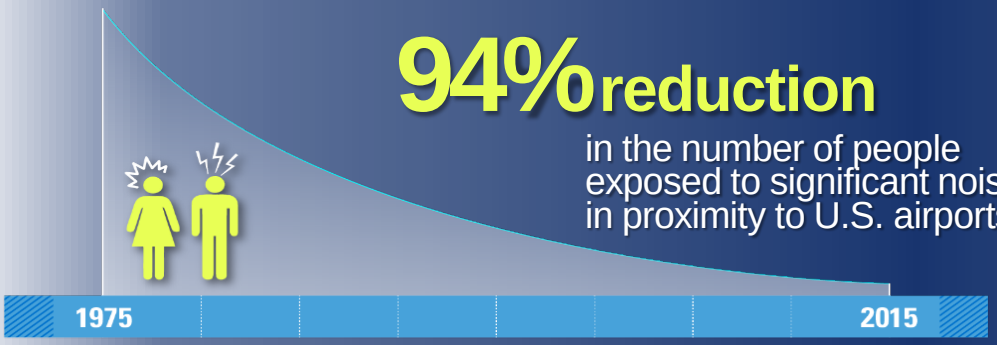
$59.9 Billion
U.S. civil aviation manufacturing trade balance (exports-imports)

SOURCE: FAA Air Traffic Organization

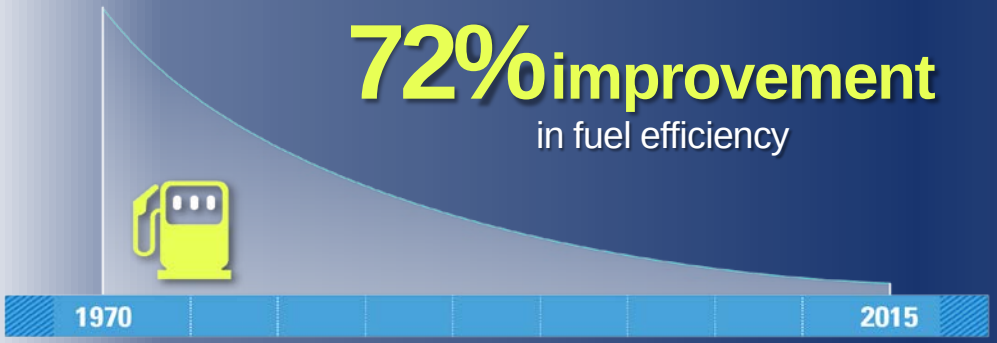
Aviation equipment (aircraft, spacecraft, and related equipment) is largest export sector in U.S. economy accounting for over 8% of total exports.

SOURCE: U.S. International Trade Commission

What We Have Achieved



94% reduction
in the number of people exposed to significant noise in proximity to U.S. airports



72% improvement
in fuel efficiency

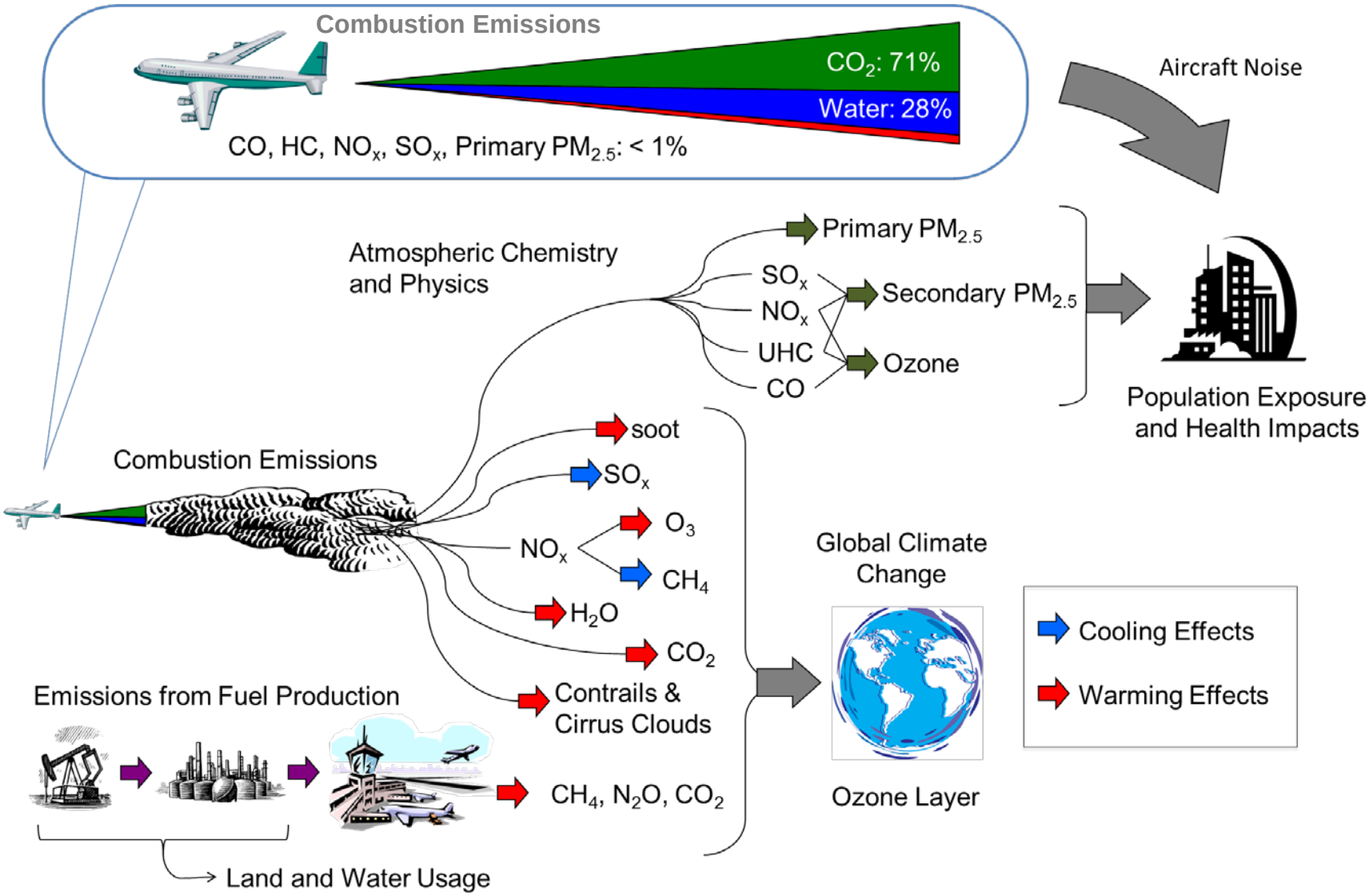
310% increase in passengers travelling in the U.S. from **202 million** to **829 million**

Ultra low nitrogen oxides (NO_X) emissions combustor technology developed and in use

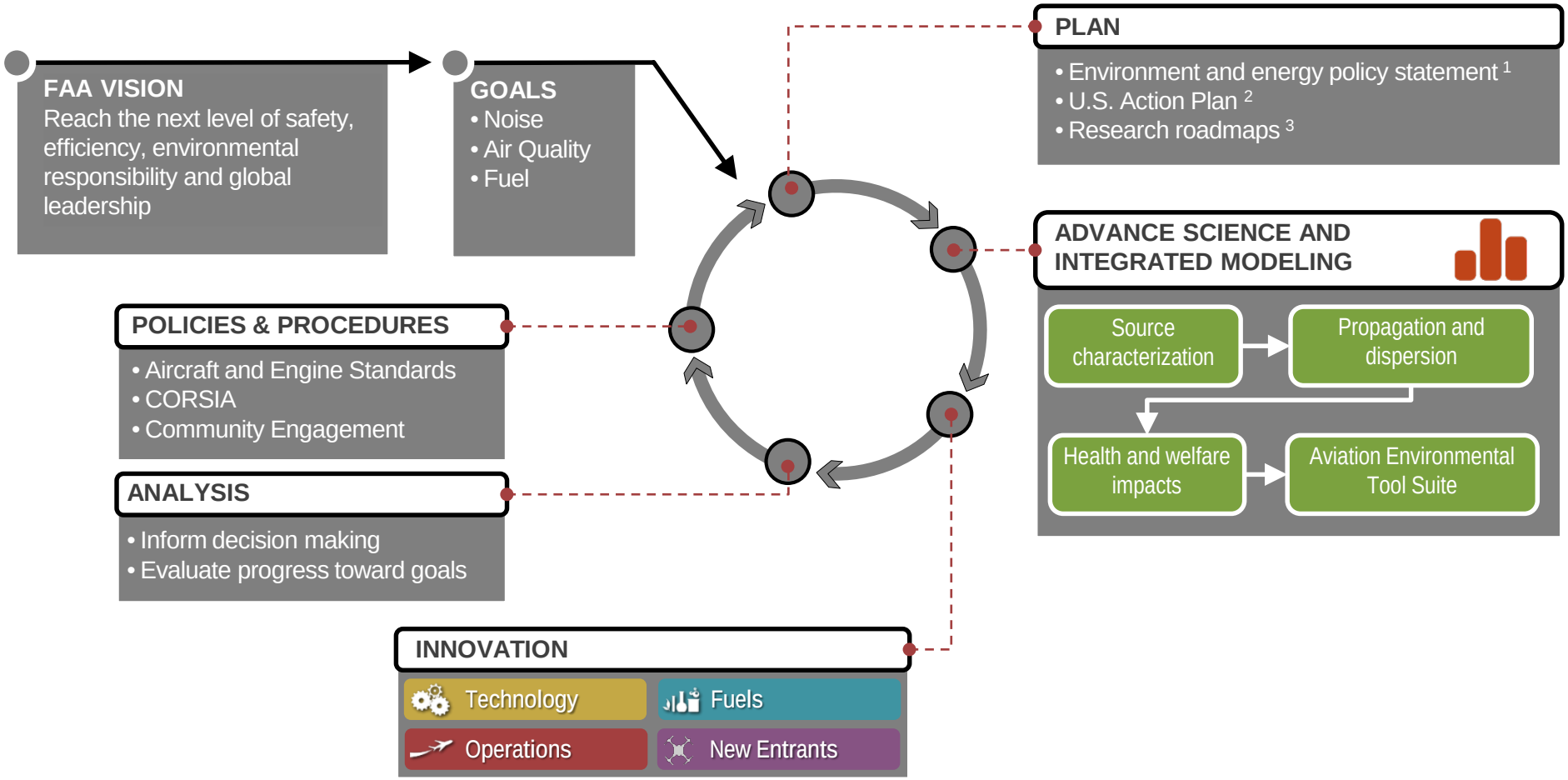
Alternative jet fuels approved and in use by industry

SOURCE: Office of Environment and Energy; Lee, J., et al. 2001, and Bureau of Transportation Statistics (BTS)

Environmental Impacts of Aviation



Environmental & Energy Strategy



Notes:

1. Aviation E&E Policy Statement (Federal Register 77 141, 2012): http://www.faa.gov/about/office_org/headquarters_offices/apl/environ_policy_guidance/policy/media/FAA_EE_Policy_Statement.pdf
2. U.S. Aviation GHG Emissions Reduction Plan: http://www.icao.int/environmental protection/Pages/ClimateChange ActionPlan.aspx
3. Environment and Energy Website: http://www.faa.gov/go/environment

Presentation Outline

- Office of Environment and Energy – Background
- **E&E Research Portfolio – Overview**
- ASCENT COE Summary
- Budget Profile for E&E Portfolio
- Summary

Environment and Energy (E&E) Research Programs

Continuous Lower Energy, Emissions and Noise (CLEEN)

- Reduce aircraft fuel burn, emissions and noise through technology & advance alternative jet fuels
- Cost share partnership with industry

ASCENT Center of Excellence (COE)

- COE for Alternative Jet Fuel and Environment
- Cost share research with universities

Additional Efforts

- Commercial Aviation Alternative Fuels Initiative (CAAFI)
- Contract mechanisms (e.g., SEMRS, PEARS-II)
- Volpe Transportation Center

Emerging Aircraft Types

- **Supersonic Aircraft**
  - Much interest by manufacturers to begin producing aircraft capable of flying Mach 1+
  - FAA announced two rulemakings regarding supersonics
    - Clarification of the process to apply for a special flight authorization to fly over Mach 1 in the U.S. (previously released NPRM)
    - Development of landing and take off noise certification process (expected in March 2020)
  - Have directed substantial R&D efforts to supersonic aircraft
- **Unmanned Aircraft Systems (UAS)**
  - Research has started to understand the potential noise impacts of UAS and to develop appropriate noise certification process for UAS
  - Currently working with Volpe to leverage the UAS Integration Pilot Program (IPP)
- **Urban Air Mobility (UAM)**
  - Looking to build on helicopter R&D efforts with new ASCENT project
- **Commercial Space**
  - Focus is on providing information on appropriate methodologies to use for noise modeling for the National Environmental Policy Act (NEPA)

Efforts Relating to Aircraft Noise

Understanding Noise

- Improving modeling capabilities
- Examining relationship between noise and annoyance, sleep, cardiovascular health and children's learning
- Evaluating current aircraft, helicopters, commercial supersonic aircraft, unmanned aerial systems, and commercial space vehicles

Outreach

- Enhanced community involvement
- Increase public understanding

Reducing Noise at the Source

- Aircraft technologies and architecture
- Noise standards

Mitigation

- Optimized operations and procedures
- Sound insulation program

MITRE

ASCENT
AVIATION SUSTAINABILITY CENTER

Continuous Lower Energy, Emissions & Noise
CLEEN
Federal Aviation Administration

the VOLPE center

NextGEN

For more information:

Aircraft noise: www.faa.gov/go/aviationnoise/

ASCENT: www.ascent.aero

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

MITRE: www.mitre.org/

Volpe: www.volpe.dot.gov/

Federal Aviation Administration

Efforts Relating to Aircraft Emissions

Understanding Emissions

- Conducting Particulate Matter (PM) measurements
- Improving atmospheric modeling capabilities; assess impacts on air quality, climate change and ozone layer
- Evaluating current aircraft, commercial supersonic aircraft, unmanned aerial systems, and commercial space vehicles

Reducing Emissions at the Source

- Aircraft technologies and architecture
- Modifications to fuel composition
- Vehicle operations
- Engine standard (NO_X, CO_2, and PM standard

Mitigation

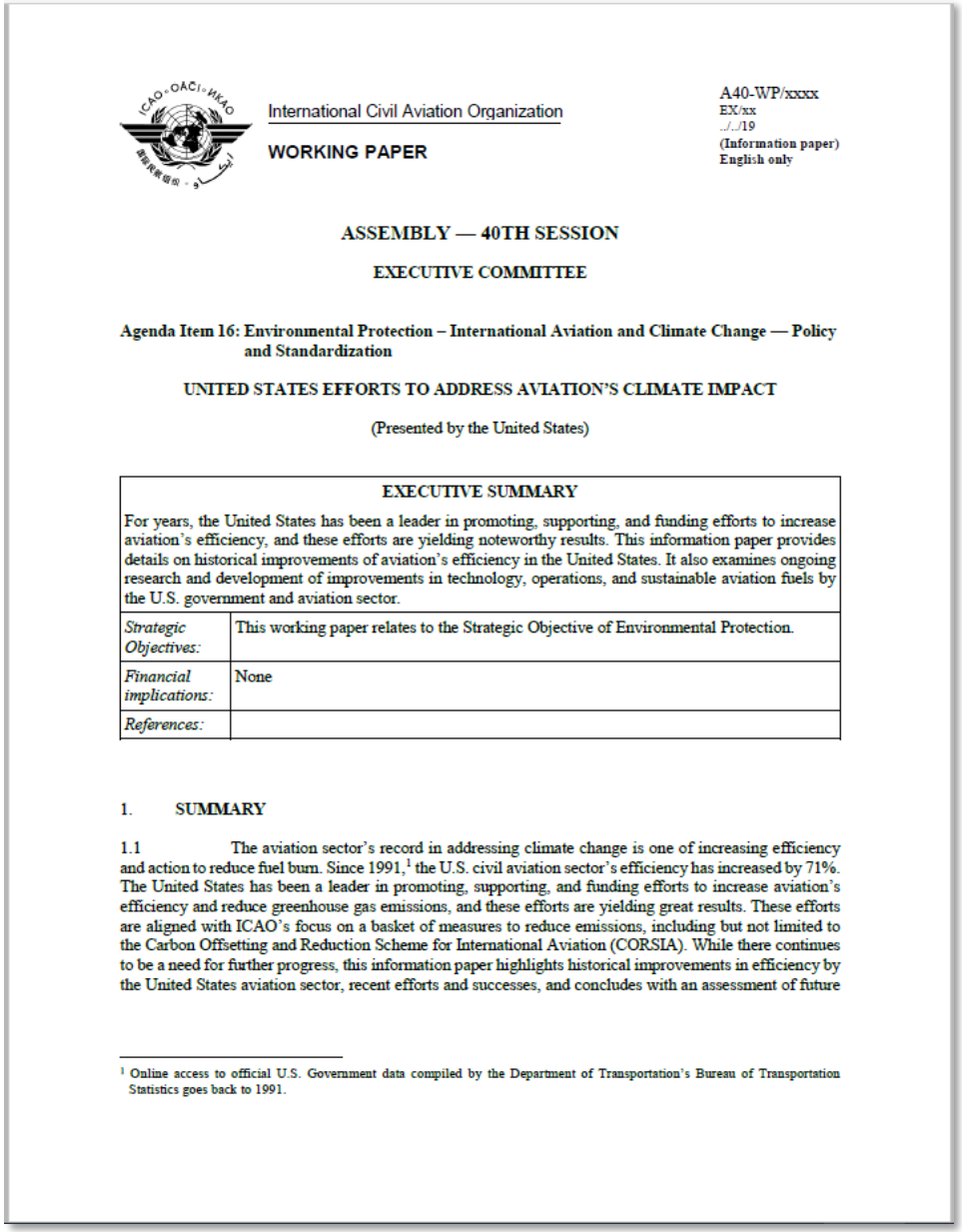
- Alternative fuel sources
- Policy measures (CORSIA)

United States Efforts to Address Aviation's Climate Impact

Information paper presented by the United States government to the 40th Assembly of the International Civil Aviation Organization (ICAO)

Provides high level summary of progress and ongoing efforts, including E&E R&D Portfolio

Paper available for download at:



International Civil Aviation Organization

WORKING PAPER

A40-WP/xxxx
EX/xx
../../19
(Information paper)
English only

ASSEMBLY — 40TH SESSION

EXECUTIVE COMMITTEE

Agenda Item 16: Environmental Protection – International Aviation and Climate Change — Policy and Standardization

UNITED STATES EFFORTS TO ADDRESS AVIATION'S CLIMATE IMPACT

(Presented by the United States)

EXECUTIVE SUMMARY

For years, the United States has been a leader in promoting, supporting, and funding efforts to increase aviation's efficiency, and these efforts are yielding noteworthy results. This information paper provides details on historical improvements of aviation's efficiency in the United States. It also examines ongoing research and development of improvements in technology, operations, and sustainable aviation fuels by the U.S. government and aviation sector.

Strategic Objectives:	This working paper relates to the Strategic Objective of Environmental Protection.
Financial implications:	None
References:	

1. SUMMARY

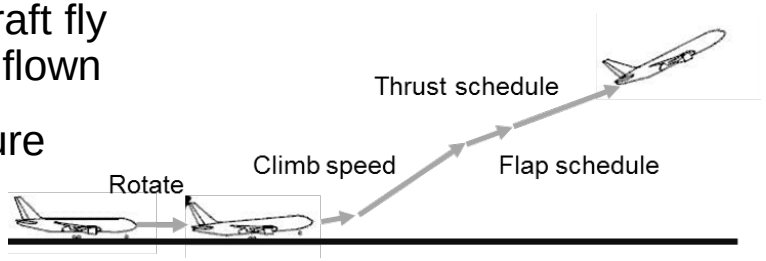
1.1 The aviation sector's record in addressing climate change is one of increasing efficiency and action to reduce fuel burn. Since 1991,[1] the U.S. civil aviation sector's efficiency has increased by 71%. The United States has been a leader in promoting, supporting, and funding efforts to increase aviation's efficiency and reduce greenhouse gas emissions, and these efforts are yielding great results. These efforts are aligned with ICAO's focus on a basket of measures to reduce emissions, including but not limited to the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). While there continues to be a need for further progress, this information paper highlights historical improvements in efficiency by the United States aviation sector, recent efforts and successes, and concludes with an assessment of future

[1] Online access to official U.S. Government data compiled by the Department of Transportation's Bureau of Transportation Statistics goes back to 1991.

Efforts Relating to Aircraft Operations

Opportunities for noise reduction:

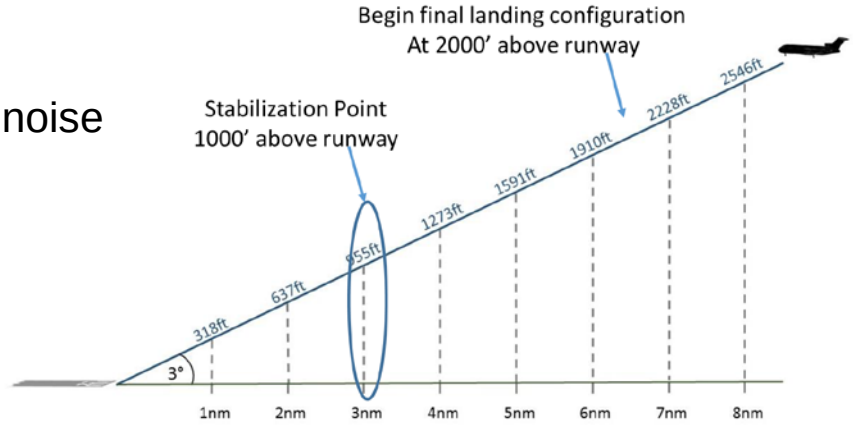
- Airlines determine *what* aircraft fly and *when*
- There might be opportunities to change *where* aircraft fly (through precision navigation) and *how* aircraft are flown
- Must consider the entirety of the airspace and ensure the continued safety of operations



Takeoff Profile

Concepts being evaluated:

- **Route changes**
- **Thrust / speed management**
  - Noise abatement procedures
  - Manage thrust and configuration to lower noise on takeoff and approach
- **Vertical profile**
  - Continuous climb operations
  - Continuous descent arrival
  - Modified approach angles
  - Staggered or displaced landing thresholds
- **Introduction of systematic dispersion**



Approach Profile

Efforts Related to Rotorcraft

Existing efforts on rotorcraft with Penn State and Volpe Center

P9: Geospatially Driven Noise Estimation Module (Georgia Tech)

- Develop a novel geospatially driven noise estimation module to support computation of noise resulting from the operation of Unmanned Aircraft Systems (UAS) and other upcoming vehicle concepts.

P49 UAM/eVTOL Noise Modeling (Penn State)

- Use existing helicopter capabilities to develop models for Urban Air Mobility (UAM) and Unmanned Aircraft Systems (UAS) – Electric Vertical Takeoff and Landing (eVTOL) aircraft

P61: Noise Certification Streamlining (Georgia Tech)

- Examine the process of noise certification and develop a streamlined approach that is flexible enough for current, emerging, and future air vehicles.

NFO-2020-C: Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities

Efforts Relating to Sustainable Aviation Fuels

Testing

- Support Certification/Qualification testing to ensure fuels are safe for use
- Improve Certification/Qualification process to reduce the time and resources required to ensure fuels are safe for use

Analysis

- Environmental sustainability to ensure fuels are properly credited under the ICAO Carbon Offsetting and Reduction Scheme (CORSIA)
- Techno-economic analysis to understand how to reduce costs
- Future scenarios

Coordination

- Interagency
- Public-Private
- State & Regional
- International

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

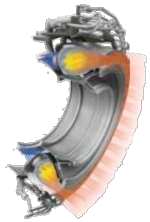
- FAA partnership with academia - 100% in-kind cost share
- Focus on broad range of innovation solutions (technology, fuels, ops, etc.)
- Conducting ground and/or flight test demonstrations to accelerate maturation of certifiable aircraft and engine technologies
- Advance technologies at any TRL, but 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 NDAs

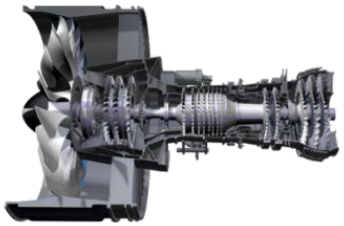
Continuous Lower Energy, Emissions & Noise (CLEEN) Program

- FAA led public-private partnership with 100% industry cost share
- Reducing fuel burn, emissions and noise via aircraft and engine technologies and alternative jet fuels
- Conducting ground and/or flight test demonstrations to accelerate maturation of certifiable aircraft and engine technologies

	Phase I	Phase II	Phase III*
Time Frame	2010-2015	2016-2020	2021-2025
FAA Budget	~$125M	~$100M	TBD
Noise Reduction Goal	25 dB cumulative noise reduction cumulative to Stage 5 ***and/or reduces community noise exposure (new goal for Phase III)***		
	33% reduction	40% reduction	-20% re: CAEP/10 Std.
NO_X Emissions Reduction Goal	60% landing/take-off NO_X emissions	75% landing/take-off NO_X emissions (-70% re: CAEP/8)	
Particulate Matter Reduction Goal			Reduction relative to CAEP/11 Std
Entry into Service	2018	2026	2031

***The information for the third phase of the CLEEN Program is notional as the FAA is in the process of developing the final solicitation.**



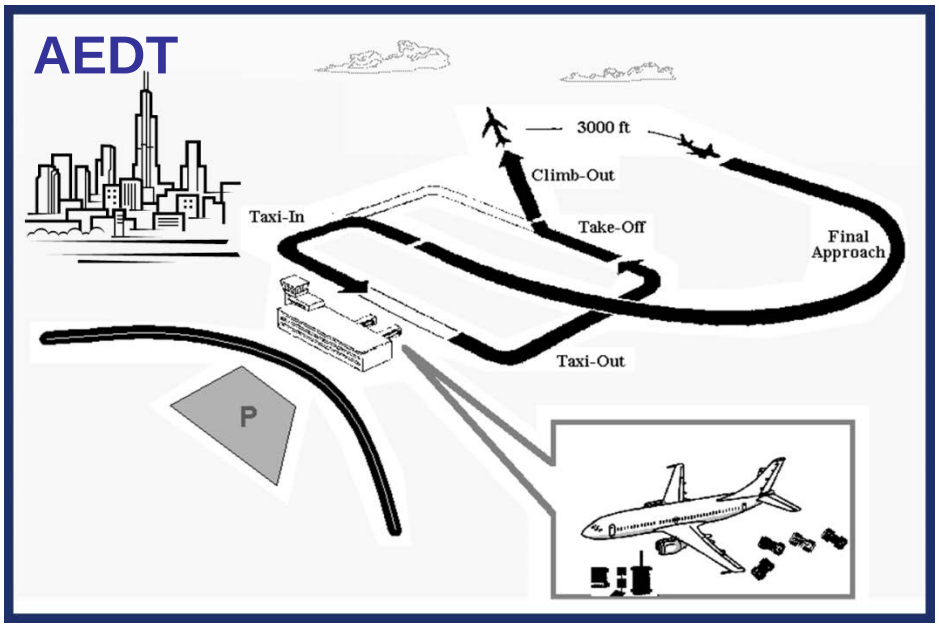


For more information on CLEEN program: http://www.faa.gov/go/cleen

CLEEN III Solicitation: https://beta.sam.gov/opp/e384f5bfa0e04ffaa6dd8b9a1881e783/view?keywords CLEEN&sort= relevance&index opp&is_active=true&page=1

Aviation Environmental Design Tool (AEDT)

- Computes noise, fuel burn and emissions simultaneously
- Can analyze airport, regional, national, and global scales
- Required for all regulatory actions
- Also in use by 464 international users from 42 countries (as of 3/2/20)

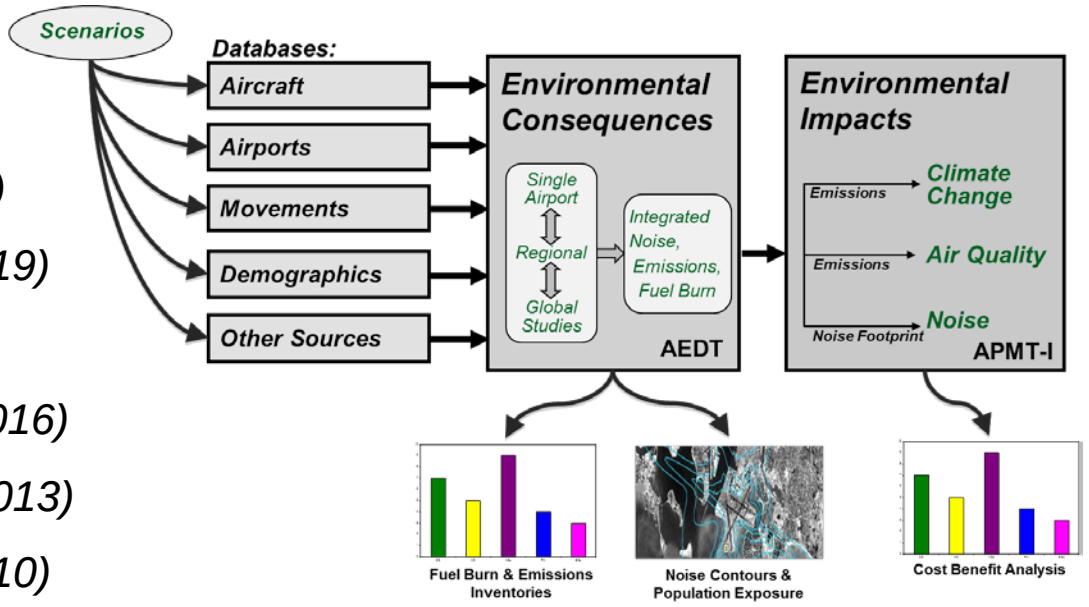


AEDT Development Plan

- Current version of tool, AEDT3c, has enhanced performance and dispersion
  - Improves fuel burn modeling below cruise (BADA 4)
  - ICAO/CAEP FOA4.0 (Doc9889) method for nvPM mass & *number* calculations, and volatile PM
  - Latest versions of AERMOD and AERMET
- Laying ground work for AEDT4 with a planned 2023 release
- Developing noise screening tool to support NEPA process

Modeling to Support Decision-Making

- Aviation environmental policies affect noise and emissions which have varied environmental impacts. Using the aviation environmental tool suite to assess the impacts of noise and emissions for policy assessment.
- Tool suite informing decision making:
  - *Fuel Composition (ongoing)*
  - *CAEP/11 PM Standard (2019)*
  - *CORSIA (2019)*
  - *CAEP/10 CO_2 Standard (2016)*
  - *CAEP/9 Noise Standard (2013)*
  - *CAEP/8 NOx Standard (2010)*



- Utilize Volpe Center and ASCENT Center of Excellence universities to assist FAA in developing data to inform decision making

Additional information on APMT Impacts and its use is available at:
http://partner.mit.edu/projects/valuation and trade offs policy options

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

- Development of innovation portfolio within ASCENT
- Renewed efforts on impacts evaluation within ASCENT
- Much effort on supersonic aircraft
- Exploring low noise operational procedures and means to improve communication among affected communities
- Work on helicopter noise is making good progress
- Standing up projects on UAS/UAM noise
- Released AEDT3c - executing long term vision for AEDT
- Sustainable aviation fuels: CORSIA, CAAFI, and ASTM
- Technology maturation in CLEEN continues and we are setting stage for 3rd Phase of CLEEN
- Commercial space noise and emissions – on the radar

Outreach Materials

Continuing to maintain/update materials:

- Environment and Energy Tri-Fold

- FAA Environment and Energy Website (faa.gov/go/environment)
- Noise Website (faa.gov/go/aviationnoise)
- CLEEN Website (faa.gov/go/cleen)

- ASCENT Website (ascent.aero)
- CAAFI Website (caafi.org)

Presentation Outline

- Office of Environment and Energy – Background
- E&E Research Portfolio – Overview
- **ASCENT COE Summary**
- Budget Profile for E&E Portfolio
- Summary

Increased Collaboration

- Over last six months, have had two NASA detailees to FAA AEE
- During Aerospace Europe Conference 2020, had a joint FAA-NASA briefing wherein Dale Van Zante covered the ASCENT COE Program

ASCENT Center of Excellence: An Overview

Presented to: Aerospace Europe Conference 2020, Bordeaux, France

By: Dr. James I. Hileman
Chief Scientific and Technical Advisor for Environment and Energy, Federal Aviation Administration

Dr. Dale E. Van Zante
Strategic Advisor for Propulsion
Advanced Air Transport Technology Project, National Aeronautics and Space Administration

Date: February 25, 2020

- Currently in discussions with the European Commission about collaboration opportunities between ASCENT research and European research programs

FAA Centers of Excellence (COE)

For 15 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)
- Currently have had 48 ASCENT Projects and looking to stand up over 20 new projects in next year

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)*

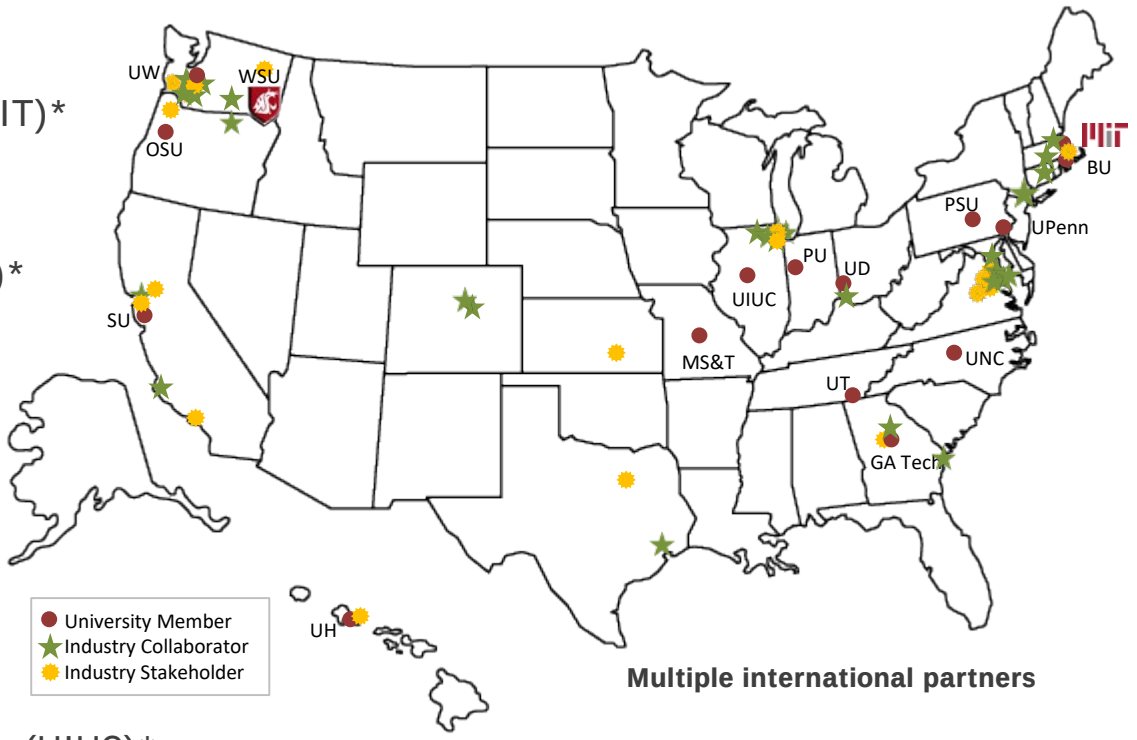
University of North Carolina at Chapel Hill (UNC)*

University of Pennsylvania (UPenn)*

University of Tennessee (UT)

University of Washington (UW)

** Indicates university was also a member of PARTNER COE*



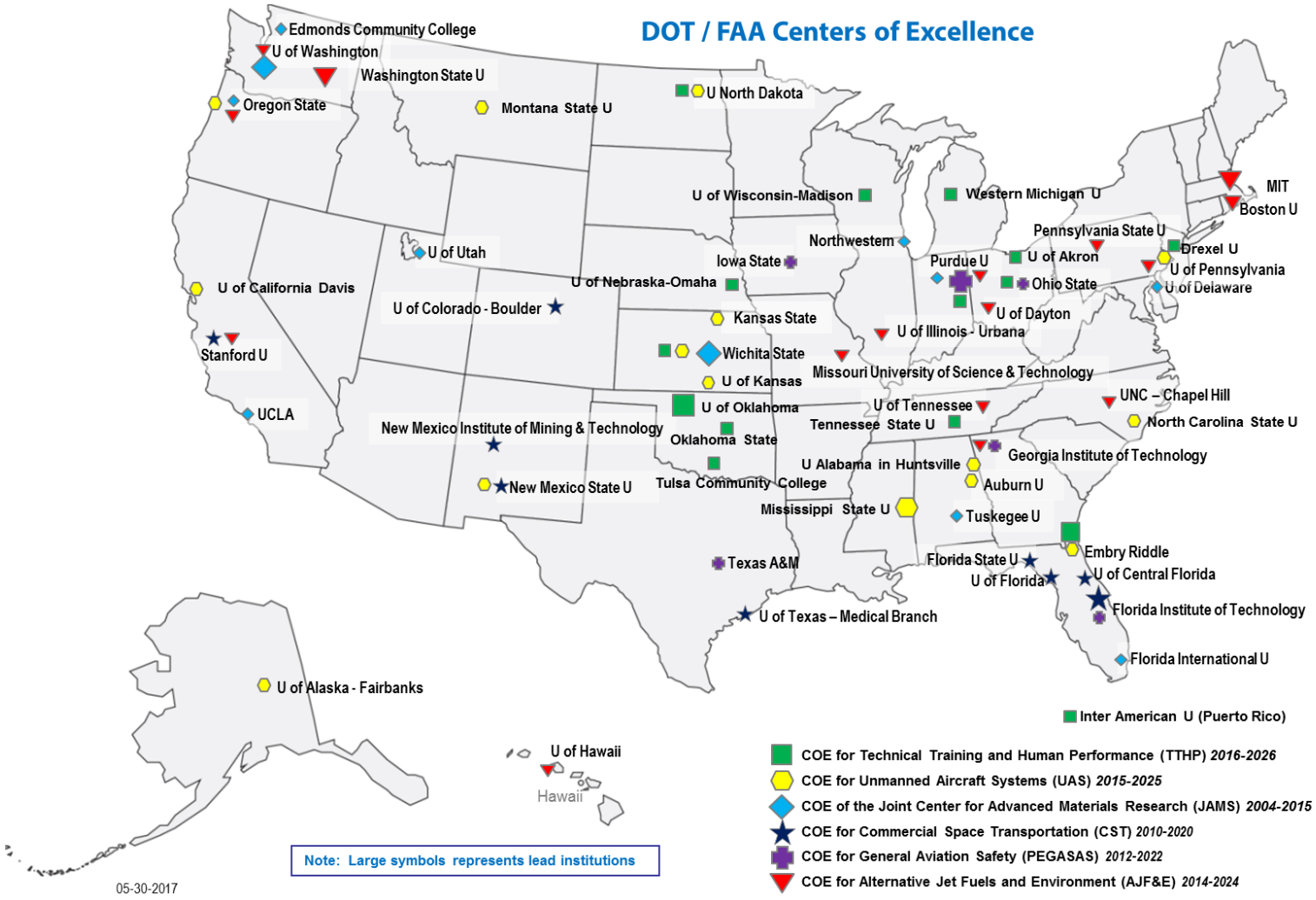
Multiple international partners

Advisory Committee - 58 organizations:

5 airports
4 airlines
7 NGO/advocacy
9 aviation manufacturers
11 feedstock/fuel manufacturers
22 R&D, service to aviation sector

DOT/FAA Centers of Excellence

(ASCENT is one of 6 active COEs within FAA)



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

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 Leadership

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

ASCENT Research Areas

- Noise, Emissions, Tools
- Technology, Operations
- Alternative Jet Fuels

	Report 1*	Report 2	Report 3	Report 4
Time period	9/2013 – 9/2015	10/2015 – 9/2016	10/2016 – 9/2017	
Research Projects	50	54	43	32
Publications, Reports, and Presentations	137	119	110	179
Students involved	131	112	105	116
Industry partners	63	70	72	72

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

DOT/FAA Centers of Excellence Funding Profile

Depending on year, ASCENT has received 1/4 to 1/2 of overall COE funding

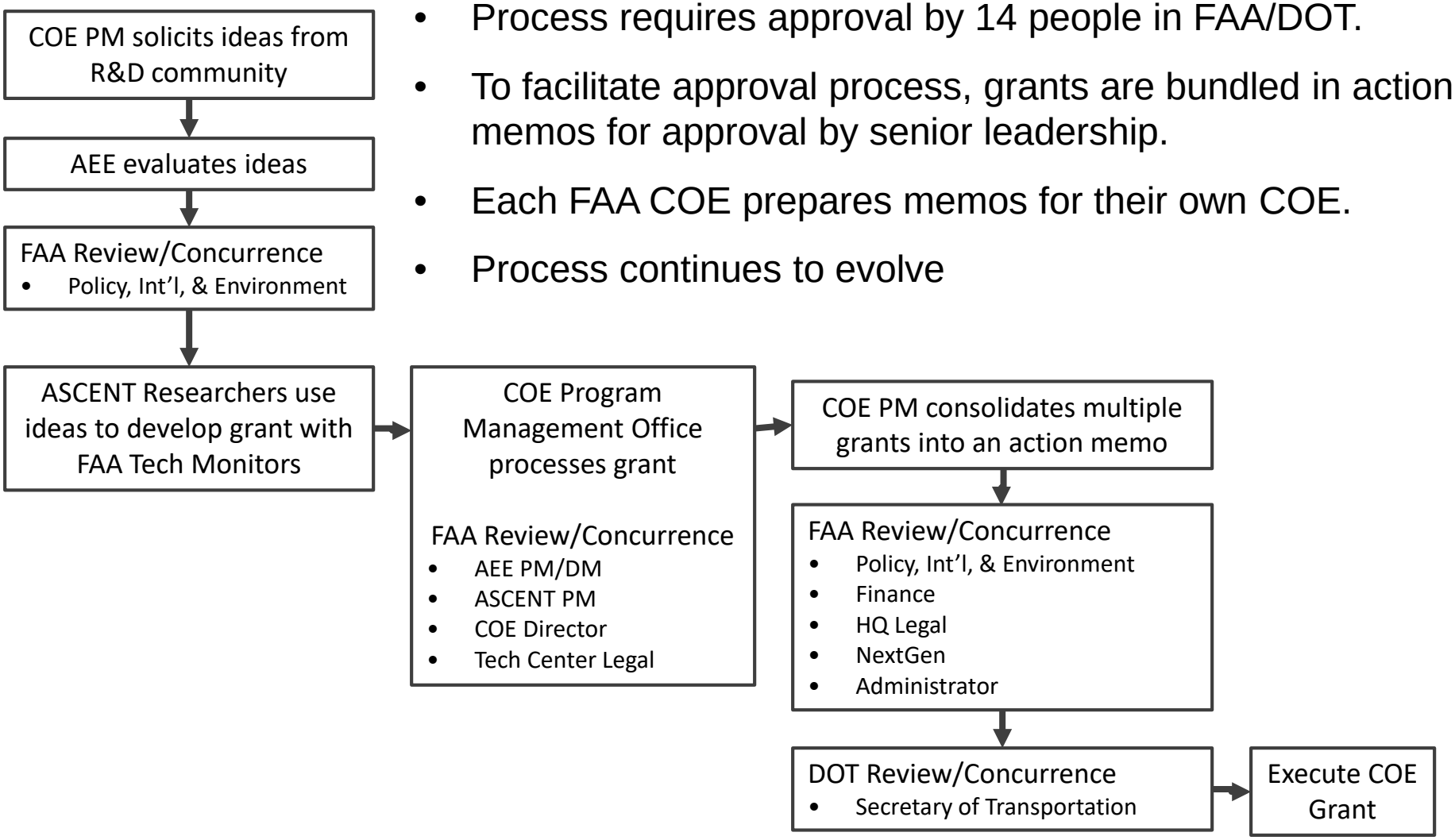
CENTER OF EXCELLENCE	FY15	FY16	FY17	FY18	FY19	*FY20 to Date*
Technical Training and Human Performance	$ -	$ 5,000,000	$ 1,538,757	$ -	$ 1,976,527	*$ -*
Unmanned Aircraft Systems	$ 4,763,506	$ 3,474,932	$ 3,883,711	$ 6,106,452	$ 3,532,507	*$ 2,578,071*
Alternative Jet Fuels and Environment	$10,598,441	$ 9,393,601	$ 9,809,723	$ 3,170,047	$ 7,685,041	*$ 14,389,189*
General Aviation	$ 3,092,624	$ 3,697,891	$ 3,267,686	$ 315,964	$ 2,008,423	*$ -*
Commercial Space Transportation	$ 1,272,864	$ 1,191,548	$ 1,264,293	$ 819,879	$ -	*$ 3,429,113*
Joint Center of Excellence for Advanced Materials	$ 2,429,612	$ 5,639,146	$ 4,894,469	$ 1,456,658	$ 5,203,186	*$ 9,163,133*
TOTAL	**$22,157,047**	**$28,397,118**	**$24,658,639**	**$11,869,000**	**$20,405,684**	***$ 29,559,506***

As of March 2, 2020

Notes:

- The table captures the year of grant execution; it does not capture the amount of the FY appropriation that is being spent in a given year. For example, ASCENT will be awarded roughly $15.2M of the FY18 FAA RE&D A13.a and A13.b appropriation, but the universities will receive these funds over the a time period that covers FY18 through FY20.
- FY19 and FY20 currently being processed

ASCENT COE Grant Approval Process



- Process requires approval by 14 people in FAA/DOT.
- To facilitate approval process, grants are bundled in action memos for approval by senior leadership.
- Each FAA COE prepares memos for their own COE.
- Process continues to evolve

Timeline of Grant Approvals

See Separate COE Project Status Document

Action Memo	# of Grants	Total Funds	APL Approval	S-1 Signature
FY2018 #1	9	$2.8M	6/10/18	9/24/18
FY2019 #1	15	$3.3M	10/11/18	3/29/18
FY2019 #2	8	$2.6M	11/28/18	5/31/19
FY2019 #3	1	$1.7M	3/21/19	6/14/19
Implemented new process and sought new project ideas from ASCENT Community				
FY2020 #1	26	$12.4M	8/28/19	2/5/20
FY2020 #2	3	$2.0M	10/24/19	2/5/20
FY2020 #3	20	$4.8M	1/9/20	TBD
Expediting process to expend remaining FY19 funds and $15M of FY20 funds				
FY2020 #4	TBD	$15.8M	TBD	TBD

ASCENT Research Themes

- Alternative Jet Fuels
- Emissions
- Noise
- Operations
- Tools

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
- 056 (NEW) - Turbine Cooling Through Additive Manufacturing
- 058 (NEW) - Improving Policy Analysis Tools to Evaluate Aircraft Operations in the Stratosphere
- 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
- 017 - Pilot Study on Aircraft Noise and Sleep Disturbance
- 041 - Identification of Noise Acceptance Onset for Noise Certification Standards of Supersonic Airplanes
- 042 - Acoustical Model of Mach Cut-off
- 049 (NEW) - Urban Air Mobility Noise Reduction Modeling
- 050 (NEW) - Over-Wing Engine Placement Evaluation
- 055 (NEW) - Noise Generation and Propagation from Advanced Combustors
- 057 (NEW) - Support for Supersonic Aircraft Noise Efforts in ICAO CAEP
- 059 (PLANNED) - Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development
- 061 (PLANNED) - Noise Certification Streamlining
- 063 (PLANNED) - Parametric Noise Modeling For Boundary Layer Ingesting Propulsors
- tbd (PLANNED) - Improved Engine Fan Broadband Noise Prediction Capabilities
- tbd (PLANNED) - Improved Open Rotor Noise Prediction Capabilities
- tbd (PLANNED) - Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities
- tbd (PLANNED) - Improved Noise Prediction Capabilities for Rotor Noise from UAS/UAM Vehicles

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

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.

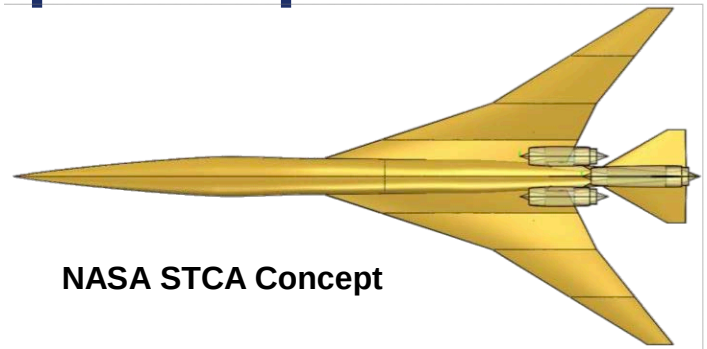
ASCENT Tools Projects

- 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
- 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
- 060 (PLANNED) - Analytical Methods for Expanding the AEDT Aircraft Fleet Database
- 062 (PLANNED) - Noise Model Validation for AEDT
- 064 (PLANNED) - Alternative Design Configurations to meet Future Demand

A Cross-Cutting Research Example: Supersonics

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.



NASA STCA Concept

ASCENT Supersonics Related Projects

- 007 (COMPLETE) - Civil, Supersonic Over Flight, Sonic Boom (Noise) Standards Development
- 010- Aircraft Technology Modeling and Assessment
- 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 (PLANNED) - Jet Noise Modeling to Support Low Noise Supersonic Aircraft Technology Development
- 074 (PLANNED) - Low Emissions Pre-Mixed Combustion Technology for Supersonic Civil Transport

ASCENT – Status and Direction

The ASCENT COE is advancing our knowledge about the impacts of aviation on the environment and investigating a broad portfolio of measures that could mitigate these impacts

In addition to helping the aviation industry through scientific and technological advancements, ASCENT is developing the next generation of aviation environment professionals.

NEW and PLANNED ASCENT projects are focused on innovation and technology development.

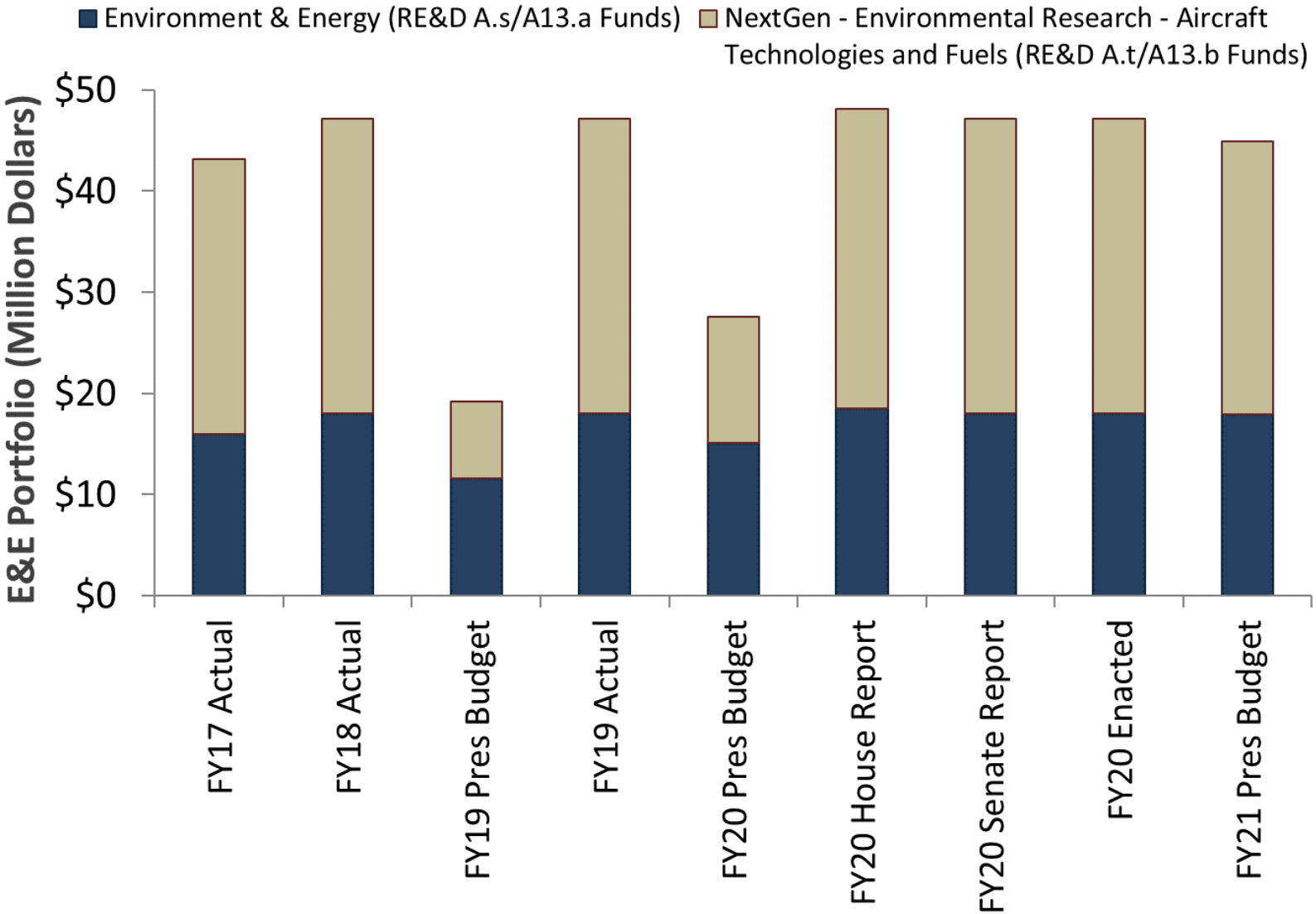
The ASCENT technology portfolio is broad and cross-cutting.

Coordination with the NASA Aeronautics portfolio is ongoing.

Presentation Outline

- Office of Environment and Energy – Background
- E&E Research Portfolio – Overview
- ASCENT COE Summary
- **Budget Profile for E&E Portfolio**
- Summary

E&E R&D Budget Profile – FY17-FY21



FY2021 President Budget for FAA (see pages 475-482 for E&E Portfolio):
https://www.transportation.gov/mission/budget/faa-cj-fy-2021-estimates

Federal Aviation Administration

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 2022, 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).

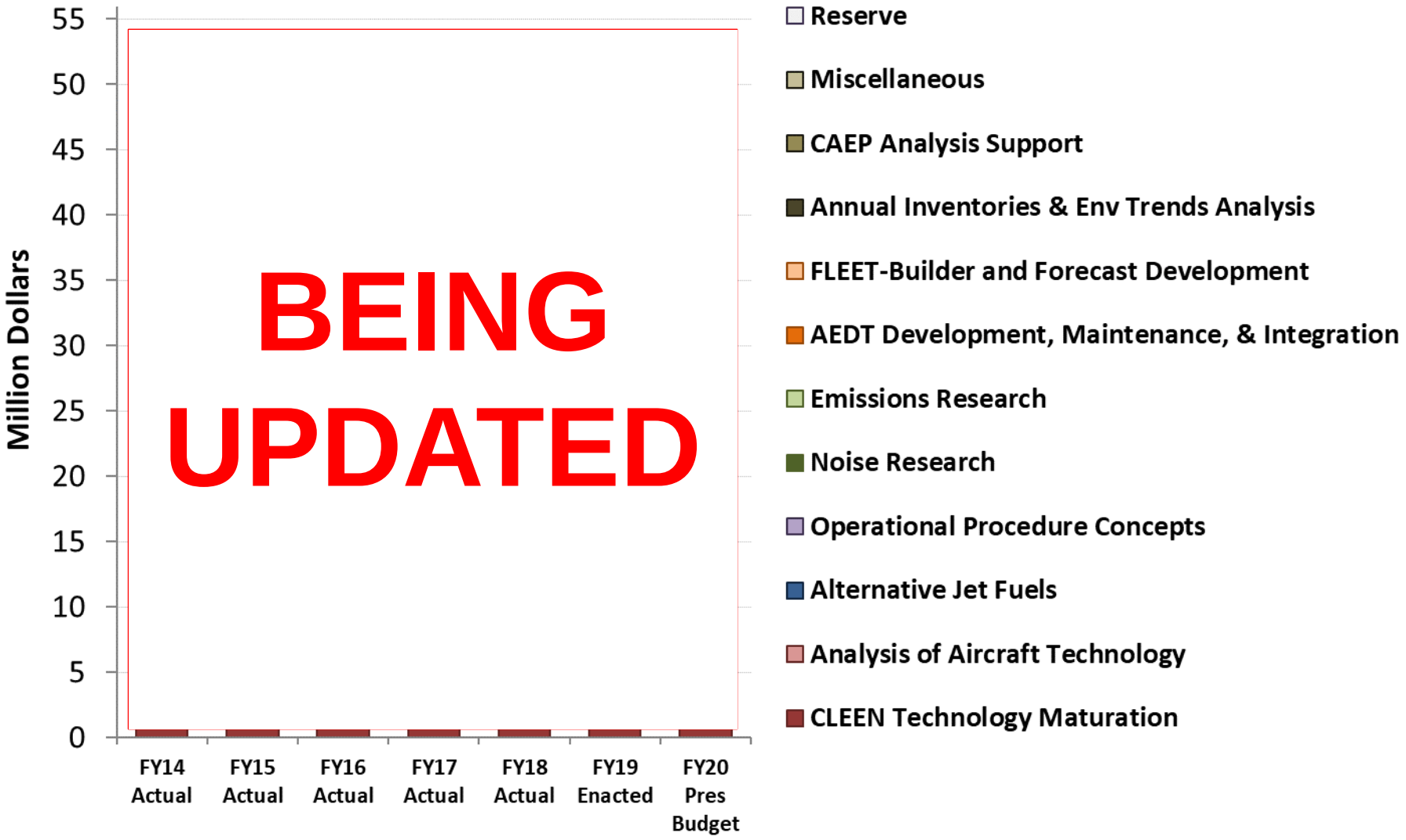
RE&D A.t: NextGen – Environmental Research – Aircraft Technology and Fuels

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.

Environment and Energy Funding

Includes: RE&D, F&E, ATR, Operations, and non-FAA funds (e.g., other US Government and Transport Canada)



Presentation Outline

- Office of Environment and Energy – Background
- E&E Research Portfolio – Overview
- ASCENT COE Summary
- Budget Profile for E&E Portfolio
- **Summary**

Recent Successes

capabilities and solutions that are helping today

- Leveraging operational procedure development work at Boston Logan to evaluate communication tools, develop additional concepts, and evaluate potential for broader use. Concept with noise reduction potential flown by Boeing 777 ecoDemonstrator at ACY
- Noise research continues. Community noise survey under review. Starting work on national sleep study. Resumed work to understand potential health impacts of noise.
- Aviation Environmental Design Tool (AEDT) being upgraded to better capture actual operations and is being used extensively.
- Measurement technique and data provided foundation for new ICAO CAEP nvPM engine standard that will replace the existing smoke number standard in 2023.
- Analytical tools provided foundation for ICAO CAEP Independent Expert review of aircraft technologies for the purpose of setting goals for noise, fuel burn, and NO_X emissions.
- Provided critical analytical support to the development of Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).
- Research efforts were critical for the inclusion of sustainable aviation fuels within CORSIA.
- Certification of six alternative jet fuel pathways – certification has enabled multiple airlines to buy and use sustainable aviation fuels in LAX and elsewhere.
- CLEEN aircraft and engine technologies appearing in new aircraft with some technologies retrofitted into today's fleet. Will reduce noise, emissions, and fuel use for decades to come.
- Research efforts are paving the way for the re-introduction of supersonic aircraft.

FAA Portion of the Remaining Agenda

Subject	Presenters
ATR Environmental Research - Update	M. Hovan & M. Flynn
Noise Research	D. Scata
Helicopters, UAS, and UAM	E. Elmore et al.
Research on Operational Procedures	C. Dorbian
Emissions Research	R. Iovinelli & D. Jacob
Supersonic Civil Aircraft Research	D. Scata, R. Iovinelli, et al.
Sustainable Aviation Fuels Research	N. Brown & A. Oldani
Analysis & Tool Development	F. Grandi
Screening Tool Update	S. Doyle
AEDT Update	M. Majeed & J. DiPardo

Dr. Jim Hileman

Chief Scientific and Technical Advisor for Environment and Energy

Federal Aviation Administration
Office of Environment and Energy

Email: james.hileman@faa.gov