

# FAA Environment & Energy Research & Development Update



Federal Aviation  
Administration

Prepared for: ASCENT Advisory Committee Meeting

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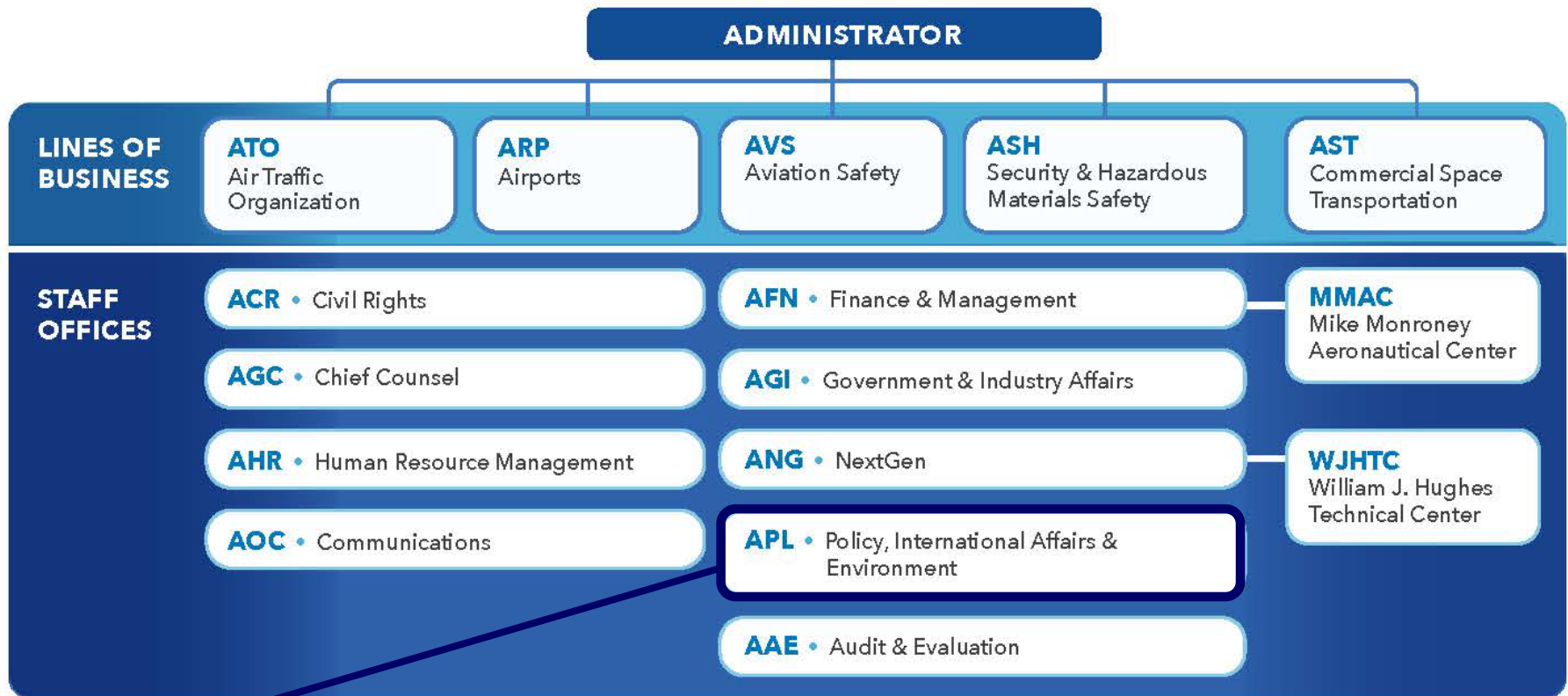


# Presentation Outline

- **Office of Environment and Energy**
- **Environment & Energy Strategy**
- **ASCENT COE Highlights**
- **Program Growth**
- **New ASCENT Research**
- **Inflation Reduction Act**
- **Summary**



# FAA Organizational Structure

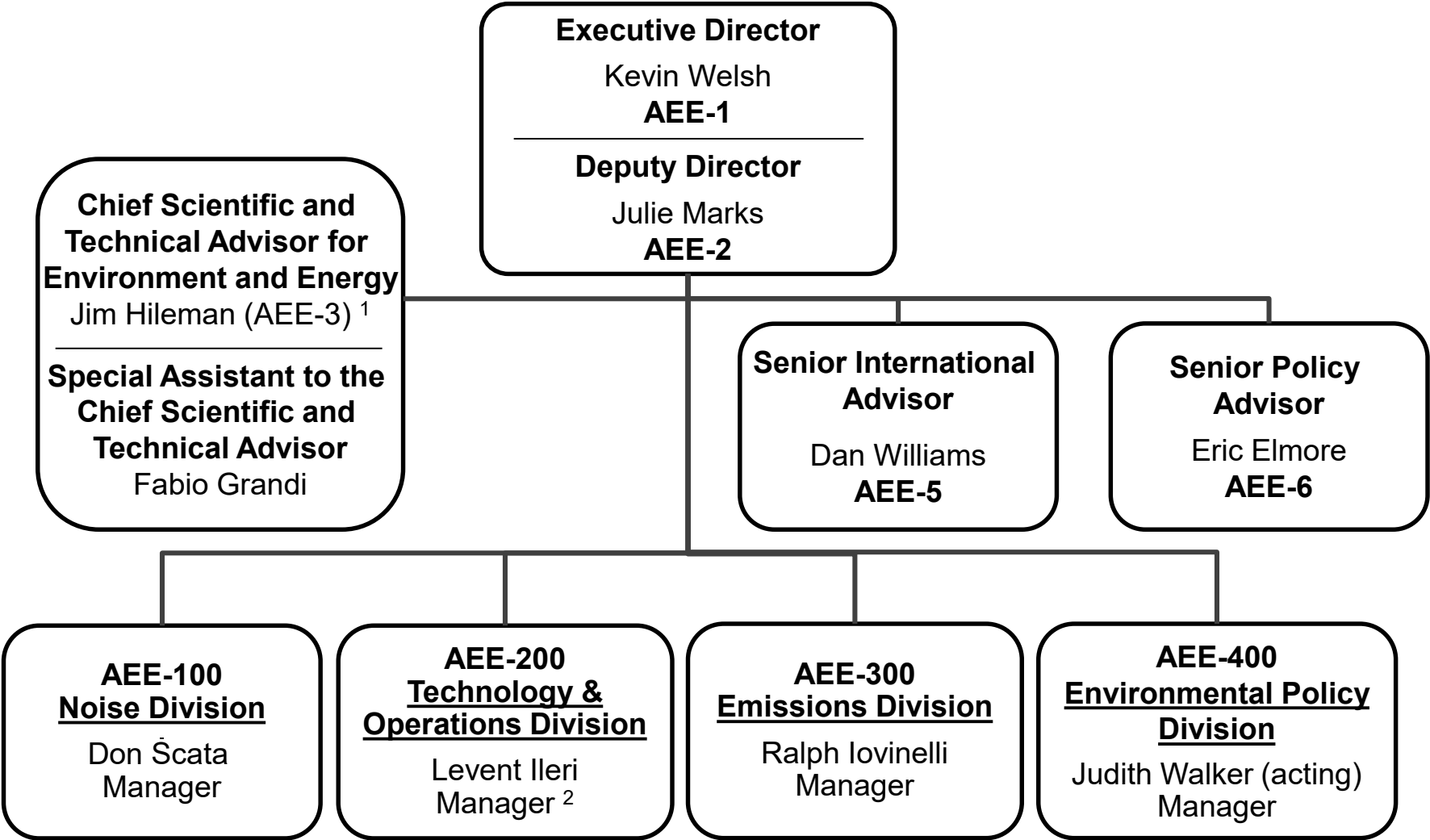


## Office of Environment and Energy (AEE)

- Office within APL, responsible for broad range of environmental policies
- About 45 staff members (*in process of expanding*)
- *Responsible for roughly 1/3 of FAA RE&D Budget and I.R.A. Programs*



# AEE Organizational Structure

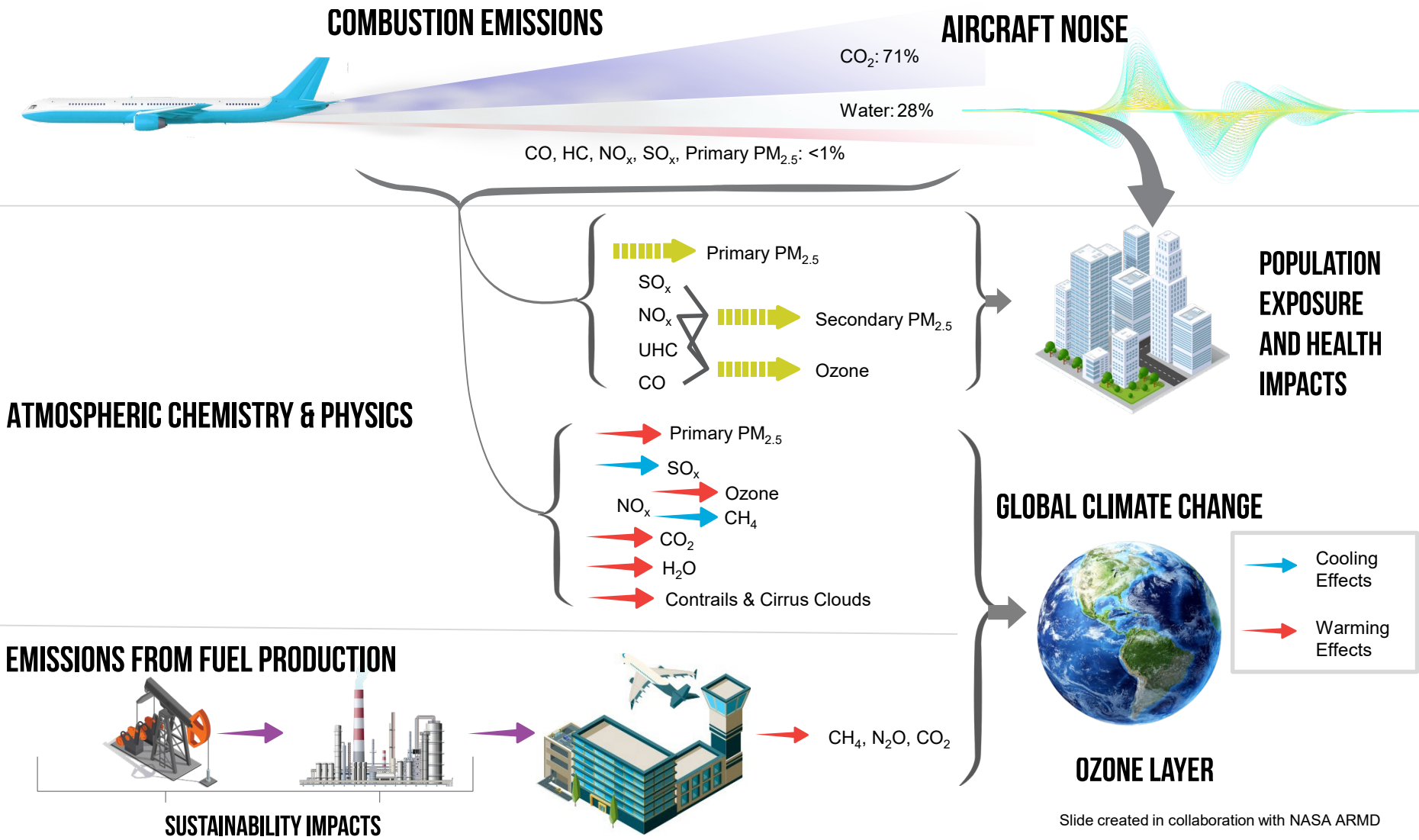


<sup>1</sup> ASCENT Program Manager, as a subset of his Chief Scientist duties

<sup>2</sup> CLEEN Program Manager, as a subset of his Division Manager duties



# Environmental Impacts of Aviation



Slide created in collaboration with NASA ARMD



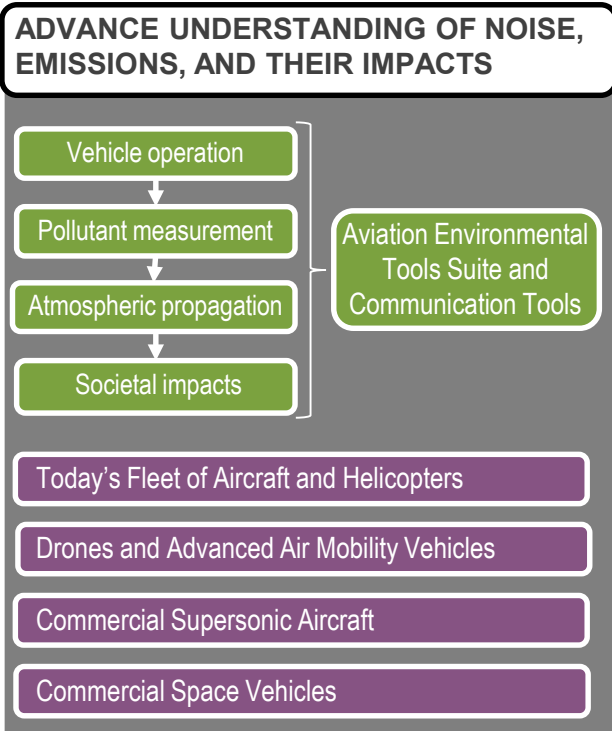
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# Environmental & Energy (E&E) Strategy

**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 Program:





# ASCENT Center of Excellence

**For 18 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 (*674 students supported and counting*).

## ASCENT Research Portfolio

- In 2013, FAA established ASCENT to conduct research on environment and alternative jet fuels
- Portfolio covers broad range of topics on Alternative Jet Fuels, Emissions, Noise, Operations, and Analytical Tools
- Currently overseeing a large increase in the COE portfolio

### 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)

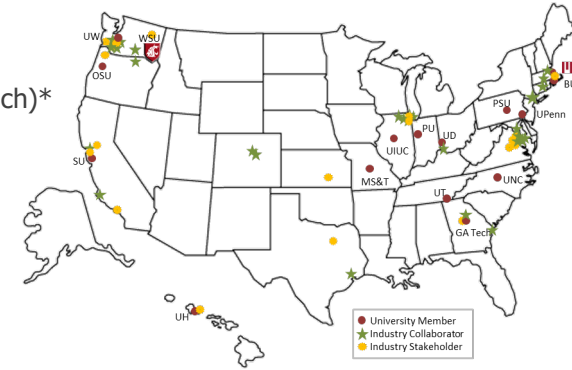
University of Illinois at Urbana-Champaign (UIUC)\*

University of North Carolina at Chapel Hill (UNC)\*

University of Pennsylvania (UPenn)\*

University of Tennessee (UT)

University of Washington (UW)



### Multiple international partners

#### Advisory Committee (57 orgs)

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

### ASCENT 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



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

- ***Published U.S. Aviation Climate Action Plan to address CO<sub>2</sub> emissions – E&E R&D featured prominently throughout***
- ***E&E R&D is at the core of the ICAO CAEP Long Term Aspirational Goal (LTAG) for international aviation CO<sub>2</sub> emissions***
- ***Co-led development of SAF Grand Challenge Roadmap with E&E R&D being a key component***
- ***R&D Portfolio is expanding***
  - ASCENT research portfolio is expanding
  - Work of CLEEN is expanding
- Research efforts continue to inform decision making on many fronts
  - Domestic efforts on noise, emissions, and fuel
  - International efforts in ICAO
- Released AEDT3e - executing long term vision for AEDT
- Rotorcraft noise research efforts continue: helicopters, drones and advanced air mobility
- Continuing wide-ranging portfolio on supersonic aircraft – expanding to examine higher speeds and commercial space





# Overseeing Rapid Growth

- ***FY10-FY21 enacted budgets:*** ~45 staff and annual budget that varied from \$40M to \$52M for R&D
- ***FY19-FY21 Pres Budgets:*** Operated under possibility of reduced budget (FY19, FY20, and FY21 Pres Budgets - \$19M, \$27M, and \$27M (initial))
- ***FY22 enacted budget:*** R&D funding increased to \$89.5M
- ***FY23 President's budget and House/Senate reports*** would see further increase (between \$92M and \$99M)
- ***Substantial R&D support to domestic policymaking and ICAO***
- ***Inflation Reduction Act (signed in August 2022)***
  - New SAF and Tech Grant Program - \$297M
  - SAF Blenders Tax Credit (Sections 13203 and 13704)



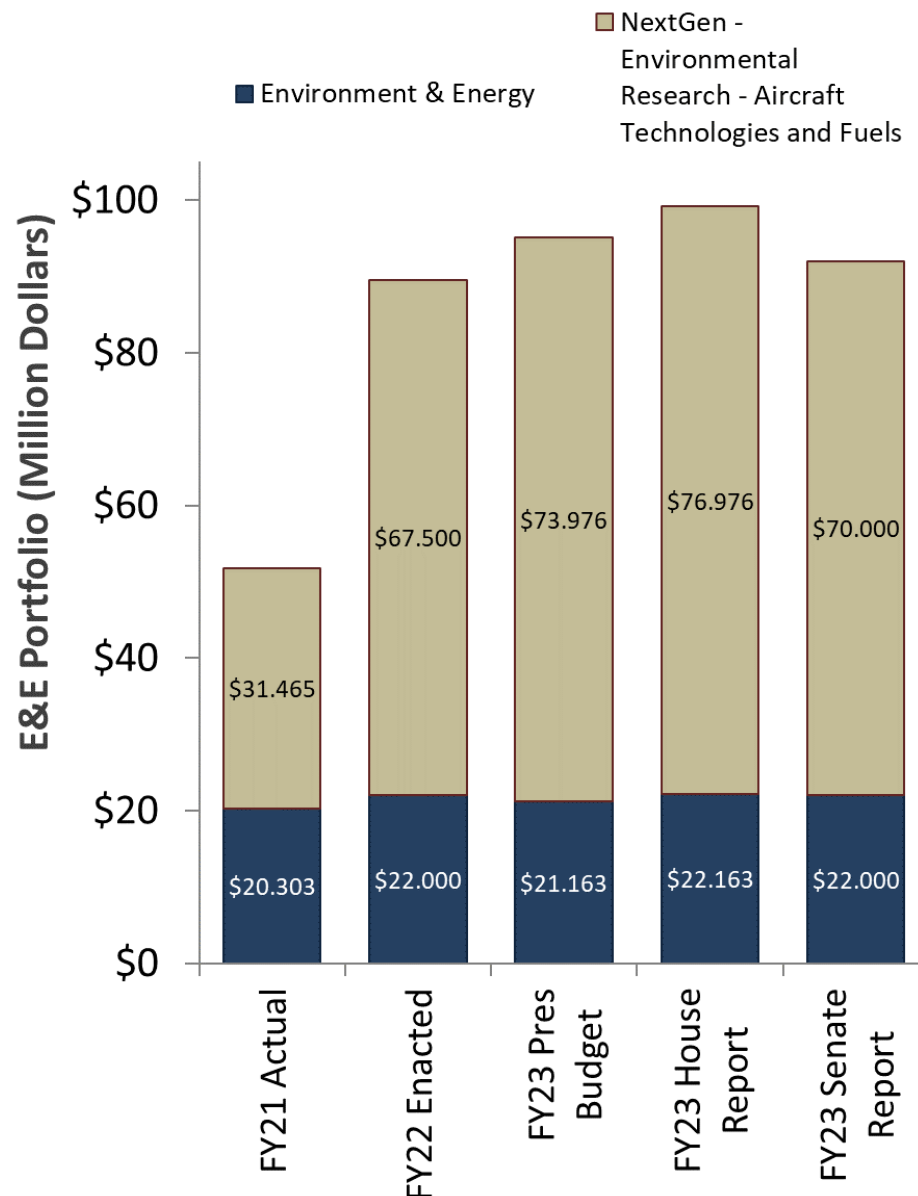
# E&E R&D Portfolio

## RE&D Environment & Energy (E&E) Budget Line Item\*

- Improved understanding of noise and emissions and their impacts
- Analytical tool development
- Analysis to inform decision making

## RE&D NextGen – Environmental Research – Aircraft Technology and Fuels Budget Line Item\*\*

- Accelerated development of aircraft and engine technologies with reduced fuel burn, noise and emissions
- Testing, analysis and coordination activities related to Sustainable Aviation Fuels



\*Budget Line Items: A.T (FY21), A11.U (FY22), A11.T (FY23)

\*\* Budget Line Items: A.U (FY21), A11.V (FY22), A11.U (FY23)



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# Changes with FY22 Budget Increase

- ***Expanded third phase of CLEEN Program***
  - *Operating at \$37.5M+ per year (had been \$19M per year)*
  - *Increased overall funding to CLEEN Phase III from \$100M to \$125M*
- ***Starting work for fourth phase of CLEEN Program***
  - *Expect to use FY23 to forward-fund majority of CLEEN Phase III*
  - *Intend to begin CLEEN Phase IV using FY24 funding*
  - *Planning for market survey in the coming months to solicit industry feedback, including on draft goals*
- ***ASCENT Program Growth***
  - *Operating at \$35M+ per year (had been \$16M per year)*
  - *Awarding ~\$32M of grants over a few months*
  - *Includes many new projects – will talk about these here and in subsequent briefings*



# CLEEN / ASCENT Budgets

	FY21 Actual	FY22 Enacted	FY23 President's Budget
<b>A11.T Environment and Energy</b>			
CLEEN	\$0	\$0	\$0
ASCENT	\$7,500,000	\$8,500,000	\$7,500,000
Other	\$12,803,000	\$13,500,000	\$13,785,000
Total	\$20,303,000	\$22,000,000	\$21,285,000
<b>A11.U NextGen – Environmental Research – Aircraft Tech and Fuels</b>			
CLEEN	\$19,000,000	\$37,500,000	\$42,000,000
ASCENT	\$9,500,000	\$26,565,000	\$27,000,000
Other	\$3,965,000	\$3,435,000	\$5,425,000
Total	\$32,465,000	\$67,500,000	\$74,425,000

\*Budget Line Items: A.T (FY21), A11.u (FY22), A11.T (FY23)

\*\* Budget Line Items: A.U (FY21), A11.v (FY22), A11.U (FY23)



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# Overview of FY2022 ASCENT Grant Awards

- In 2018, a grant review and approval process was established wherein Secretary of Transportation approved all grants, including research grants
- Status of grant awards for FY2022

	Grant Awards	Projects	Value of Awards	OST Approval Date
Memo 1	11	10	\$2,580,230	May 2022
Memo 2	32	26	\$13,441,791	Sept 2022
Memo 3	43	33	\$19,463,979	Pending
<b>Total</b>	<b>86</b>	<b>69</b>	<b>\$35,486,000</b>	



# FY2022 ASCENT – Select Fuels Projects

Project	Title	University
1	Alternative Jet Fuel Supply Chain Analysis	Washington State University Massachusetts Institute of Technology University of Hawaii Pennsylvania State University University of Tennessee Purdue University
31	Alternative Jet Fuels Test and Evaluation	University of Dayton
52	Comparative Assessment of Electrification Strategies for Aviation	Massachusetts Institute of Technology
80	Hydrogen and Power to Liquid (PtL) Concepts for SAF Production	Washington State University Massachusetts Institute of Technology
81	Measurement and Prediction of non-volatile particulate matter size and number emissions from sustainable and conventional aviation fuels	Missouri University of Science and Technology
87	Measurement of nvPM size, number and compositional emissions, for Boeing eco-Demonstrator aircraft burning Sustainable Aviation Fuel	Missouri University of Science and Technology
88	A Method for Rapidly Assessing Jet Fuel Compatibility with non-Metallic Materials	University of Dayton
89	Characterization of Compositional Effects on Dielectric Constant	University of Dayton
90	World Fuel Survey	University of Dayton
93	Collaborative Research Network for Global SAF Supply Chain Development	Massachusetts Institute of Technology University of Hawaii Washington State University





# FY2022 ASCENT – Select Emissions Projects

Project	Title	University
78	Contrail Avoidance Decision Support and Evaluation	Massachusetts Institute of Technology
81	Measurement and Prediction of non-volatile particulate matter size and number emissions from sustainable and conventional aviation fuels	Missouri University of Science and Technology
82	Integrated Noise and CO2 Standard Setting Analysis	Georgia Tech Massachusetts Institute of Technology
83	NOx Cruise/Climb Metric System Development	Massachusetts Institute of Technology
87	Measurement of nvPM size, number and compositional emissions, for Boeing eco-Demonstrator aircraft burning Sustainable Aviation Fuel	Missouri University of Science and Technology
91	Environmental Impacts of High Altitude and Space Vehicle Emissions	Massachusetts Institute of Technology University of Illinois



# FY2022 ASCENT – Select Noise Projects

Project	Title	University
3	Cardiovascular Disease and Aircraft Noise Exposure	Boston University
82	Integrated Noise and CO2 Standard Setting Analysis	Georgia Tech Massachusetts Institute of Technology
84	Noise Modeling of Advanced Air Mobility Flight Vehicles	Massachusetts Institute of Technology
86	Study on the use of broadband sounds to mitigate sleep disruption due to aircraft noise	University of Pennsylvania
94	Probabilistic Unmanned Aircraft Systems (UAS) Trajectory and Noise Estimation Tool	Georgia Tech

# FY2022 ASCENT – Select Technology Project

Project	Title	University
79	Novel Noise Liner Development Enabled by Advanced Manufacturing	Pennsylvania State University
92	Advanced Two-Stage Turbine Rig Development	Pennsylvania State University



# Inflation Reduction Act

- ***I.R.A. Section 40007 – New SAF and Tech Grant Program***  
*\$297M to establish “a competitive grant program for eligible entities to carry out projects located in the United States that produce, transport, blend, or store sustainable aviation fuel, or develop, demonstrate, or apply low-emission aviation technologies”*
- ***I.R.A. Sections 13203 and 13704 SAF Blenders Tax Credit and Clean Fuel Production Credit***
  - *Have 16 years of FAA supported research to inform development of method to quantify life cycle greenhouse gas emissions*
  - *Have deep collaborations with DOE, USDA, and EPA from many years of work and the SAF Grand Challenge Roadmap effort*
  - *Stood up SAF GC Life Cycle GHG Working Group*



# I.R.A. Section 40007: FAST-SAF & FAST-Tech

- Leveraging existing FAA Office of Environment and Energy (AEE) Staff and Expertise (i.e., subject matter experts behind ASCENT COE, CAAFI, CLEEN, SAF Grand Challenge)
- Expanding AEE staff to support this new program
- Developing two linked programs
  - Fueling Aviation's Sustainable Transition through Sustainable Aviation Fuels (**FAST-SAF**) - \$244.5M for *projects on SAF*
  - Fueling Aviation's Sustainable Transition through Technology (**FAST-Tech**) - \$46.5M for *projects on Technology*



# Fueling Aviation's Sustainable Transition through Sustainable Aviation Fuels (FAST-SAF) Grant Program

- **I.R.A. Section 40007 Direction:** “carry out projects located in the United States that produce, transport, blend, or store sustainable aviation fuel.”
- **Key Objective:** *make investments through a new FAST-SAF Grant Program to accelerate the production and use of SAF, in line with the SAF Grand Challenge, to meet U.S. aviation climate goals to reduce aviation carbon emissions*
- **Definition of Sustainable Aviation Fuel from Section 40007:**
  - Hydrocarbon fuels that meet the ASTM requirements for alternative jet fuels; are derived from biomass, waste streams, renewable energy, or gaseous carbon oxides; are not derived from palm fatty acid distillates
  - Must achieve at least a 50% reduction in life cycle emissions compared with petroleum based jet fuel



# Fueling Aviation's Sustainable Transition through Technology (FAST-Tech) Grant Program

- **I.R.A. Section 40007 Direction:** “carry out projects located in the United States that develop, demonstrate, or apply low-emission aviation technologies.”
- **Key Objective:** *make investments through a new FAST-Tech Grant Program to accelerate the development and demonstration of low-emission aviation technologies in line with U.S. aviation climate goals to reduce aviation carbon emissions*
- **Definition of Low-Emission Aviation Technologies from Section 40007:** “technologies, produced in the United states, that significantly—(A) improve aircraft fuel efficiency; (B) increase utilization of sustainable aviation fuel; or (C) reduce greenhouse gas emissions produced during operation of civil aircraft”





# FAST-SAF and FAST-Tech Industry Day

- **December 14, 2022**
- Looking to hold a hybrid event with the in-person portion being held in the West Atrium of DOT Headquarters
- Holding a one day hybrid workshop on I.R.A. Section 40007 FAST-SAF and FAST-Tech Programs
- FAA will provide details on the Programs and offer an opportunity to provide feedback
- Intend to issue a market survey and/or Request For Information (RFI) to solicit further input on the Program



# ASCENT and the FAST-SAF/Tech Programs

- Thinking about how to leverage ASCENT research within the new FAST-SAF and FAST-Tech Programs
- Could have ASCENT universities and Volpe Center provide support through analytical tools and data that would be used by FAST-SAF applicants to help identify their infrastructure needs
- Would like to quantify the increased use of SAF and technologies, as well as resulting emissions reduction, that will come from the projects
- If interested, please let me know.



# Recent Successes - Capabilities and Solutions Helping Today

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

- Provided analysis at the core of the U.S. Aviation Climate Action Plan
- At forefront of informing the development of a *long term aspirational goal for international aviation CO<sub>2</sub> emissions* within International Civil Aviation Organization (ICAO).
- Providing critical support to development of *Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)*.
- Measurement technique and data provided foundation for 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 (SAF)

- At forefront of informing policies on life cycle analysis of SAF (e.g., IRA SAF Blenders Tax Credit, CORSIA)
- Efforts featured prominently throughout the *SAF Grand Challenge Roadmap*
- *Certification of seven alternative jet fuel pathways and two co-processing pathways* enabling multiple airlines to use SAF in LAX, SFO, and elsewhere. Efforts have also *significantly reduced fuel volumes required for new approvals*.

## Accelerating Technological Innovation

- *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.

## 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. Informing ongoing noise policy review.
- 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.





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