

FAA Environment & Energy Research & Development Overview and Update



Federal Aviation
Administration

Prepared for: CLEEN Consortium Meeting

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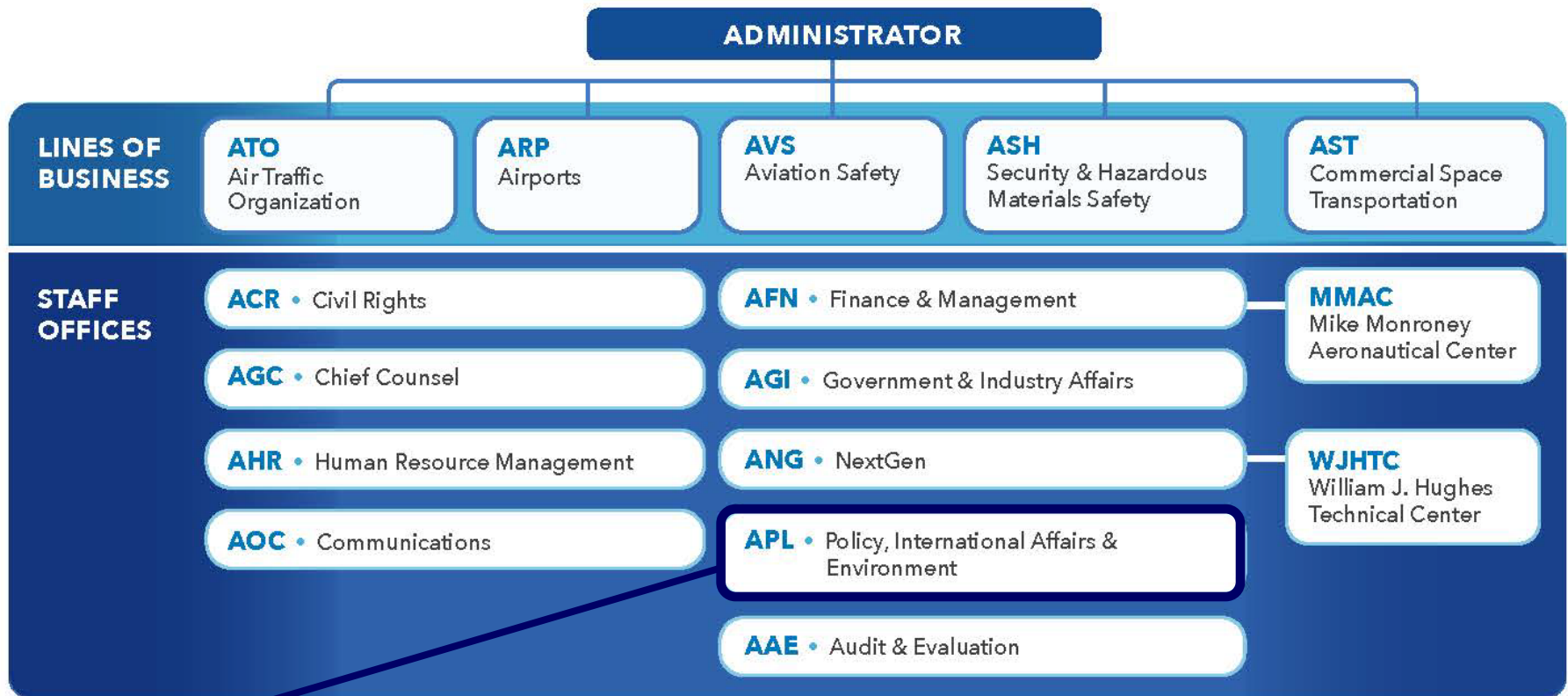


Presentation Outline

- **Office of Environment and Energy**
- **Environment & Energy Strategy**
- **ASCENT COE Highlights**
- **Program Growth**
- **Inflation Reduction Act (IRA)**
- **Summary**



FAA Organizational Structure

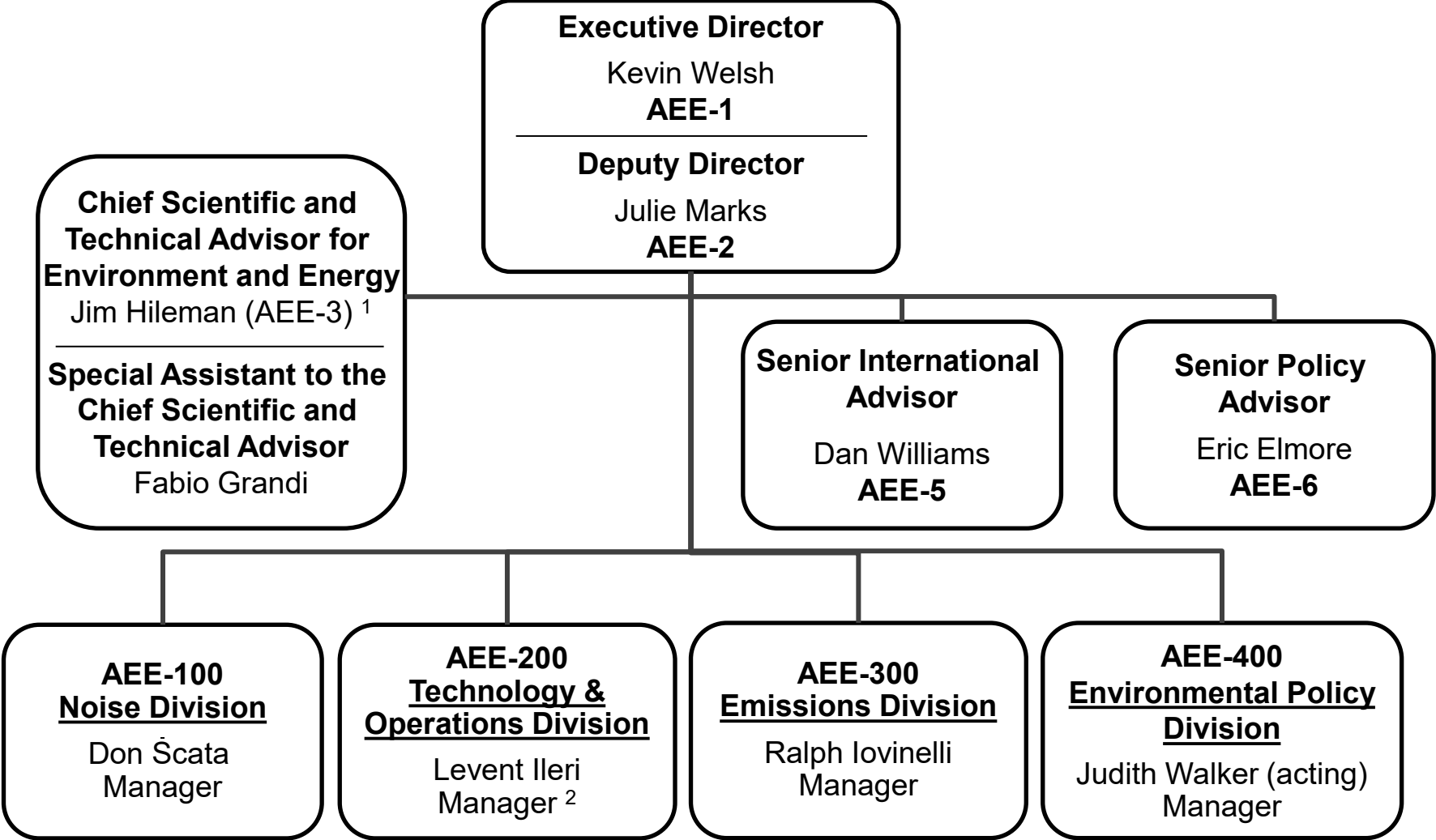


Office of Environment and Energy (AEE)

- 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

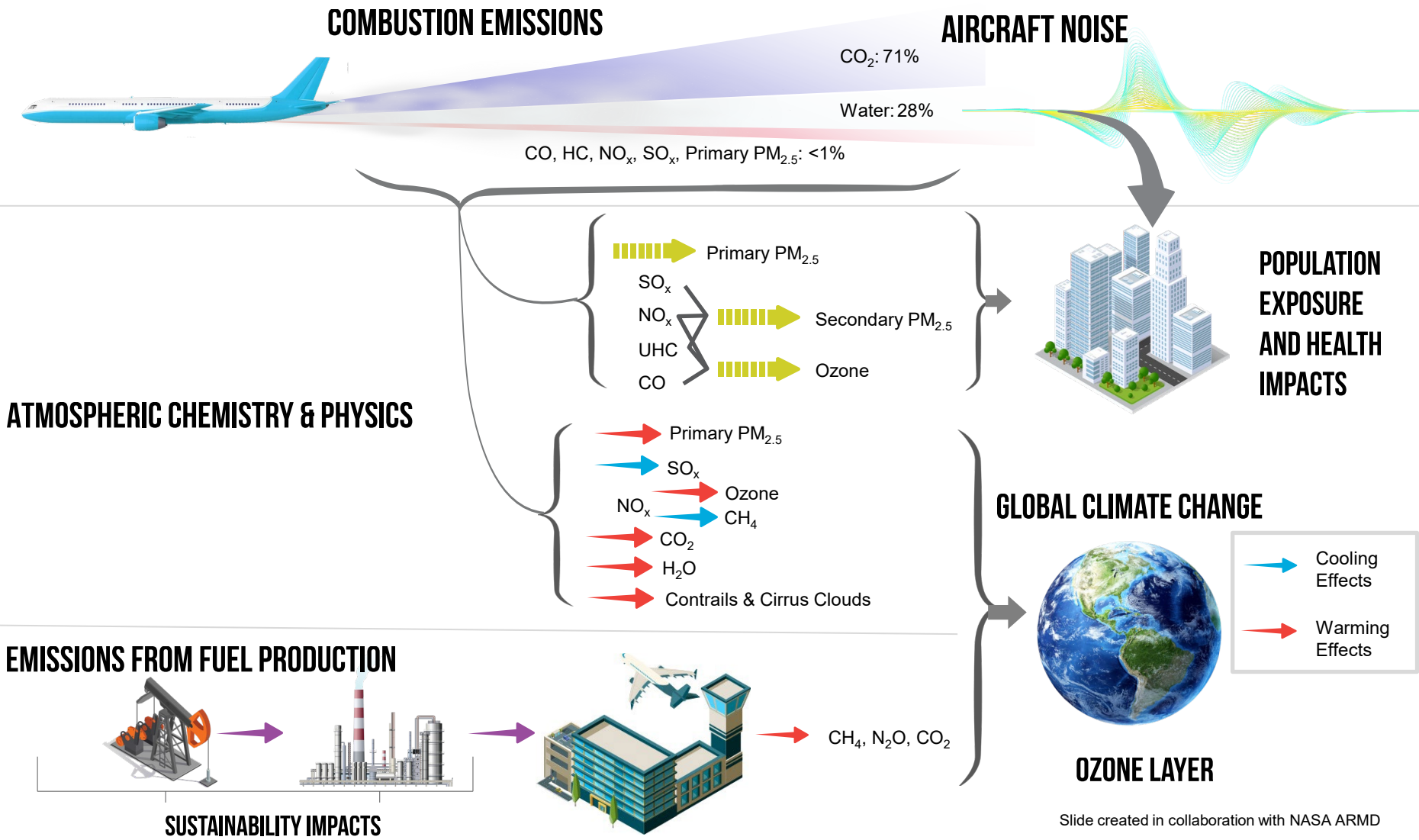


¹ ASCENT Program Manager, as a subset of his Chief Scientist duties

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



Environmental Impacts of Aviation



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:

ADVANCE UNDERSTANDING OF NOISE, EMISSIONS, AND THEIR IMPACTS



POLICY MAKING

- Domestic Policies
- Aircraft and Engine Standards
- CORSIA
- Long Term Climate Goal Development
- Community Engagement

DEVELOP INNOVATIVE SOLUTIONS TO REDUCE NOISE AND EMISSIONS

- Aircraft and Engine Technology
- Sustainable Aviation Fuels
- Optimized Operations and Procedures



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)

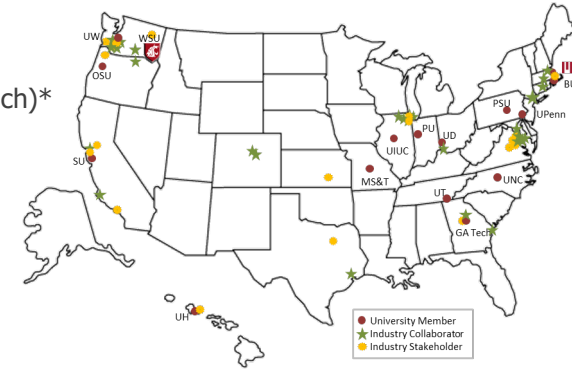
University of Illinois at Urbana-Champaign (UIUC)*

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 CO₂ 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 CO₂ 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 Aviation Environmental Design Tool (AEDT) 3e - 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)



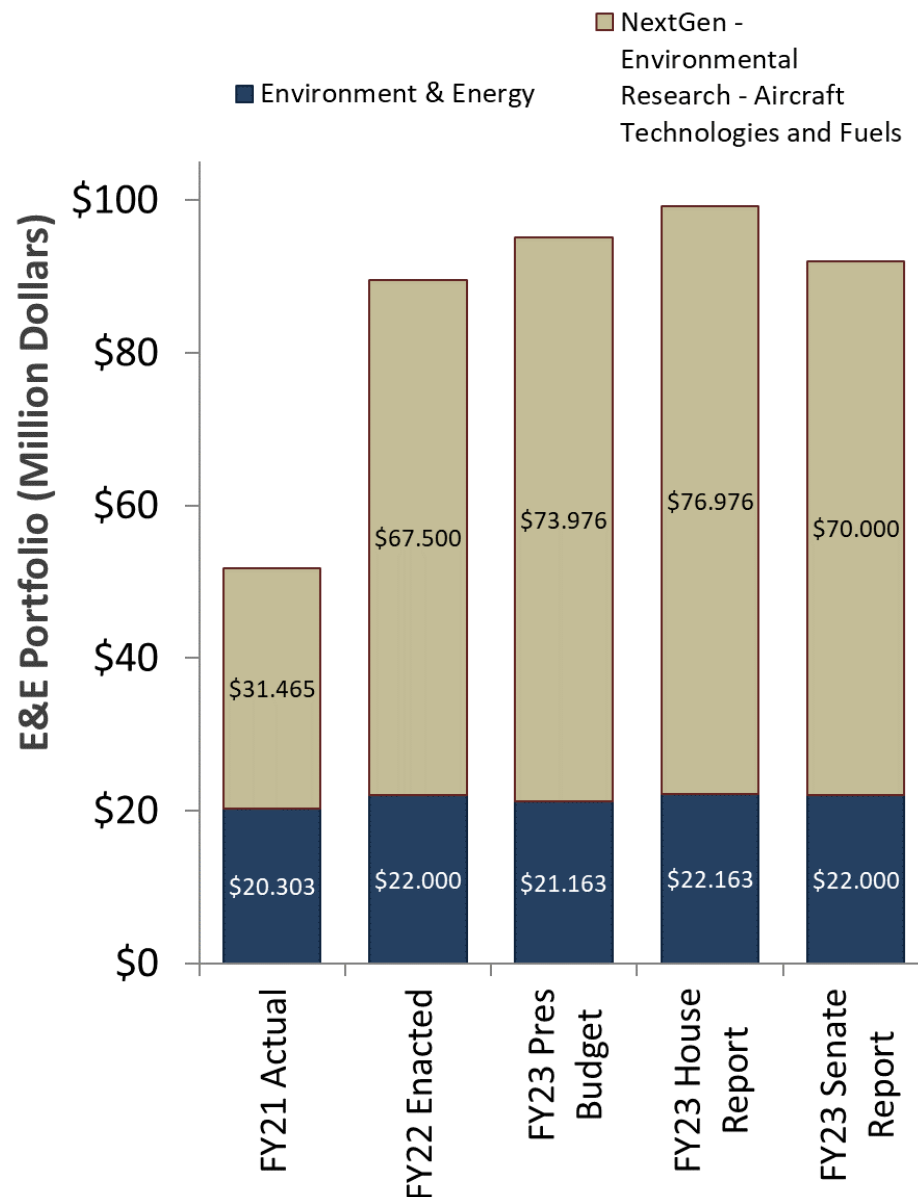
E&E R&D Portfolio

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)



Changes with FY22 Budget Increase

- ***Expanding 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*



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 Public Meeting

- **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 meeting 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 Request For Information (RFI) to solicit further input on the program



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 CO₂ 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.



Backup Slides



Aviation Climate Action Plan

- International Civil Aviation Organization (ICAO) – “State Action Plans”
- Plan builds on ongoing FAA Environment & Energy Program – long-term focus on reducing climate impacts of aviation
- Administration focus on climate – Achieving net zero emissions economy-wide by 2050
- Climate Action Plan Press Release:
<https://www.faa.gov/newsroom/us-releases-first-ever-comprehensive-aviation-climate-action-plan-achieve-net-zero>
- Climate Action Plan Document:
https://www.faa.gov/sites/faa.gov/files/2021-11/Aviation_Climate_Action_Plan.pdf



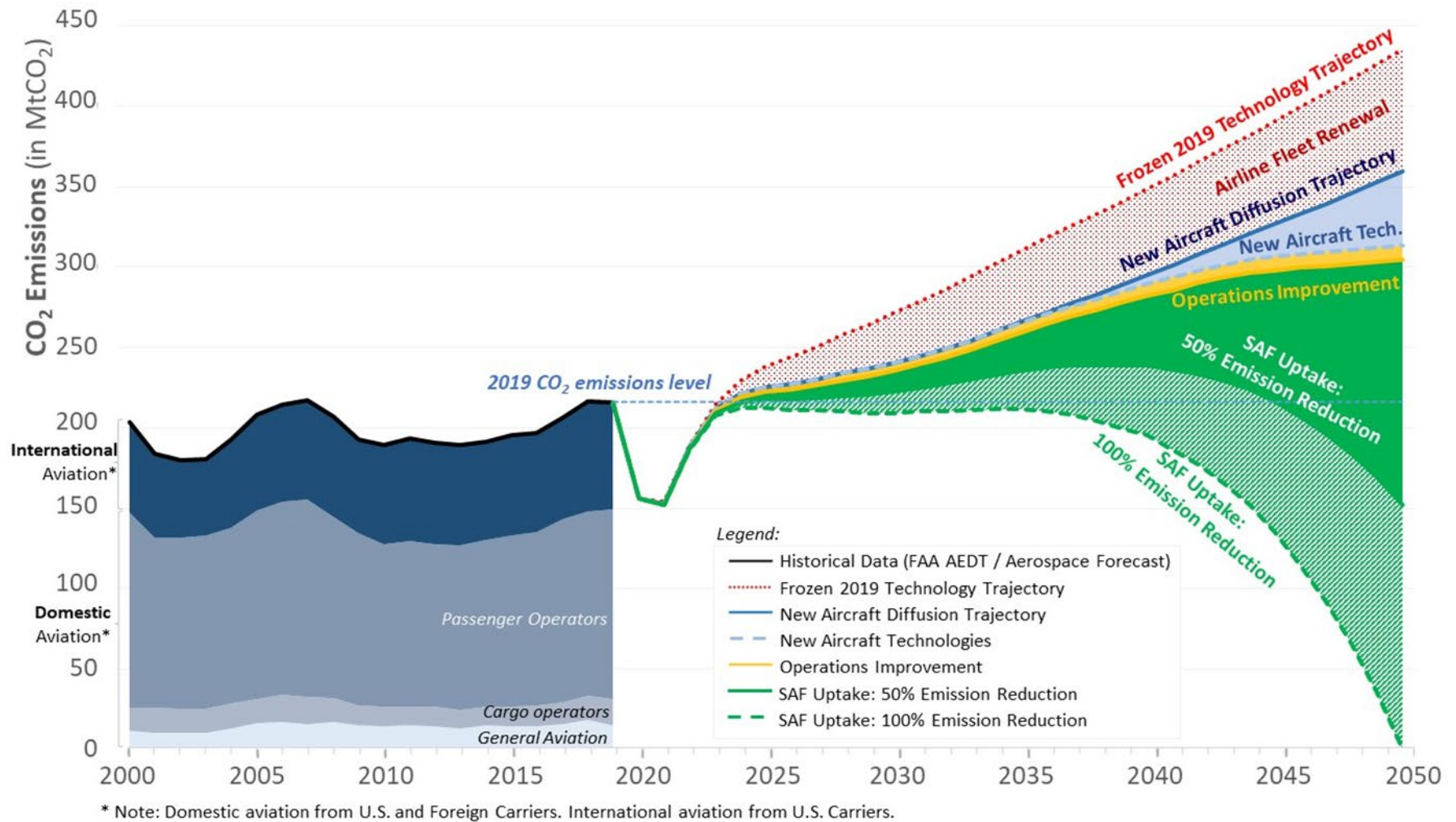
Full Report Contents

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

- Introduction
- Climate Goals and Approach
- Aircraft and Engine Technology Development
- Operational Improvements
- Sustainable Aviation Fuels
- International Leadership and Initiatives
- Airport Initiatives
- FAA Leadership on Climate, Sustainability and Resilience
- Non-CO₂ Impacts of Aviation on Climate
- Policy and Measures to Close the Gap



Analysis of Future Domestic and International Aviation CO₂ Emissions



NOTE: Analysis conducted by BlueSky leveraging FAA Aerospace Forecast and R&D efforts from the FAA Office of Environment & Energy (AEE) regarding CO₂ emissions contributions from aircraft technology, operational improvements, and SAF

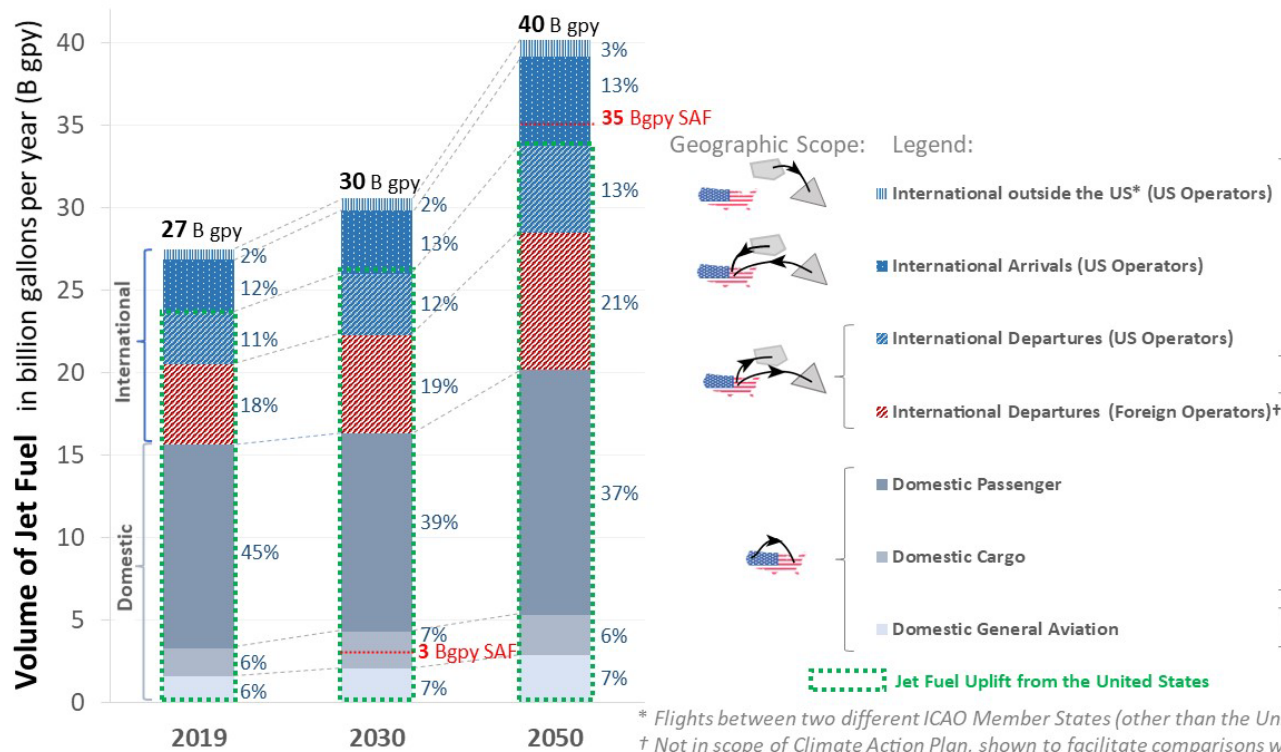


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SAF Grand Challenge

The US Government has identified the development and deployment of SAF as a key aviation climate priority. The USG has established a multi-agency effort led by the DOT, DOE, and USDA to implement the “SAF Grand Challenge” to reduce cost, enhance sustainability, and expand production and use of SAF that achieves a minimum of a 50% reduction in life cycle GHGs compared to conventional fuel.

Potential demand for jet fuel in gallons per year (gpy) across domestic operations (by U.S. and Foreign Carriers).



Data Sources and Assumptions:

2019: BTS T-2 (International operations reported by US carriers).

2030-2050: CO₂ emissions based on FAA Aerospace traffic Forecast, after technology and operations improvements. Assuming breakdown of flows (departures from US, arrivals in US and foreign-foreign based on 2019 CORSIA breakdown).

2019: EPA GHG Inventory, international departures by foreign operators scaled based on 2019 traffic mix (FAA Data).

2030-2050: FAA Modeling based on EPA GHG Inventory (Domestic) scope. CO₂ emissions based on FAA Aerospace traffic Forecast, after technology and operations improvements.

2019-2050: General Aviation from FAA Aerospace Forecast (2021-2041).

SAF Grand Challenge Roadmap

Multi-agency plan to define needs for the next decade to enable SAF GC Goals

- Six Action Areas
 1. Feedstock Innovation
 2. Conversion Technology Innovation
 3. Building Supply Chains
 4. Policy and Valuation Analysis
 5. Enabling End Use
 6. Communicating Progress and Building Support
- 26 Workstreams with 139 Activities
- 2022-2030 & 2030-2050 timeframes
- Released at the Global Clean Energy Action Forum on September 23, 2022

<https://www.energy.gov/eere/bioenergy/articles/sustainable-aviation-fuel-grand-challenge-roadmap-flight-plan-sustainable>



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