

Environment & Energy Research & Development Portfolio Overview

Prepared for: CLEEN Consortium Meeting

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Federal Aviation
Administration

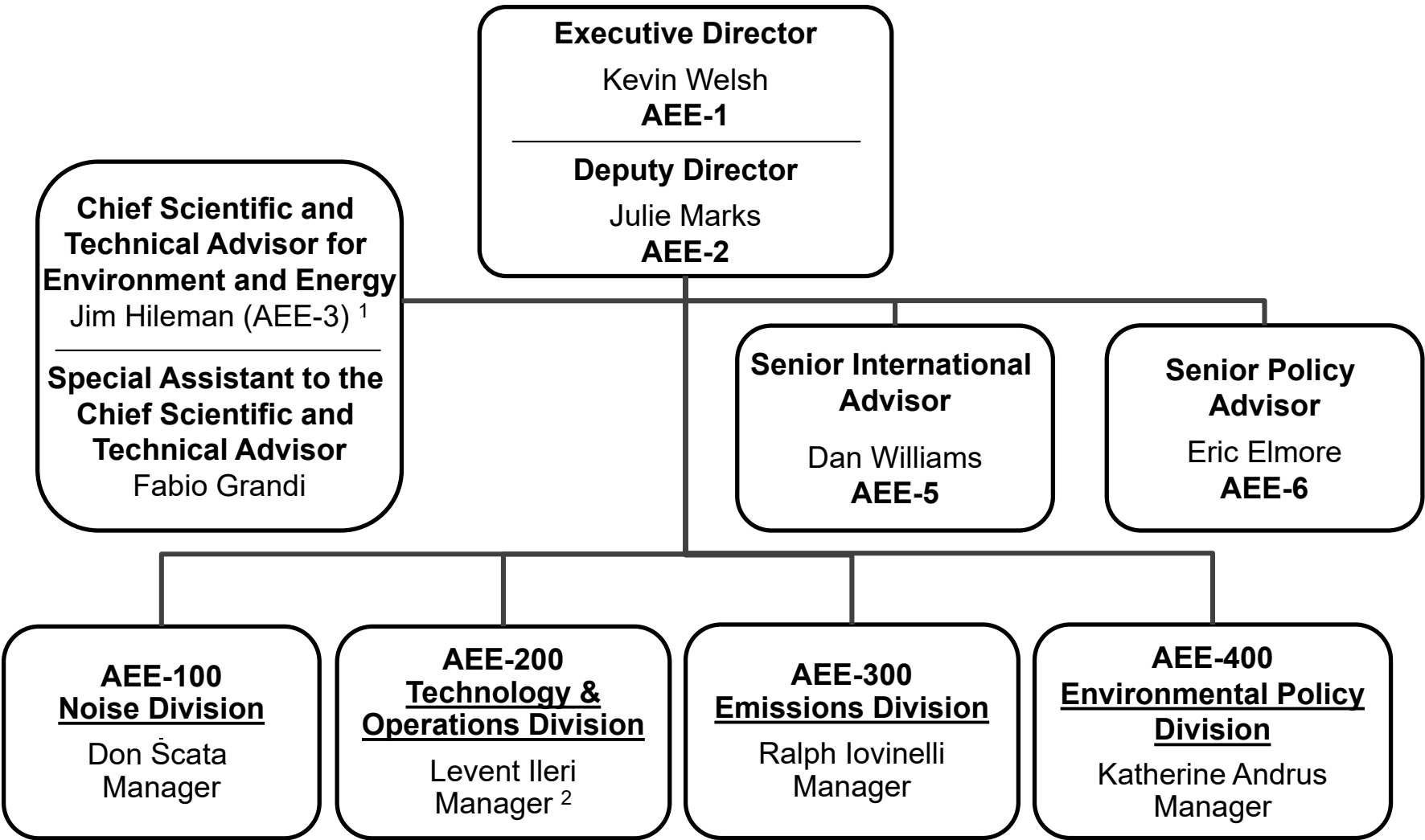


Presentation Outline

- **Office of Environment and Energy – Background & E&E Overview**
- **Direction of the E&E Portfolio**
 - Noise and Emissions
 - Overview of Climate Change Efforts
 - Sustainable Flight National Partnership
 - SAF Grand Challenge
- **Summary**



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

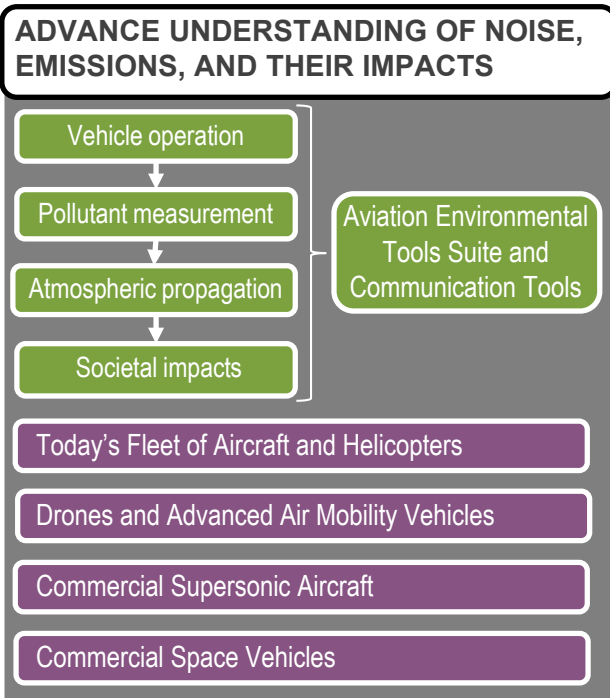


Environmental & Energy (E&E) Strategy

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



Environmental & Energy R&D Portfolio

RE&D Environment & Energy BLI*

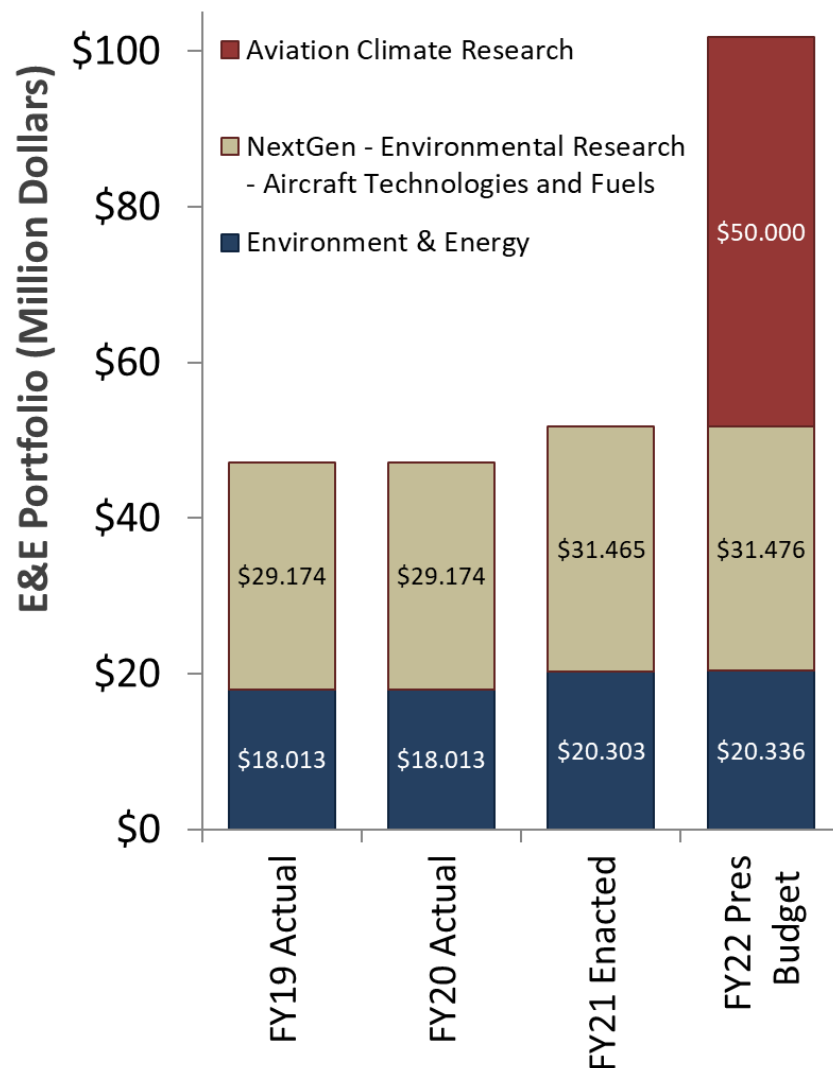
- Advance understanding of noise and emissions
- Analysis to inform decision making

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

- Accelerate development of aircraft and engine technologies
- Testing, analysis and coordination on Sustainable Aviation Fuels (SAF)

RE&D Aviation Climate Research BLI***

- New budget line item for FY22
- Enhances efforts on SAF, technology development, and efforts related to unleaded aviation gasoline (led by AVS/ANG)



* Budget Line Items: A13.a (FY19), A12.a (FY20), A.T (FY21), A11.u (FY22)

** Budget Line Items: A13.b (FY19), A12.b (FY20), A.U (FY21), A11.v (FY22)

*** Budget Line Item: A11.z (FY22)



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

Received 4,162 comments

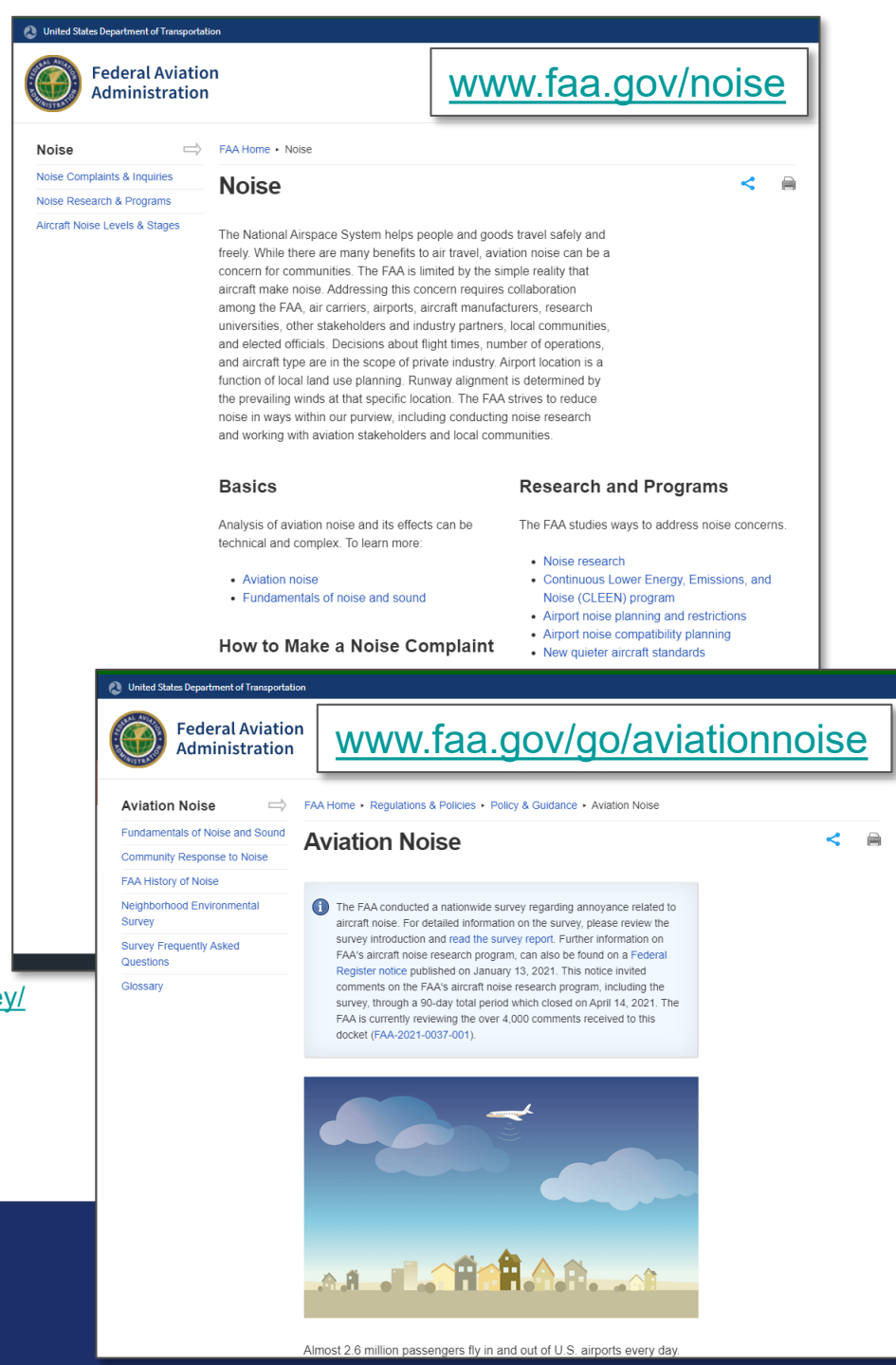
<https://www.regulations.gov/docket/FAA-2021-0037>

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 February 22, 2021.

Webinar link <https://www.youtube.com/watch?v=Mku13gL0xGc>



The image displays two screenshots of the Federal Aviation Administration (FAA) website. The top screenshot shows the 'Noise' page, which provides an overview of the National Airspace System's efforts to address aviation noise. It includes a sidebar with links to 'Noise Complaints & Inquiries', 'Noise Research & Programs', and 'Aircraft Noise Levels & Stages'. The main content area features a paragraph about the FAA's commitment to reducing noise and two columns of links: 'Basics' (Analysis of aviation noise, Aviation noise, Fundamentals of noise and sound) and 'Research and Programs' (Noise research, Continuous Lower Energy, Emissions, and Noise (CLEEN) program, Airport noise planning and restrictions, Airport noise compatibility planning, New quieter aircraft standards). The bottom screenshot shows the 'Aviation Noise' page, which includes a sidebar with links to 'Fundamentals of Noise and Sound', 'Community Response to Noise', 'FAA History of Noise', 'Neighborhood Environmental Survey', 'Survey Frequently Asked Questions', and 'Glossary'. The main content area features a large informational box about a nationwide survey on aviation noise, stating that the FAA conducted the survey from January 13, 2021, to April 14, 2021, and received over 4,000 comments. Below the box is an illustration of a city skyline with a plane flying overhead.

United States Department of Transportation
Federal Aviation Administration
www.faa.gov/noise

Noise
Noise Complaints & Inquiries
Noise Research & Programs
Aircraft Noise Levels & Stages

Noise

The National Airspace System helps people and goods travel safely and freely. While there are many benefits to air travel, aviation noise can be a concern for communities. The FAA is limited by the simple reality that aircraft make noise. Addressing this concern requires collaboration among the FAA, air carriers, airports, aircraft manufacturers, research universities, other stakeholders and industry partners, local communities, and elected officials. Decisions about flight times, number of operations, and aircraft type are in the scope of private industry. Airport location is a function of local land use planning. Runway alignment is determined by the prevailing winds at that specific location. The FAA strives to reduce noise in ways within our purview, including conducting noise research and working with aviation stakeholders and local communities.

Basics
Analysis of aviation noise and its effects can be technical and complex. To learn more:
• Aviation noise
• Fundamentals of noise and sound

Research and Programs
The FAA studies ways to address noise concerns.
• Noise research
• Continuous Lower Energy, Emissions, and Noise (CLEEN) program
• Airport noise planning and restrictions
• Airport noise compatibility planning
• New quieter aircraft standards

How to Make a Noise Complaint

United States Department of Transportation
Federal Aviation Administration
www.faa.gov/go/aviationnoise

Aviation Noise
Fundamentals of Noise and Sound
Community Response to Noise
FAA History of Noise
Neighborhood Environmental Survey
Survey Frequently Asked Questions
Glossary

Aviation Noise

The FAA conducted a nationwide survey regarding annoyance related to aircraft noise. For detailed information on the survey, please review the survey introduction and read the [survey report](#). Further information on FAA's aircraft noise research program, can also be found on a [Federal Register notice](#) published on January 13, 2021. This notice invited comments on the FAA's aircraft noise research program, including the survey, through a 90-day total period which closed on April 14, 2021. The FAA is currently reviewing the over 4,000 comments received to this docket (FAA-2021-0037-001).

Almost 2.6 million passengers fly in and out of U.S. airports every day.

Helicopters, New Entrants and Commercial Space

Helicopters

- Continuing efforts to use noise measurements and modeling to improve our analytical capabilities and develop measures to reduce noise from operations

Unmanned Aerial Systems

- Conducting noise measurements and developing analytical capabilities to enable improved noise predictions for potential use in AEDT

Advanced Air Mobility Vehicles

- Conducting noise measurements and developing analytical tools to aid in designing quieter vehicles
- Looking to stand up research to enable improved noise predictions for AEDT

Supersonic Civil Aircraft

- Continuing research efforts on multiple fronts through ASCENT, CLEEN and Volpe to support standard setting in ICAO, understand environmental impacts, and to aid in the development of lower noise / emissions vehicles

Hypersonic Civil Aircraft / Commercial Space

- Monitoring environmental efforts in this area – depending on appropriations levels, will stand up research effort to examine climate/ozone impacts



Efforts Relating to Aircraft Emissions

Understanding Emissions

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

Reducing Emissions at the Source

- Aircraft technologies and architecture
- Modifications to fuel composition
- Vehicle operations
- Engine standard (NO_x, CO₂, and PM standards)
- Future trends analysis
- *Working across agency to address lead emissions*

Mitigation

- Alternative fuel sources
- Policy measures (CORSIA)



For more information:

ASCENT: www.ascent.aero/

CAAIFI: www.caafi.org/

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

Volpe: www.volpe.dot.gov/



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U.S. Announcements and Action

On September 9, 2021, United States government and industry leaders convened to announce key actions to address aviation's impact on climate.

Key federal actions include:

- Sustainable Aviation Fuel Grand Challenge
- New and ongoing funding opportunities to support sustainable aviation fuel projects and fuel producers totaling up to \$4.3 billion;
- By 2030 Demonstrate new technologies that can achieve at least a 30% improvement in aircraft fuel efficiency
- Efforts to improve air traffic and airport efficiency to reduce fuel use, eliminate lead exposure, and ensure cleaner air in and around airports
- Intent to release an aviation climate action plan for submission to the International Civil Aviation Organization.

White House Sustainable Aviation Fact Sheet:

<https://www.whitehouse.gov/briefing-room/statements-releases/2021/09/09/fact-sheet-biden-administration-advances-the-future-of-sustainable-fuels-in-american-aviation/>

The screenshot shows the official White House website page for the fact sheet. At the top, the header includes 'THE WHITE HOUSE' on the left, the White House seal in the center, and a 'MENU' button on the right. Below the header, the page is identified as a 'BRIEFING ROOM' document. The main title is 'FACT SHEET: Biden Administration Advances the Future of Sustainable Fuels in American Aviation', dated 'SEPTEMBER 09, 2021 • STATEMENTS AND RELEASES'. A sub-header reads: 'New Actions Aim to Produce Three Billion Gallons of Sustainable Fuel, Reduce Aviation Emissions by 20% by 2030, and Grow Good-Paying, Union Jobs'. The body text describes President Biden's steps to coordinate leadership across federal government, industry, and non-governmental organizations to advance sustainable fuels. It mentions goals for 2030 and 2050, and lists participating departments: Energy, Transportation, Agriculture, Defense, the National Aeronautics and Space Administration, the General Services Administration, and the Environmental Protection Agency. A sidebar on the right contains social media sharing icons for Facebook, Twitter, and LinkedIn. At the bottom left of the page, there are small icons for a speech bubble and a translation icon labeled 'Tr'.

THE WHITE HOUSE

BRIEFING ROOM

FACT SHEET: Biden Administration Advances the Future of Sustainable Fuels in American Aviation

SEPTEMBER 09, 2021 • STATEMENTS AND RELEASES

New Actions Aim to Produce Three Billion Gallons of Sustainable Fuel, Reduce Aviation Emissions by 20% by 2030, and Grow Good-Paying, Union Jobs

Today, President Biden is taking steps to coordinate leadership and innovation across the federal government, aircraft manufacturers, airlines, fuel producers, airports, and non-governmental organizations to advance the use of cleaner and more sustainable fuels in American aviation. These steps will help make progress toward our climate goals for 2030 and are essential to unlocking the potential for a fully zero-carbon aviation sector by 2050. Today's executive actions across the Departments of Energy, Transportation, Agriculture, Defense, the National Aeronautics and Space Administration, the General Services Administration, and the Environmental Protection Agency will result in the production and use of billions of gallons of sustainable fuel that will enable aviation emissions to drop 20% by 2030 when compared to business as usual. Together with President Biden's Build Back Better Agenda, these new agency steps and industry partnerships will transform the aviation sector, create good-paying jobs, support American agriculture and manufacturing, and help us tackle the climate crisis.

Today, aviation (including all non-military flights within and departing from the United States) represents 11% of United States transportation-related emissions. Without increased action, aviation's share of emissions is likely to increase as more people and goods fly. That is why leadership and innovation in this sector is so essential if we hope to put the aviation industry, and the economy, on track to achieve net-zero greenhouse gas emissions by 2050. Achieving a sustainable aviation industry requires energy efficiency improvements in aircraft technology and better operations. In the future, electric and hydrogen-powered aviation may unlock affordable and convenient local and regional travel. But for today's long-distance travel, we need bold partnerships to spur the deployment of billions of gallons of sustainable aviation fuels quickly.

Actions Being Implemented to Reduce Aviation Emissions

Technology:

Develop new more fuel efficient aircraft and engine technologies

- Public-private R&D partnerships to accelerate development of new technology
- FAA/NASA “Sustainable Flight National Partnership”
- FAA CLEEN Program
- Airworthiness standards on CO₂, NO_x, Particulate Matter, and Noise – harmonized through ICAO

Sustainable Fuels:

Develop and deploy sustainable aviation fuels (SAF)

- Significant Potential to Reduce Lifecycle GHG Emissions
- Coordinated, multi-agency effort (DOE, DOT/FAA, NASA, USDA)
- Enhance Public-Private Partnerships, like Commercial Aviation Alternative Fuels Initiative (CAAIFI)
- International Leadership in ICAO

Operations:

Modernize air space and implement new procedures

- Optimized operational procedure concepts could further reduce fuel burn, emissions, and noise
- Implement NextGen and seek opportunities to further improve efficiency (e.g., trans-oceanic flights)

Policy Measures and Non-CO₂ Impacts

- Develop climate action plan for aviation
- Aviation climate and environment issues are addressed by the International Civil Aviation Organization (ICAO)
- Implement ICAO Carbon Offsetting and Reduction Scheme for International Aviation – CORSIA
- R&D on Non-CO₂ climate impacts

Leveraging university expertise in all areas through the Aviation Sustainability Center, ASCENT

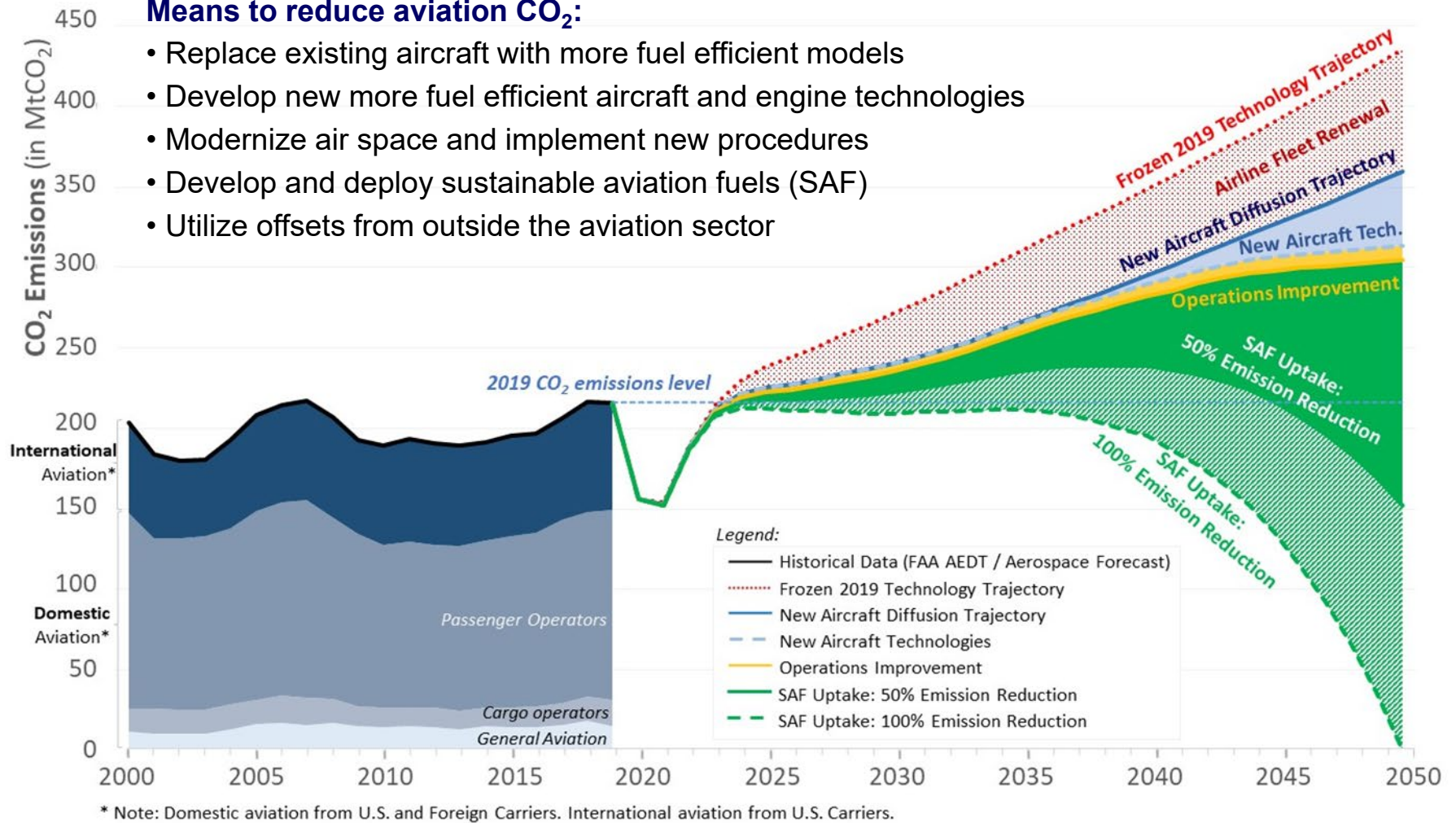


Actions to Reduce U.S. Aviation CO₂ Emissions

Working to accelerate industry action to lower CO₂ emissions trajectory

Means to reduce aviation CO₂:

- Replace existing aircraft with more fuel efficient models
- Develop new more fuel efficient aircraft and engine technologies
- Modernize air space and implement new procedures
- Develop and deploy sustainable aviation fuels (SAF)
- Utilize offsets from outside the aviation sector



NOTE: Graphic developed by Philippe Bonnefoy of Blue Sky based on ongoing analysis efforts supported by the FAA Office of Environment & Energy (AEE).



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Aircraft Technology

Through the Continuous Lower Energy, Emissions, and Noise (CLEEN) Program, FAA are working in a public-private partnership with industry to accelerate maturation of certifiable aircraft and engine technologies.

- Technological innovation will be essential to enable environmentally sustainable growth and maintain U.S. global leadership.
- FAA announced CLEEN Phase III on Sept 9, 2021
- Through **Sustainable Aviation National Partnership**, NASA and FAA (through CLEEN) working together to demonstrate technologies that provide a 30% reduction in fuel burn relative to best in class

CLEEN Phase III Technologies



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

For the CLEEN Phase 3 Press Release:
<https://www.faa.gov/newsroom/faa-awards-100m-develop-next-generation-sustainable-aircraft-technology>

For a summary of CLEEN Accomplishment:
<https://www.faa.gov/newsroom/continuous-lower-energy-emissions-and-noise-cleen-program?newsId=22534>



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The SAF Grand Challenge

U.S. government-wide effort to reduce the cost, enhance the sustainability, and expand the production and use of Sustainable Aviation Fuel (SAF) to produce 3 billion gallons/yr in 2030 and meet 100% of aviation demand by 2050

- SAF are key to aviation decarbonization – also provide air quality benefits
- Price differential of SAF with conventional jet fuel and renewable diesel are key challenges to their deployment – can bridge this difference with policy, use of existing infrastructure, and technology development
- FAA efforts are focused on testing to ensure new fuel types are safe, research to understand full environmental benefit, economic analysis focused on reducing costs, and coordination across aviation and energy industries
- Working through ASTM Intl to establish fuel standards for safety and ICAO on sustainability standards for use in CORSIA
- Under the SAF Grand Challenge Memorandum Of Understanding (MOU), working to develop a multi-agency roadmap to reduce the cost of SAF, enhance sustainability of SAF, and expand SAF supply and end use



FY22 Funding

- **Operating under budget uncertainty**
- **Expect to use any funding increases to:**
 - Expand efforts on aircraft technology maturation in CLEEN and ASCENT
 - Develop SAF that could be used in jet engines without blending with conventional petroleum-based jet fuel
 - Evaluate aviation fuel supply chains to reduce the cost to produce SAF and maximize environmental benefits
 - Obtain the data and develop the analytical tools to support evaluation and certification of new vehicle types



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 (CORSIA)*.
- 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 (SAF)

- *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*.
- 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.





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