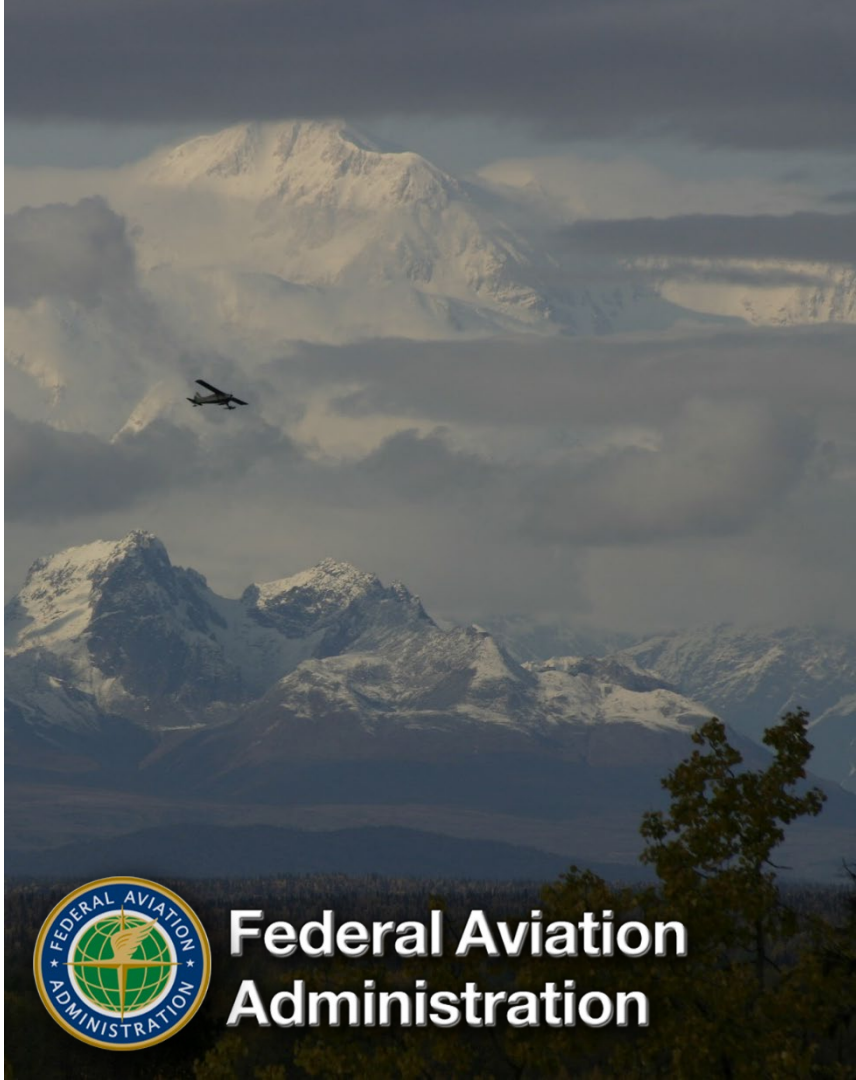
FAA Environment & Energy Overview

To: FAST-SAF/Tech Meeting
By: Kevin Welsh
Executive Director
Office of Environment & Energy

Date: December 14, 2022



To submit questions - scan the QR code

or visit **menti.com** and enter code **8293 5249**

White House Sustainable Aviation Event

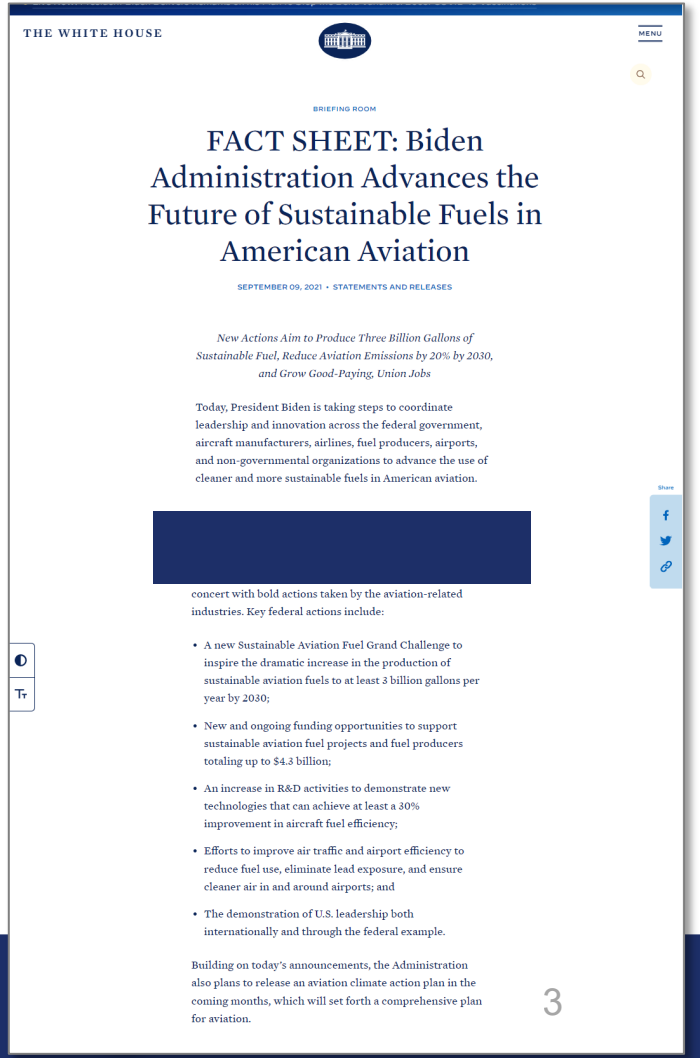
On September 9, 2021, government and industry leaders met to discuss actions and make new announcements regarding efforts to address aviation and climate change in the near-term, with a view to long-term ambition.

Key federal actions include:

- A new Sustainable Aviation Fuel Grand Challenge to inspire the dramatic increase in the production of sustainable aviation fuels to at least 3 billion gallons per year by 2030;
- An increase in R&D activities to 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; and
- The demonstration of U.S. leadership both internationally and through the federal example.

"…the Administration also plans to release an aviation climate action plan in the coming months, which will set forth a comprehensive plan for aviation."

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 WHITE HOUSE

MENU

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.

Share

concert with bold actions taken by the aviation-related industries. Key federal actions include:

- A new Sustainable Aviation Fuel Grand Challenge to inspire the dramatic increase in the production of sustainable aviation fuels to at least 3 billion gallons per year by 2030;
- New and ongoing funding opportunities to support sustainable aviation fuel projects and fuel producers totaling up to $4.3 billion;
- An increase in R&D activities to 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; and
- The demonstration of U.S. leadership both internationally and through the federal example.

Building on today's announcements, the Administration also plans to release an aviation climate action plan in the coming months, which will set forth a comprehensive plan for aviation.

Aviation Climate Action Plan

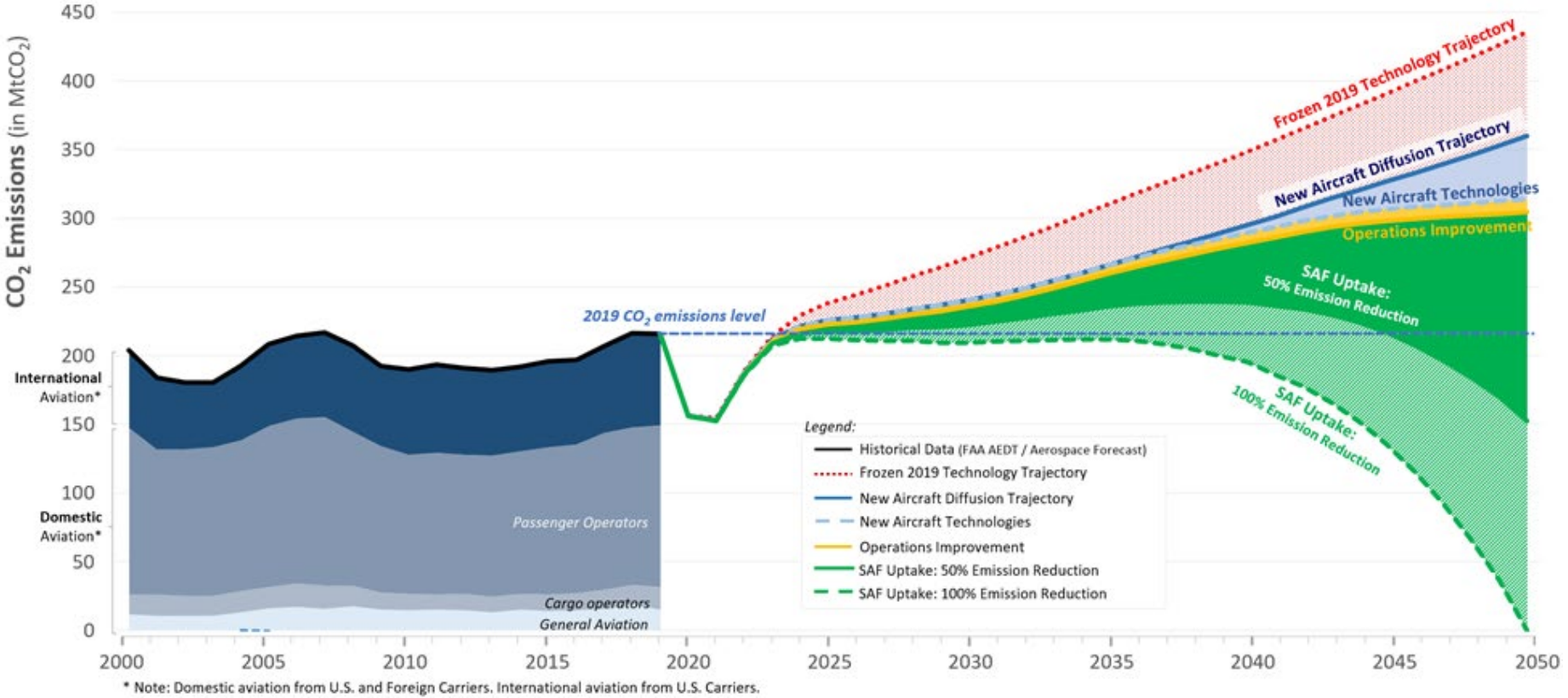
State Action Plan submission to International Civil Aviation Organization (ICAO)

- Whole-of-government approach to put the aviation sector on a path toward achieving net-zero emissions by 2050.
  - New, more efficient technologies;
  - Improvements in aircraft operations;
  - Sustainable Aviation Fuels (SAF);
  - Advancements in airport operations;
  - International initiatives; and
  - Research & Development

Available at:

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

Opportunities to Reduce CO_2 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

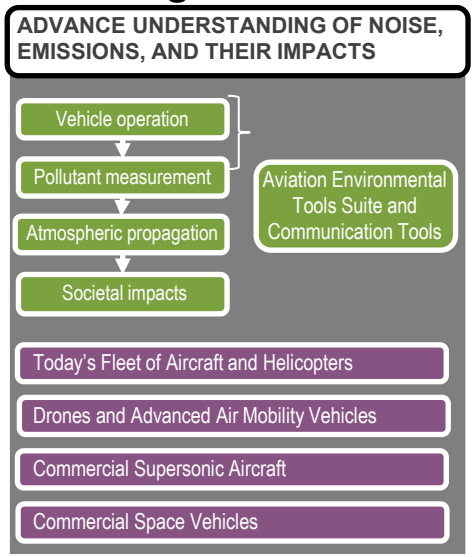
Federal Aviation Administration

FAA 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 AVIATION SUSTAINABILITY CENTER
www.ascent.aero/

CAAFI®
www.caafi.org/

Continuous Lower Energy, Emissions & Noise
CLEEN
Federal Aviation Administration
www.faa.gov/go/cleen/

the VOLPE center

Sustainable Flight National Partnership

A sustained major technology development initiative, under which NASA and FAA will work with industry, to accelerate the maturation of aircraft and engine technologies that enable a step-change reduction in fuel burn, emissions, and noise, (i.e., 25-30% lower fuel burn and 10-15 dB noise reduction relative to best-in-class aircraft).

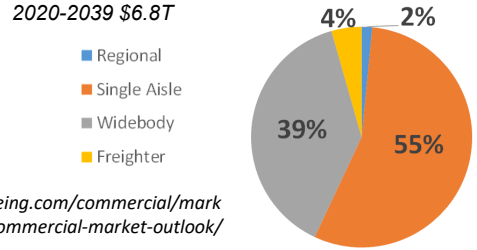
SFNP will build upon successful cooperation among FAA, NASA, and industry:

- NASA's investments under the SFNP include a suite of integrated, large-scale aircraft and propulsion flight and ground technology demonstrations, including ultra-efficient wings (such as transonic truss-braced wings), small-core gas turbines, electrified and hybrid electric aircraft propulsion system(s), and new manufacturing techniques such as high-rate composite manufacturing to enable rapid production of such new aircraft.
- FAA R&D is focused on engine technologies, low-emissions combustion, and aircraft technologies that enable future operational concepts. At the FAA, these technology development efforts will be executed primarily under the CLEEN Program and the ASCENT Center of Excellence.

Initially target narrow-body aircraft family as it accounts for 55% of future global market value ($3.7 trillion), 40% of CO_2 emissions from commercial operators globally, and 60% of domestic population exposure to significant noise.

Global Market Value*

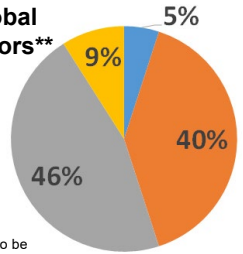
2020-2039 $6.8T



**boeing.com/commercial/market/commercial-market-outlook/*

Estimated CO_2 Emissions from Global Commercial Operators**

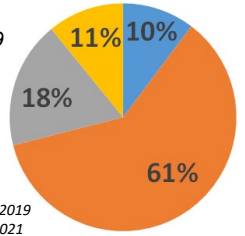
(2018)



****Volpe Preliminary Data – used with permission** final data to be published in Chapter 1 of 2022 ICAO Environmental Report

Population Exposed to Significant Noise ***

65 DNL, U.S. CY 2019



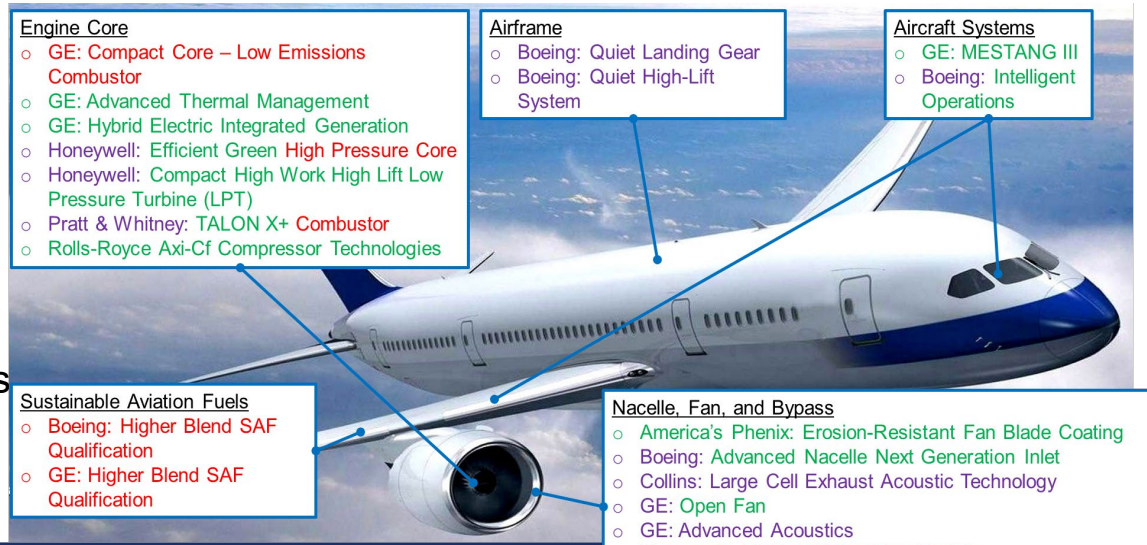
***** F. Grandi, AEDT3c, CY 2019 U.S. inventory, 18 March 2021*

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 have been operating CLEEN Program since 2010 (initially set up during Bush administration).
- FAA announced CLEEN Phase III on Sept 9, 2021. Currently expanding program and setting up Phase IV.
- Summary of CLEEN accomplishments over first two phases (10+ years) available online.

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

Fuel
Emissions
Noise

Federal Aviation Administration

Sustainable Aviation Fuels (SAF)

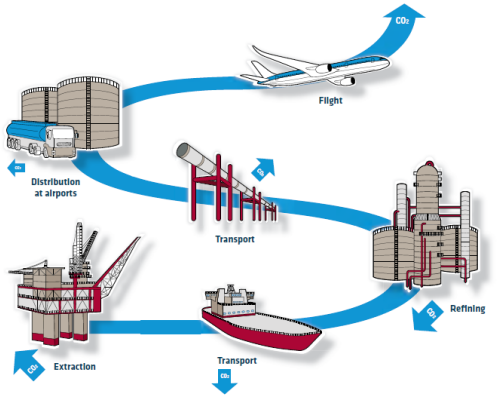
- SAF are “drop-in” liquid hydrocarbon fuels with the same performance and safety as conventional jet fuels produced from petroleum
- SAF are fully fungible with the existing fuel supply and can be used in the same infrastructure, engines, and aircraft
- SAF can be produced from renewable feedstocks, waste materials, and industrial waste gases
- Some types of SAF reduce emissions that impact air quality and contrail formation, which also impacts climate change

Image courtesy of Anna Oldani from Frankfurt Intl Airport

Sustainable Aviation Fuels – Life Cycle Benefit

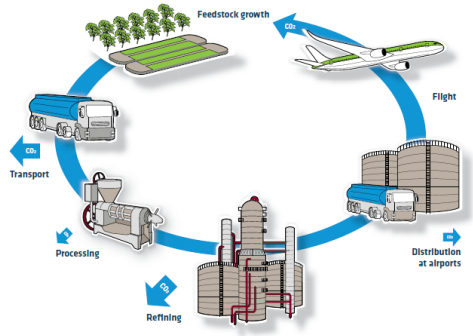
The extent to which SAF provides a climate benefit depends on the life cycle of the fuel, taking into account the production, transportation, and combustion of the SAF, as well as indirect effects.

Carbon lifecycle diagram: fossil fuels



At each stage in the distribution chain, carbon dioxide is emitted through energy use by extraction, transport, etc.

Carbon lifecycle diagram: Sustainable aviation fuel



Carbon dioxide will be reabsorbed as the next generation of feedstock is grown.
Note: *the diagram above does not demonstrate the lifecycle process of SAF derived from municipal waste.*

FAA have extensive research that have supported development of rigorous life cycle accounting methods over the last decade:

- Argonne National Labs GREET Model
- ICAO Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)
- SAF Blenders Tax Credit (I.R.A. Sections 13203 and 13704)

Diagram from ATAG Beginner's Guide to SAF, which is available at:
https://aviationbenefits.org/downloads/beginners-guide-to-sustainable-aviation-fuel/

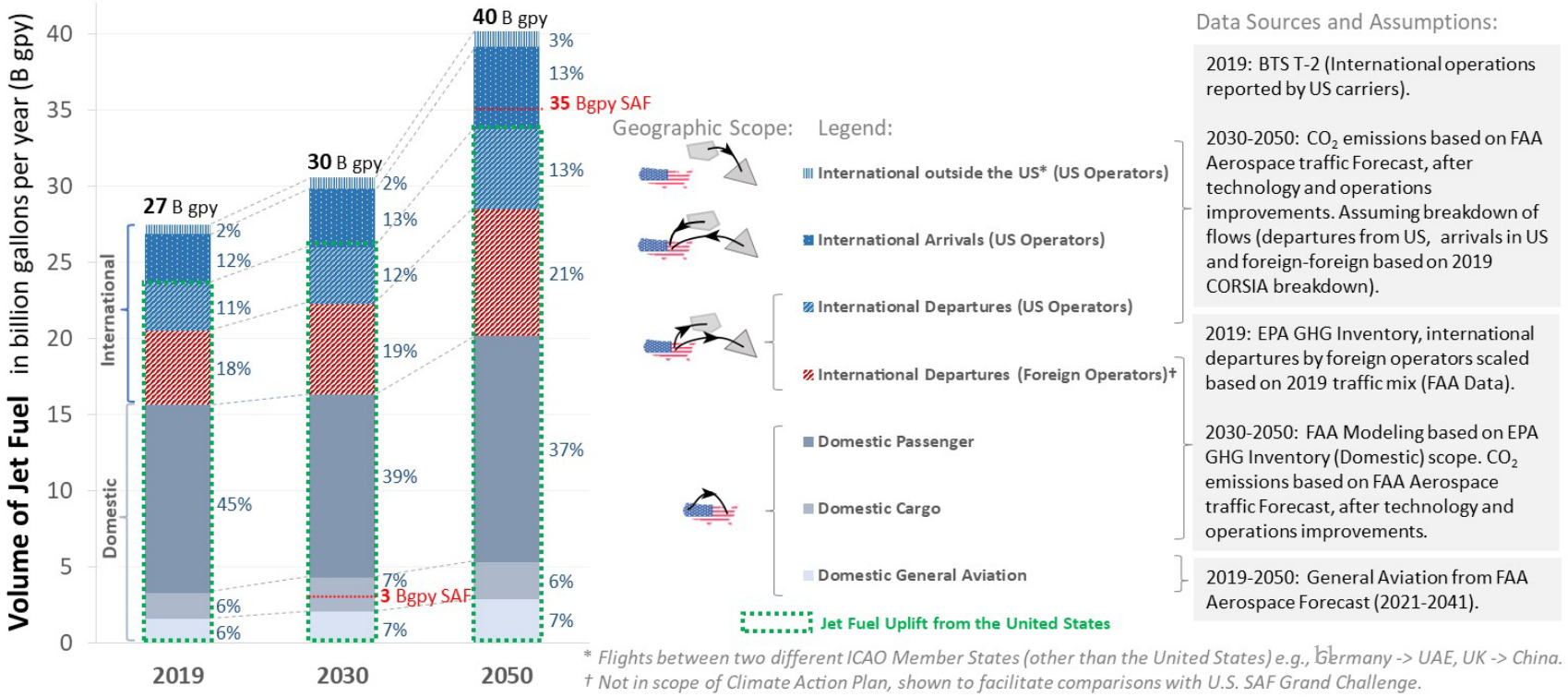
SAF Grand Challenge

https://www.energy.gov/eere/bioenergy/sustainable-aviation-fuel-grand-challenge

Sustainable Aviation Fuel 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: CO_2 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. CO_2 emissions based on FAA Aerospace traffic Forecast, after technology and operations improvements.

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

** Flights between two different ICAO Member States (other than the United States) e.g., Germany -> UAE, UK -> China.*

† Not in scope of Climate Action Plan, shown to facilitate comparisons with U.S. SAF Grand Challenge.

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 (FI)
  2. Conversion Technology Innovation (CT)
  3. Building Supply Chains (SC)
  4. Policy and Valuation Analysis (PA)
  5. Enabling End Use (EU)
  6. Communicating Progress and Building Support (CP)
- 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

ASCENT Center of Excellence

For 18 years, FAA Office of Environment and Energy has relied on university centers of excellence to:

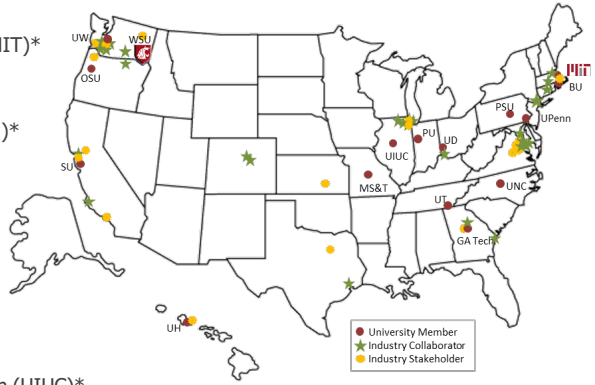
- Provide knowledge to inform decision making on environment and energy matters;
- Enable the introduction of innovative solutions to cost-effectively mitigate the environmental impacts of aviation; and
- Support the instruction of hundreds of professionals with knowledge of the environmental challenges 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
- Over 80 research projects with over $15M annual budget

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

For more information: https://ascent.aero/

Closing Observations

- We are taking a holistic and whole-of-government approach to address aviation's impact on climate change
- SAF are central to this approach - critical to reducing CO_2 emissions from aviation in near, mid, and long term
- Continued improvements in aircraft technology needed to ensure SAF goes as far as possible
- US Government committed to SAF production through the SAF Grand Challenge and technology development through the Sustainable Flight National Partnership
- FAA sees FAST-SAF/Tech Programs as a new opportunity to accelerate action.

First flight from continuous commercial production of SAF
UAL 0708, 10 March 2016, LAX-SFO

Fuel from World Energy - Paramount (HEFA-SPK 30/70 Blend).