FAA Environment & Energy Research & Development Program Overview

Prepared for: CAAFI Biennial General Meeting

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

Date: June 2, 2022
# SAF Grand Challenge Roles (in MOU¹)

<table>
<thead>
<tr>
<th><strong>DOE</strong></th>
<th><strong>DOT/FAA</strong></th>
<th><strong>USDA</strong></th>
</tr>
</thead>
</table>
| • Continue investments and develop expertise in sustainable technologies to develop cost effective low carbon liquid fuels and enabling coproducts from renewable biomass and waste feedstocks  
• Continue a significant multi-year SAF scale-up strategy committed to in FY21  
• R&D aimed at creating new pathways toward higher SAF production  
• Advance environmental analysis of SAF  
• Collaborate with EPA to expedite regulatory approvals of SAF with significant life-cycle GHG reductions | • Develop overall strategy to decarbonize aviation  
• Coordinate ongoing SAF testing and analysis  
• Work with standards organizations to ensure safety and sustainability of SAF  
• Continue International technical leadership  
• Promote end use of SAF  
• Support infrastructure and transportation systems that connect SAF feedstock producers, SAF refiners, and aviation end users.  
• Collaborate with EPA to expedite regulatory approvals of SAF with significant life-cycle GHG reductions | • Continue investments and build expertise in sustainable biomass production systems  
• Decarbonize supply chains  
• Invest in bio-manufacturing capability & workforce development  
• Community and individual education  
• Provide outreach & technology transfer to producers, processors and communities to accelerate adoption and participation  
• Commercialization support  
• Collaborate with EPA to expedite regulatory approvals of SAF with significant life-cycle GHG reductions |

1. SAF Grand Challenge MOU available at: [https://www.energy.gov/sites/default/files/2021-09/S1-Signed-SAF-MOU-9-08-21_0.pdf](https://www.energy.gov/sites/default/files/2021-09/S1-Signed-SAF-MOU-9-08-21_0.pdf)
FAA SAF Program Focus

Testing
accelerate SAF development
- Test fuels
- Improve testing methods
- Conduct evaluation
- Streamline approval

Analysis
environmental and economic sustainability
- Lifecycle emissions
- Cost reduction
- Supply potential
- Supply chain opportunities

Coordination
support SAF integration
- Public-private partnership – CAAFI
- U.S. interagency cooperation
- International cooperation – ICAO
Office of Environment and Energy (AEE)
- Office within APL, responsible for broad range of environmental policies
- About 50 staff members
- Responsible for roughly one-third of FAA RE&D Budget (FY22 budget)
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**
- Vehicle operation
- Pollutant measurement
- Atmospheric propagation
- Societal impacts
- Aviation Environmental Tools Suite and Communication Tools
- Today’s Fleet of Aircraft and Helicopters
- Drones and Advanced Air Mobility Vehicles
- Commercial Supersonic Aircraft
- Commercial Space Vehicles

**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

---

www.ascent.aero/
www.faa.gov/go/cleen/
www.caafi.org/
Environmental & Energy R&D Portfolio

RE&D Environment & Energy 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 ($16M in FY22 budget)

*Budget Line Items: A12.a (FY20), A.T (FY21), A11.u (FY22), A11.T (FY23)

** Budget Line Items: A12.b (FY20), A.U (FY21), A11.v (FY22), A11.U (FY23)

FY23 President’s Budget: https://www.faa.gov/about/budget
CLEEN Program

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

- Summary of CLEEN accomplishments over first two phases (10+ years) available online

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
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

For more information: https://ascent.aero/
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 - Comparative Assessment of Electrification Strategies for Aviation
• 065 - Fuel Testing Approaches for Rapid Jet Fuel Prescreening
• 066 - Evaluation of High Thermal Stability Fuels
• 067 - Impact of Fuel Heating on Combustion and Emissions
• 073 - Combustor Durability with Alternative Fuel Use
• 078 (NEW) - Contrail Avoidance Decision Support and Evaluation
• 080 (NEW) - Hydrogen and Power-to-Liquid (PtL) Concepts for Sustainable Aviation Fuel Production

In Development

• 081 - Measurement and Prediction of non-volatile particulate matter size and number emissions from Sustainable and Conventional Aviation Fuels
• 087 - Measurement of nvPM size, number and compositional emissions, for Boeing eco-Demonstrator aircraft burning Sustainable Aviation Fuel
• 088 - Evaluation of Jet Fuel Composition on Non-metallic Fuel System Components
• 089 - Characterization of Compositional Effects on Dielectric Constant
• 090 - World Fuel Property Survey
• 093 - Collaborative Research Network for Global SAF Supply Chain Development

Additional projects forthcoming

• Testing to support efforts to approve fuels at blends above 50% blend wall in today’s fleet
• Examine means to cost effectively maximize environmental benefits of sustainable aviation fuels
# CLEEN / ASCENT Budgets

<table>
<thead>
<tr>
<th></th>
<th>FY21 Actual</th>
<th>FY22 Enacted</th>
<th>FY23 President’s Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A11.s Environment and Energy</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLEEN</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>ASCENT</td>
<td>$7,500,000</td>
<td>$8,500,000</td>
<td>$7,500,000</td>
</tr>
<tr>
<td>Other</td>
<td>$12,803,000</td>
<td>$13,500,000</td>
<td>$13,785,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$20,303,000</td>
<td>$22,000,000</td>
<td>$21,285,000</td>
</tr>
<tr>
<td><strong>A11.t NextGen – Environmental Research – Aircraft Technologies and Fuels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CLEEN</td>
<td>$19,000,000</td>
<td>$37,500,000</td>
<td>$42,000,000</td>
</tr>
<tr>
<td>ASCENT</td>
<td>$9,500,000</td>
<td>$26,565,000</td>
<td>$27,000,000</td>
</tr>
<tr>
<td>Other</td>
<td>$3,965,000</td>
<td>$3,435,000</td>
<td>$5,425,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$32,465,000</td>
<td>$67,500,000</td>
<td>$74,425,000</td>
</tr>
</tbody>
</table>

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

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

FY23 President’s Budget: https://www.faa.gov/about/budget
## A11.U NextGen – Environmental Research – Aircraft Technologies and Fuels
### FY23 Major Activities Related to SAF

<table>
<thead>
<tr>
<th>Major Activities</th>
<th>Objective</th>
<th>Expected Outputs</th>
<th>Value Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ensure Novel Jet Fuels are Safe for Use</strong></td>
<td>Support the approval of novel jet fuel pathways within the ASTM International certification process through testing and coordination to ensure these fuels are safe for use</td>
<td>Research reports to demonstrate the safety of novel jet fuel pathways for certification by ASTM Intl and streamline the ASTM certification process to reduce the time and cost of certification</td>
<td>The development and approval of new fuel pathways will expand the opportunities to move towards environmental sustainability in a cost-effective manner.</td>
</tr>
<tr>
<td><strong>Move Beyond the 50% SAF Blend Wall to Enable 100% SAF Use</strong></td>
<td>Develop and test sustainable aviation fuels through ASCENT, CAAFI, and CLEEN that could be used safely in jet engines without blending with conventional petroleum-based jet fuel</td>
<td>Research reports to demonstrate the safety of sustainable aviation fuel pathways that can be used without blending for certification by ASTM Intl</td>
<td>Eliminate current limitations on environmental benefits of SAF due to current blending constraints</td>
</tr>
<tr>
<td><strong>Maximize environmental benefits of sustainable aviation fuels</strong></td>
<td>Evaluate aviation fuel supply chains within ASCENT to reduce the cost to produce sustainable aviation fuels and maximize their environmental benefits</td>
<td>Analyses and data to support actions by industry and government to cost-effectively produce sustainable aviation fuels with minimal life cycle GHG emissions</td>
<td>Enable aviation industry to cost effectively reach net zero CO₂ emissions through the use of sustainable aviation fuels</td>
</tr>
<tr>
<td><strong>Support inclusion of Sustainable Aviation Fuels in ICAO CORSIA</strong></td>
<td>Support the inclusion of sustainable aviation fuels created from waste and renewable feedstocks, and lower carbon aviation fuels created from fossil feedstocks, within the ICAO CORSIA framework</td>
<td>Develop robust lifecycle greenhouse gas emissions values and methods for alternative fuel pathways and sustainability criteria for use in ICAO CORSIA</td>
<td>High integrity international standards are needed to ensure that sustainable aviation fuels provide CO₂ reductions in a sustainable manner.</td>
</tr>
</tbody>
</table>

FY23 President’s Budget: [https://www.faa.gov/about/budget](https://www.faa.gov/about/budget)
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