

Aeronautics and Astronautics Massachusetts Institute of Technology

November 7, 2023

The Honorable Michael Whitaker Administrator Federal Aviation Administration

Dear Administrator Whitaker:

Attached below please find the Findings and Recommendations from the Aircraft Safety, Airports, Environment and Energy, Human Factors, and NAS Operations Subcommittees from the Summer-Fall 2023 meetings which have been reviewed and supported by the full REDAC on October 4, 2023.

In addition, the full REDAC discussed a number of more general observations for your consideration.

Post NEXTGEN Research Strategy – As the modernization of NEXTGEN becomes a reality, the FAA has the opportunity to strategically redirect some of its research focus to emerging challenges. In considering future research and development strategy the REDAC is eager to help if we can be of assistance.

Innovate 28 and Autonomy – The REDAC was pleased to see the integrated approach to new aircraft, technologies and operations represented in the Innovate 28 and Autonomy roadmaps. We believe that this type of system level approach which looks across traditional stovepipes and lines of business will be important. We further we believe that these innovations represent an opportunity to improve the safety and performance of the NAS.

Integrated Human Systems Approaches – The innovations represented by Innovate 28 and Autonomy along with advances in AI and Machine Learning have significant potential impact on the roles of humans in future operations. The REDAC urges careful consideration and inclusion of human factors early in the R&D and system development process.

Improving the Environmental Sustainability of the NAS – The pressure for improving aviation sustainability will continue to increase in the coming decade. The REDAC strongly supports the existing FAA activities in this area and suggests that environmental sustainability also be an objective in future NAS modernization.

We appreciate the opportunity to support the FAA in promoting the safety, efficiency and sustainability of aviation. I would be happy to meet at your convenience to discuss how the REDAC could be of assistance.

Sincerely,

R. John Hansman Chair, FAA Research, Engineering and Development Advisory Committee

Enclosure

Research, Engineering, and Development Advisory Committee (REDAC) Guidance on the FY 2026 Research and Development Portfolio

Subcommittee on Airports

<u>General Observations</u>: The Airports Subcommittee remains supportive of the Program's ongoing work and future research directions, which continue to emphasize foundational research to support (1) advisory circulars and design guidance promulgated by the FAA Office of Airports; (2) airport capital improvements currently eligible or prospectively eligible for federal grant funding under the Airport Improvement Program; and (3) U.S leadership in areas of airport safety, planning, and airport infrastructure, and airfield pavements.

The Subcommittee had the following additional observations.

- 1. The Subcommittee was pleased to see that our recommendations regarding the Branch's Strategic Outlook for Research (SOR) chart—specifically expediting research into greener pavement technologies and use of automated ground vehicles on airport airsides—have been incorporated into the Branch's current research plans.
- 2. The Subcommittee appreciates the efforts of Branch staff to engage airport and other federal government agency stakeholders in its preparation of F3 transition plans through the ARFF Advisory Group established in January 2023. This Advisory Group continued meeting periodically over the Spring and Summer of 2023 and has brought key subject matter experts from airports, the National Fire Protection Association (NFPA), aircraft manufacturers, and Department of Defense together to help manage an orderly transition from aqueous film forming foams (AFFF) to F3 at certificated airports across the United States.
- 3. The Subcommittee continues to be impressed by the speed at which research activities associated with Uncrewed Aircraft Systems (UAS) are proceeding. We look forward to seeing the findings and conclusions of the current phases of UAS detection and mitigation research, which is wrapping up this Fall.
- 4. We are also impressed by the productivity of researchers working under the Airport Asphalt Pavement Technology Program (AAPTP) and Airport Concrete Pavement Technology Program (ACPTP) which have supplemented the Branch's other pavement research efforts.
- 5. Finally, we appreciated briefings on several Research Program Areas (RPAs) that have not been discussed in our recent meetings including those on the topics of wildlife hazard mitigation, visual guidance, and airport safety data mining.

Finding: During presentations regarding Runway Roughness research, Branch staff noted that the current FAA software tool for assessing pavement roughness—ProFAA—is constrained by two factors: (1) an assumption that aircraft taxi at constant speed and (2) a very limited library of aircraft types that can be evaluated, most of which are no longer used for scheduled commercial

service by airlines. Branch staff would like to address these shortcomings through additional software development.

<u>Recommendation</u>: The Subcommittee recommends that Branch staff proceed with modifications to ProFAA software to incorporate variable aircraft speed profiles, including takeoff acceleration and landing deceleration profiles, and a broader range of prototypical aircraft types reflecting modern aircraft designs.

Subcommittee on Human Factors

<u>General Observations</u>: Proposed AVS Research Strategy - The Subcommittee was pleased to receive a briefing on the proposed overall AVS research strategy, including the new proposal for specific "research thrust areas", and appreciated the opportunity to provide feedback on it from a Human Factor's (HF) perspective. The Subcommittee observed that critical Human Factors research is insufficiently visible in the proposed AVS research strategy given the preliminary list of research thrust areas. The Subcommittee understands that this type of problem is longstanding due to the cross-cutting aspect of Human Factors. This need for sufficient emphasis on Human Factors arises in two ways:

- Although there is important Human Factors research that needs to be done under the auspices of the listed research thrust areas, there is a concern that Human Factors research may not be conducted early enough or sufficiently to support guidance in programs with a technology development focus.
- There are research areas that are more generic in nature and should not be nested under the items in the existing list of research thrust areas. Examples from recent research focus areas include the revision of color standards and guidance, fatigue for the effective integration of humans and automation, human- Artificial Intelligence (AI) interaction integration into software systems, etc.

The recognition of these two types of HF research can help ensure the appropriate awareness and integration into the broader description of AVS research. The Subcommittee will request another briefing on the AVS Research Strategy at the Winter/Spring 2024 meeting.

Finding: Urban/Advanced Air Mobility Research Timeline - The Human Factors Subcommittee was pleased to see the FAA has research planned to address Advanced Air Mobility (AAM) Human Factors needs beginning in 2026. This project is proposed under the Human Factors Flight Deck NextGen Portfolio. For example, research question 8.2 under flight crew displays and interfaces research states: "*What are the anticipated human-machine interface and pilot/crew interaction issues with novel control inceptors that support precise 4-dimensional trajectory navigation accuracy requirements in highly automated rotorcraft and fixed-wing aircraft*?" The HF Subcommittee received two briefings from AAM Original Equipment Manufacturers (OEM) on their research needs. In both cases the timelines for Human Factors Flight Standards and Aircraft Certification guidance are fast approaching as these OEMs are targeting a 2025 Entry into Service date. **Recommendation:** The FAA should accelerate the Advanced Air Mobility (AAM) related research projects that were previously submitted as formal requests and are currently planned to begin in mid-2026. The timing for these projects should be accelerated to begin in 2024 so that the FAA's Flight Standards Organization and Aircraft Certification are better prepared to meet evaluation timelines proposed by the Original Equipment Manufacturer (OEM) applicants.

Consequences: If the FAA does not have technical and scientific data, based on research, available, the FAA staff within Flight Standards and Aircraft Certification will not have any basis for conducting their evaluations, developing issue papers, or policy. This may result in inconsistency across offices, delays, and frustration for both the applicants and the FAA, and safety risks in the system.

Finding: Competency Based Training and Assessment (CBTA) Timeline - Airbus and EASA have provided guidance to operators on the implementation of CBTA as one means of compliance for recurrent training for operators not utilizing the FAA's Advanced Qualification Program (AQP). Several major non-US airlines have implemented CBTA for recurrent training and are also investigating it for initial training. Boeing recently announced an effort to implement a version of CBTA for non-US operators and is investigating CBTA for its U.S. operators.

The FAA and U.S. operators need to understand the underlying concepts of CBTA and how CBTA concepts relate to current FAA training guidance and effective U.S. training programs already in place such as AQP. There may be important aspects of existing FAA guidance for training (that is already being effectively used by operators) which may not be included in current implementations of CBTA. The FAA needs to understand how CBTA has been implemented so it can assess its effectiveness in developing, maintaining, and applying required operational knowledge and skills for all work groups during airline operations. This would include an assessment of what CBTA concepts and objectives work well, what is problematic, how current FAA guidance fits, or should be updated, and how to mitigate any new risks.

Recommendation: Research is needed to enable the FAA to assess the effectiveness of CBTA and to take a data-driven strategy to possibly update FAA training program guidance to operators and other training providers that may want to incorporate CBTA concepts.

To start, the Human Factors Subcommittee recommends that the FAA accelerate the CBTA research proposed under OC 1: Improving Pilot Training, Procedures, and Operations within the Human Factors Flight Deck Core portfolio.

Research should include operators and OEM's that are actively investigating how to implement CBTA and may proceed to do so without FAA research and guidance. The research should investigate the effectiveness of CBTA and may include:

- How CBTA defines effective training and evaluation/assessment methods;
- How the CBTA training objectives and training methods are established;
- How the CBTA method effectively develops and maintains the required knowledge and skills;

• The feedback mechanisms Competency Based Training and Assessment (CBTA) provides to ensure appropriate feedback is included in the training program.

<u>**Consequences:**</u> Under Advanced Qualification Program (AQP), operators have the latitude to introduce new training concepts. Without the FAA and operators having an appropriate understanding of what the concepts, objectives, and effectiveness of what CBTA really is, along with applied Human Factors issues associated with human learning and human performance, and how CBTA is related to current FAA guidance and operator AQP training programs, appropriate guidance on CBTA pros and cons, operators may inadvertently introduce concepts (such as the competency of knowledge) that could have detrimental impacts to the development of critical knowledge and skills required during operational safety.

Finding: Air Traffic Organization AI/ML Human Factors Research Plan - The FAA has indicated a strong interest in the design, evaluation, and use of future software tools that integrate Machine Learning (ML) and Artificial Intelligence (AI) technologies more broadly into FAA software to support Air Traffic Control, Traffic Flow Management, Technical Operations, and other areas. In response to expectations for applications of ML within FAA software, the FAA has funded a research project focused on characterizing the state of the art in terms of the integration of Human Factors into the design and use of ML and symbolic AI as relevant to FAA applications. The FAA is to be commended for pursuing this work. This project is expected to complete in the Fall of 2024 however there is currently no additional research planned to provide guidance on the effective integration of Human Factors into the design, evaluation, and use of these technologies for use in support Air Traffic Control, Traffic Flow Management and Technical Operations.

Recommendation: The FAA should develop a plan to conduct research necessary to develop guidance on human-AI/ML integration through all development phases. Human Factors should play a leading role in guiding the design, evaluation, and use of AI/ML in support of Air Traffic Control, Traffic Flow Management, Technical Operations, and other potential technical applications.

The research the FAA has completed in this area to date has not resulted in sufficient guidance for future work in this area. Given that AI/ML human-integration is a dynamic and changing art, there is a need to create implementation guidance that also evolves as the technologies and their applications change. However, there is currently no additional research planned to provide guidance on the effective integration of Human Factors into the design, evaluation, and use of these technologies for use in support air traffic control, traffic flow management and technical operations.

Consequences:

There is a current need to develop a plan focused on the needs of the FAA's Air Traffic Organization that ensures that the corresponding Human Factors research focused on human-AI integration does not lag. Otherwise, there is a risk that the technologies will be matured and enter the FAA's Air Traffic Organization acquisition process without sufficient Human Factors guidance to ensure the design of safe and effective new tools. **Finding:** Training and Checking Program Changes due to Changing Pilot Entry-Level Experience - Recent events have shown that the entry skill expectations for part 121 pilots are changing. Research is needed to determine how operators are reassessing and adjusting the foundational assumptions on which their training and qualification programs are built. This includes an analysis of the entry skills of the changing new-hire workforce, (including an assessment of the effectiveness of training to prepare pilots for flight tests). It also includes an analysis of the effectiveness of training to ensure an understanding of the underlying systems now managed through increased automation support. Absent this, airline training programs might allow new-hire pilots to complete their training and begin flying line operations without the necessary knowledge or skills.

Recommendation: The FAA should conduct research to determine the degree to which operators are effectively managing safety threats associated with the lower level of experience for part 121 pilots relative to the expectations of flight operators. The research should investigate to what extent, and to what degree of effectiveness, operators are:

- Measuring entry skills and knowledge,
- Conducting gap analyses between measured entry skill/knowledge levels and assumed levels for existing training/checking curricula, and,
- Adjusting curricula and training appropriately to close identified gaps.

The research should also investigate potential methods to accelerate ways to effectively mitigate gaps in pilot knowledge and skills. The results of this research could be used to inform updates to required training content and methods informed by baseline assumptions about pilot knowledge and skills.

Consequences: If operators are not actively performing gap analyses focused on the underlying experience and skill assumptions upon which their training programs are based and assessing entry experience levels of the current incoming workforce, then the airline training programs might allow new-hire pilots to complete the training and begin flying line operations without the necessary knowledge or skills.

(Note: as an example, the Subcommittee was made aware of a specific case at a major airline where a new-hire pilot got almost to the end of Initial Operating Experience when it was accidentally discovered that this new-hire had no knowledge nor skill in the principles of weather radar operation. This topic was not included in the operator's existing program – only the technical operation of the installed weather radar equipment was trained. That was because how to use a radar generally was assumed to have been known by all entering new-hires – an assumption that had held true for decades.)

Subcommittee on Aircraft Safety

<u>General Observations</u>: The Subcommittee on Aircraft Safety (SAS) submits the following information related to Strategic Research Planning, Artificial Intelligence/Machine Learning and Wearable Sensors and Aircraft Automation Technology as observations from our most recent meeting.

1. Strategic Research Planning

During the SAS Summer/Fall meeting, the Subcommittee received a briefing from the Director of the Office of Senior Technical Experts, Aviation Safety/Aircraft Certification Services on the FAA's Strategic Research Planning. This is the top-down approach the FAA is taking to ensure FAA Research and Development (R&D) is establishing research goals that provide a stronger role for strategic priorities to drive research. It was well received and supported by the SAS members. The SAS further supports the development of research strategic thrusts across the domains that addresses the significant role that FAA plays in aviation safety research.

2. Artificial Intelligence/Machine Learning

The Subcommittee appreciates the follow-up action that the FAA took on our previous Findings and Recommendations regarding the development of a roadmap for Artificial Intelligence/Machine Learning (AI/ML). We note that the FAA has prepared a first industry draft of the Roadmap for Artificial Intelligence Safety Assurance, DRAFT 0.2 and plans to hold an industry workshop to introduce the roadmap to industry and collect feedback. The SAS views these as very positive developments and encourages the FAA to continue with the same quality and sense of urgency on this topic that has been demonstrated in the past year. Furthermore, the SAS appreciates the opportunity for the industry to comment on the roadmap in an upcoming technical exchange workshop.

3. Wearable Sensors and Aircraft Automation Technology

The SAS Subcommittee believes that new developments in artificial intelligence and machine learning, coupled with new wearable sensors and aircraft automation technology, have a potential role in improving aviation safety, while creating possibilities to alleviate current and projected pilot shortages. The FAA should actively monitor industry activity in pilot physiological state monitoring. When specific and viable applications are proposed to the FAA, it should leverage industry partners and academia to assess what research (if any) is needed to enable the FAA to write policy, guidance, and grant approval for specific use of the application.

Finding: Cyber Resiliency for Digital Safety Systems - The Subcommittee appreciates your consideration of the Finding and Recommendation (F&R) submitted to the FAA from the March 2023 REDAC SAS meetings along with your response that "no RE&D funded research is required since the SAS recommendation is already being or will be addressed by the FAA's Program Management Office (PMO)...". So that the SAS Subcommittee members better understand the full context of FAA RE&D in this area and subsequently may provide improved inputs on this topic in the future, it would be of interest to the Subcommittee, for the FAA to

provide a briefing by the Program Management Office (PMO) on what development activities funded or planned that may address the various Subcommittee questions that were listed in our original submitted Findings and Recommendations (F&R). The Subcommittee members are aware of the context and details of the FAA Cyber Security Data Science program through its engagement with industry and active industry research collaboration with the Cyber Safety Commercial Aviation Team (CSCAT), the Aerospace Industries Association (AIA) Civil Aviation Cybersecurity Subcommittee, Airlines for America (A4A), and other industry forums.

Recommendation: - The Subcommittee on Aircraft Safety (SAS) recommends and requests a briefing by the FAA on the development activities, funded or planned, that may address the various Subcommittee questions listed in our original F&R. This will provide members of the SAS to develop more informed input to support to the FAA at the Spring 2024 REDAC SAS meetings.

Finding: Reduced Crew Operations - Extended Minimum Crew Operations, (eMCO), is a recent initiative being aggressively explored by aircraft manufactures, avionics manufacturers, and airlines. Regulators outside of the U.S. have been involved in discussions with at least one OEM and implementation timetables have been proposed. Stakeholders see many potential benefits, most currently related to pilot fatigue management and crew complement.

Systems that allow greater autonomy, however, can also degrade pilot situational awareness by masking changes in aircraft system health. Additionally, current or proposed monitoring technology using a reduced crew complement is backed by limited scientific research and has not been validated in real world operations.

There are significant gaps in current knowledge dealing with fatigue management and flight time limitations with crew complements different than those currently in use in airline operations, and even less knowledge concerning new entrants such as Electric Vertical Take-Off and Landing (eVTOL) operations.

The SAS agrees with the FAA that it is not the Agency's responsibility to develop or mature the science and technology to enable use of the eMCO concept, but the FAA needs to be ready to apply rigorous guidance and oversight once they are approached by a stakeholder looking to implement eMCO in commercial operations.

Recommendation: The Subcommittee recommends that the FAA assess the potential applications of eMCO to aviation operations and safety, develop a research plan/roadmap that includes a multidisciplinary team and leverages work in other government agencies, academia, and industry to provide both certification standards and internal implementation guidance for eMCO.

<u>Recommendation</u>: In addition, the Subcommittee recommends the FAA develop requirements for means of compliance against the established rules, regulations, and procedures to assist industry in introducing additional automation and increasing autonomy for enhanced safety.

<u>Finding</u>: Detection of Bleed Air Contaminants: The Committee recognizes current research being undertaken as directed by the FAA Reauthorization Act of 2018, specifically, A11J FCMS.2, "Detection of Bleed Air Contaminants in the Cabin". A solid understanding of the

chemical constituents in cabin air is essential. When completed, it is anticipated the work will be reflective of a similar undertaking by SAE, published in 2020 as Aerospace Information Report AIR1539C, "Environmental Control System Contamination". These are good starting points.

Follow-on research is required to determine if there is a direct correlation between exposure to cabin air, beyond engine bleed air, and reported illnesses in well maintained passenger aircraft.

Specifically, scientific study is needed to establish which substances are both hazardous and present in concentrations of concern. The research should support development of standards to inform in-situ measurement techniques that could identify required maintenance as well as safe environments.

Recommendation: The Subcommittee recommends research that builds on previous work that identified chemical compounds and substances present in engine bleed air to include additional constituents typical in 1) normal operations, 2) smoke/odor/fire events, and 3) as a result of maintenance issues. For those substances that impact human health and are likely to be significantly present, research should establish acceptable concentrations and durations of human exposure, supporting standards development.

Subcommittee on Environment and Energy

General Observations: The Subcommittee focused on reviewing the Research and Development (R&D) Portfolio for Office of Environment and Energy that was developed based on the RE&D budget for FY23 that was enacted on March 15, 2022 (RE&D received \$248.5M). The Inflation Reduction Act has \$297M to be spent over five years. The use of these funds within the Section 40007 Program has been programmed into the research efforts. The new Sustainable Aviation Fuel (SAF) Tax Credit and Grant Programs are significant: this includes \$297M for FAST-SAF and FAST-Tech grant programs. There was a major about the lack of funding in the proposed House bill for Environment and Energy and concerns over the possible government shutdown at the end of September, 2023. During the meeting, the staff from the Office of Environment and Energy (AEE) provided updates and highlighted accomplishments on all of the major research projects within the portfolio since our last meeting.

Work on programs such as the Aviation Sustainability Center of Excellence (ASCENT); Continuous Lower Energy, Emissions and Noise (CLEEN); Commercial Aviation Alternative Fuels Initiative (CAAFI) and the Aviation Environmental Design Tool (AEDT) have been progressing. NASA also provided a comprehensive update on its programs. The primary focus of the briefing was on ultra-efficient transport, the future airspace, high speed commercial flight and advanced air mobility. The Subcommittee would like to know *whether the FAA had developed definitions for the different types of Unmanned Vehicles that will be entering the NAS. How does the FAA differentiate between a UAS vs a UAM vs an AAM*?

As has been the case in previous reports from this Subcommittee, listing the individual accomplishments and their impacts on many of the different facets of aviation is not realistic during this presentation, but these accomplishments further validate the benefits and the need for

sound research when developing regulations, policies, and procedures. These updates highlighted some of the new projects that have been started and are being proposed given the current mandates and additional funding within the FY23 enacted budget.

The presentations outlined a high level of communication between the Office of Environment and Energy (AEE) staff and their partners to continue these necessary research efforts. The Subcommittee is pleased to see the improved working relationship between the FAA and the EPA on multiple fronts. One example of this corporation will result in the improvement in the AERMOD model, which is a key tool for airports to model community exposure to aircraft emissions. The latest FAA initiative to Eliminate Aviation Gasoline Lead Emissions (EAGLE) to lead the transition to unleaded piston general aviation fuel is very important.

As was noted before, the current Administration has made a commitment on climate change and issued an Executive Order 14008 that outlines its goals. It has commitment towards "reducing the aviation sector's emissions in a manner consistent with the goal of net-zero emissions for our economy by 2050". This was further captured in the U.S. Aviation Climate Action Plan. Through this document, the government announced its intention to advance the development and deployment of sustainable aviation fuels, and to maintain a leadership position at the world level with organizations such as the International Civil Aviation Organization (ICAO). Recently ICAO reached agreement on Long Term Aspirational Goal (LTAG) with some adjustments to CORSIA. So now U.S. Aviation Climate Action Plan's net zero 2050 goal is now matched by ICAO LTAG and industry goals. We firmly believe that partnerships with other governments, other federal agencies, the Centers of Excellence and private corporations who are involved in the research portfolios that AEE has in place are key to completing this mission and are the most effective vehicle to conduct and coordinate future research and maximize limited resources.

The Subcommittee believes that AEE is doing a very good job and has once again presented a balanced portfolio. We believe that the priorities that we had previously identified have not changed and that AEE has added research projects that address these priorities as well as those necessary to address the goals outlined by the current administration. Many of these new projects have been added to the Continuous Lower Energy, Emissions and Noise (CLEEN) and Aviation Sustainability Center of Excellence (ASCENT) portfolios. The Subcommittee members realize that there is still additional research required to address ongoing areas of concern. We are happy to see the recent addition of staff to AEE but believe that further evaluation of staffing needs should take place given the additional funding and additional projects that are required in order to meet the goals outlined by this current administration.

The FAA has not filled the Chief Scientific and Technical Advisor for Environment and Energy position and this with the recent departure of the Executive Director of the Office of Environment and Energy has created additional burdens on the existing staff to perform multiple roles. We would like to thank the outgoing executive for his contribution to the overall success of this program for many years. With the retirement of the former President of the Cargo Association, the Subcommittee has lost an icon of the aviation industry and a valued and longtime member and friend. The AEE Subcommittee wishes both these gentlemen much success in their future endeavors. The need to maintain a leadership position at International Civil Aviation Organization (ICAO)/Committee on Aviation Environmental Protection (CAEP) is still vital to the U.S. aviation interest. The recent departure of the AEE Executive Director, who was the Chair of CAEP Committee will need to be addressed as soon as possible.

The results that have been accomplished by the projects in Continuous Lower Energy, Emissions and Noise (CLEEN) Phase 1 and CLEEN Phase 2 as well as Aviation Sustainability Center of Excellence (ASCENT) highlights the value of the Public/Private Partnerships that AEE has made an integral part of its research portfolio. The additional funding to CLEEN has enabled the FAA to expand CLEEN Phase 3 while also accelerating the start of CLEEN Phase 4. Another advantage of these partnerships is that universities and hundreds of students have benefited from these advanced research projects. The partnerships with the FAA have allowed universities to improve their facilities and capabilities and thus recruit better students that help improve the quality of the research being done in the USA. The timely awarding of these grants is still a challenge. There are ongoing concerns that these delays in awarding these grants will also affect the award of FAST – Tier 1 grants which will have consequences. As was noted before, the delay in approving and awarding of these projects has resulted in missed research opportunities and will create challenges in being able to address the priorities ahead and the ability to accomplish our goals.

Guided by the updates and presentations, the Subcommittee has proceeded with the following "Findings and Recommendations".

Finding: Sustainable Aviation Fuels (SAFs) - We know that the Sustainable Aviation Fuel (SAF) Program (including efforts in the Commercial Aviation Alternative Fuels Initiative (CAAFI), Continuous Lower Energy, Emissions and Noise (CLEEN); and ASCENT is a critical component of the industry's global emission reduction strategy. To meet the federal goals of increasing the production of SAFs to at least 3 billion gallons per year by 2030, there will need to be an increase in the research projects within the ASCENT portfolio. We are happy to see that some of these research projects have already been added to the portfolio. The same can be said if we hope to develop fuels that can be blended above 50% in today's fleet of aircraft. The current research has helped with the creation of several companies that have the potential to benefit the rural economies of several states and the U.S. Aviation industry. The establishment of the Sustainable Aviation Fuel Grand Challenge will ensure that the U.S. Government and the private sector are working together to address aviation sector emissions. The signatories of the SAF MOU, the DOE, DOT and USDA are all working very hard and have made progress and have developed goals and made commitments to this program. The new SAF Credit and Grant Programs are vehicles geared towards implementation of the SAF Program. The EPA is also heavily engaged as well. There are ongoing efforts to ensure that alternative jet fuels are in CORSIA through International Civil Aviation Organization (ICAO)/Committee on Aviation Environmental Protection (CAEP).

Recommendation: The Subcommittee agrees with the mandate proposed by the current Administration that the work on Sustainable Aviation Fuels (SAF) is a critical component for the reduction of aviation sector emissions and supports the SAF Grand Challenge. Since the maturation of the Sustainable Aviation Fuel program will be a major environmental benefit for the public, will create a new industry within the U.S. that benefits rural America, and will benefit the U.S. aviation industry, we strongly recommend that the FAA AEE continues to allocate funds for the continuation of research on SAFs.

<u>Recommendation</u>: We endorse what has been started but strongly recommend that AEE needs to accelerate this program in order to accomplish the goal of being able to supply 100% of the aviation fuel needed in 2050. The awarding of FAST-SAF and FAST-TECH grants is significant

for the success of the SAF program. The FAA must also maintain a leadership role in the development of SAFs to ensure that the rules to be considered at a global level International Civil Aviation Organization (ICAO) will be beneficial to the U.S. industry.

Finding: Public Private Partnerships - The Subcommittee continues to acknowledge and support the fact that the Office of Environment and Energy (AEE) have proven over decades to be very good stewards of taxpayer money. The leadership team at AEE has used their budgeted amounts to conduct and coordinate the research necessary to produce informed, data-driven policies; facilitate technological advances in the aviation industry; and produced models and data that have positioned the U.S. as both a State leader at International Civil Aviation Organization (ICAO)/Committee on Aviation Environmental Protection (ICAO/CAEP) and on the global aviation stage. The execution of this research portfolio has been accomplished by working collaboratively with private industry, major universities through the Aviation Sustainability Center of Excellence (ASCENT), other Federal Departments and Foreign Governments. Three quarters of Environment and Energy research funds generate 100% plus cost matching from nonfederal partners, Continuous Lower Energy, Emissions and Noise (CLEEN), Commercial Aviation Alternative Fuels Initiative (CAAFI), and Aviation Sustainability Center of Excellence (ASCENT). The results that we have seen in the CLEEN Phase 1 and CLEEN Phase 2 projects as well as those in the ASCENT Center of Excellence is proof that these partnerships clearly work. These partnerships leverage scarce FAA R&D funds to accomplish significant advances and improvements. In addition, we believe that government funding has been used and executed effectively to lower the risk of new and emerging technologies such that they can be adopted by industry. The research benefits of these partnerships have clearly been proven over time and is very apparent in the current projects. The maturation of new technologies has delivered improved environmental performance and has enabled aviation system growth and associated positive economic impacts. In order to comply with Executive Order 14008 on Tackling the Climate Crisis, there will be an increased reliance on these Public Private Partnerships.

One of the benefits that has not been highlighted before is that these partnerships have created new industry and new jobs in aviation. In addition, private industry, universities, and hundreds of students have benefited from the partnership with the FAA. Getting the timely award of these grants is critical to the COE's ability to start vital projects.

Recommendation: Whereas the Subcommittee continues to endorse Public Private Partnerships like the CLEEN, CAAFI and ASCENT programs to leverage resources, we believe that the FAA will not be able to accomplish any of the priorities set forth by the current administration without allocating robust funding for these programs. The Subcommittee recommends that AEE utilize the additional funding that it has received in FY22 and any additional funding it receives in FY23 and FY24 on new and existing projects that will enhance and accelerate research to best address the current federal mandates. The Subcommittee endorses the establishment of new partnerships with other federal agencies similar to the one that exist with NASA as a key to success.

Finding: Global Leadership - Despite the fact that the FAA AEE currently maintains a leadership role in ICAO CAEP and has been the driving force behind the push for data driven rule making, based on the commitments made by the current administration on Climate Change, the Subcommittee firmly believes that maintaining the U.S. global leadership position at ICAO CAEP is essential and advantageous to U.S. aviation industry and will allow the U.S.

government to defend its positions based on scientific research. Previous work that has been done with ASCENT and the Volpe Center has clearly allowed the FAA to maintain a scientifically supported position at ICAO CAEP. The close collaboration with NASA and individuals that have been involved in research projects under the E&E portfolio have played significant roles at ICAO CAEP and that is also clearly supporting U.S. global leadership. The work done within the CAEP Task Group to reach an agreement on a Long-Term Aspirational Goal for international CO₂ emissions (LTAG TG) is major accomplishment and one example of this collaboration and support setting the stage for U.S. leadership. Establishing international standards for SAF is also important. Anything that jeopardizes ongoing research at AEE will impact the FAA/U.S. global leadership position at ICAO CAEP. The FAA's ability to attend in person meeting and represent the U.S position regarding international policy making at the international level is essential.

Recommendation: The Subcommittee recommends the continuing strong support of all research efforts/programs that will allow the FAA and the U.S. to maintain its current global leadership position at ICAO CAEP. It is the belief of the Subcommittee that if the FAA/U.S. does not maintain its leadership position at ICAO CAEP it will not be able to influence policy/rulemaking and this could have a significant negative impact on the U.S. aviation industry.

Finding: Noise Research - Aviation noise is and will continues to be one of the biggest environmental impacts related to the aviation industry and it requires ongoing research in order to address the concerns of the citizens. Despite the fact that we have learned a lot based on the results of many of the projects in the "Noise Portfolio", the Subcommittee's position on noise has not changed in that there is much research that is still necessary to address the ongoing topic of aviation noise. Whether there are new technologies or new procedures that can be implemented to help reduce the impacts of noise as the aviation industry rebuilds needs to be evaluated. Historically, advances in aircraft technology have been the major factor in reducing aviation's environmental impacts. The Subcommittee recognizes that there is about a seven (7) year lag between flight testing a technology and it's appearing in the fleet. Therefore, if we want to consider any new technology being introduced into the fleet in early 2030, we need to invest in the research now. The use of government resources during the initial research stages helps mitigate technology risk and incentivize private companies to invest and develop cleaner, quieter technology. AEE has seen a number of research projects that have contributed to more fuel efficient and quieter aircraft. They have also developed new operational procedures that have reduced the noise impacts in communities in and around airports. There are a number of new research projects that have been added to address issues related to new entrants, such as Unmanned Aerial Systems (UAS) and Advanced Air Mobility (AAM) into the aviation system. Many of these new entrants will be active participants in our airspace in the not-too-distant future. There is strong collaboration with NASA on the noise front. There also have been significant upgrades made to the Aviation Environmental Design Tool (AEDT). AEE has established an AEDT User Review Group for ideas and feedback in order to ensure that the tool is beneficial to the actual users. FAA has also launched an initiative to partner with airports to gather more noise data resulting from noise complaints. Finally, AEE is working with industry to accelerate the development of technologies that reduce noise through the CLEEN Program.

<u>Recommendation</u>: The Subcommittee once again recommends the continued prioritization of noise research and the prioritization of the projects that will support informed decision-making as it relates to the introduction of new entrants to the national air space.

Finding: Staffing - AEE still has not filled the Chief Scientific and Technical Advisor and has loss additional key staff positions. With additional funding from the Inflation Reduction Act and new SAF Tax Credit and Grant Program, there will be many additional projects being created in the near term. The Subcommittee has concerns that these vacated positions place burdens on the existing staff to handle and manage the increased workload. AEE needs to fill these current vacant positions so that the existing staff can focus on the increased challenges and expectations that already exist at AEE.

<u>Recommendation</u>: The Subcommittee strongly recommends that the FAA, AEE carefully examine the workload on its current staff and ensure that it has sufficient staff to support the additional priorities and projects that have been added to the portfolio.

Finding: Grants - There has been additional funding for new grant programs. With the addition of the FAST – Tier 1 grants, the Subcommittee is concerned that any delay in approving and awarding of these projects will result in missed research opportunities and will create challenges in being able to address the priorities ahead and the ability to accomplish our goals.

<u>Recommendation</u>: The FAA needs to streamline the process and remove any obstacles that are delaying the approval and awarding of these projects that are necessary to the success of its mission.

Subcommittee on NAS Operations

<u>General Observations</u>: The NAS Operations Subcommittee continues to be interested in seeing the FAA's planned Strategic Outlook for Aviation Research (SOAR) as it matures and becomes available for review. A strategic overview of major research areas and their phases over time will help the Subcommittee and others understand how FAA RE&D is prioritized and planned to address critical needs. The Subcommittee is also interested in seeing a more strategic view of each of the Budget Line Items (BLIs) that traditionally provide presentations at our biannual meetings. One example could be a summary chart showing each of a BLI's research tasks on a common timeline showing key milestones, interdependencies, connections to other activities, and outcomes the research is intended to inform. We will work with our Designated Federal Officer to explore new approaches toward organizing those presentations so that they can be most effective.

The NAS Operations Subcommittee received a briefing on the FAA Innovate 28 (I28) Roadmap. The Subcommittee was pleased to see an integrated approach and commends the FAA for articulating a clear approach and roadmap, as well as. the requirements for the integration of first-generation Advanced Air Mobility (AAM) vehicles into the NAS under existing rules, regulations, and procedures. The Subcommittee believes the roadmap will help provide AAM manufactures and operators with guidelines by which to develop their technologies. **Finding:** Airport Surface Safety Human Factors - The NAS Ops Subcommittee received an update on Human Factors ATC Tech Ops (BLI A11.i) which noted that a new activity will begin in FY24 to support an FAA response to NTSB Report AIR-18-01. This NTSB report was generated following the July 2017 taxiway overflight of an Air Canada A320 at San Francisco International Airport. Since 2017, there have been a number of other noteworthy runway incursions and related near-miss events at a range of large and medium airports -- most recently including incidents at John F. Kennedy International Airport in January 2023, Austin in February 2023, and Boston and San Diego in August 2023. The Subcommittee noted that these incidents are indicators of safety risks that need to be explored in order to determine what mitigations might be most effective in preventing a potential future major accident at an airport.

Recommendation: The NAS Operations Subcommittee recommends that the FAA accelerates research into Human Factors-related causes and potential mitigations for runway incursions, wrong surface approach alignments, and related incidents during takeoff and landing operations. The planned effort in response to NTSB Report AIR-18-01 should be expanded to encompass all forms of runway incursion and surface safety events. This would include studies that re-evaluate operational procedures (e.g., Line Up and Wait while concurrently clearing aircraft to land on the same runway), pilot and controller training, workload, duty schedules, and potential technologies to improve situational awareness and alerting to runway incursions, wrong surface approach alignments, or other loss-of-separation events.

Finding: Airport Surface Safety Research Roadmap - The Subcommittee received an update on the Runway Incursion Reduction Program (RIRP). The Subcommittee noted that recent work in RIRP has been focused on lower-cost surveillance and safety solutions for small and medium airports but there did not appear to be an overarching RE&D strategy at this time. The program's near-term focus is on an operational demonstration of surface surveillance and direct-to-pilot warning lights to be conducted at San Antonio airport. Although there are certainly safety benefits to be gained at smaller airports, recent runway incursion events at major airports (see Finding #1 above) demonstrate that even though significant hazard mitigations have been deployed at large airports, safety risks remain that still warrant continued research and development.

Recommendation: The NAS Operations Subcommittee recommends that the FAA RIRP develop an updated research roadmap that lays out the landscape of runway incursion and surface safety risks, identifies gaps and research needs, and provides a prioritized and time-sequenced research plan to mitigate runway incursion and other surface safety risks. This plan should not be restricted to low-cost systems for smaller airports and should include considerations for major airports including those where several recent runway incursion events have occurred.

<u>Finding</u>: Wake Risks under Advanced Air Mobility Concepts - There may be mixed Advanced Air Mobility (AAM) operations at airports in which Electric Vertical Take-Off and Landing (eVTOL) aircraft could be exposed to risks from persistent conventional aircraft wake turbulence. These wake risks at low altitude, coupled with novel aircraft performance characteristics and flight profiles, may require new approaches to defining wake separation criteria for AAM operations. **<u>Recommendation</u>**: The NAS Operations Subcommittee recommends that the wake programs (A11.p and 1A04A0) begin research to understand how wakes might affect Electric Vertical Take-Off and Landing (eVTOL) aircraft transiting across the runway, approach, and departure environments during intervals between conventional takeoff and landing operations. This activity may lead to establishing constraints on Advanced Air Mobility (AAM) flight profiles and/or new wake separation criteria for AAM operations.

<u>Finding</u>: Human Factors for Highly Automated and Autonomous Advanced Air Mobility Concepts - The NAS Ops Subcommittee received updates on Enterprise Human Factors (BLIs 1A12B0/1A11B0) and Air Traffic Control / Technical Operations Human Factors (BLI A11.i), both of which appeared focused on utilization and integration of legacy and current technologies and vehicles. However, with the upcoming integration of Advanced Air Mobility concepts, it is envisioned that highly automated and increasingly autonomous vehicles will begin operations within the NAS. In addition, the ground-based controller assistance tools will also contain higher levels of automation. It is not clear how these vehicles will impact how a controller manages the airspace, and if the roles and procedures will or will not change. In addition, clear articulation of the roles and responsibilities, graceful degradation, and off-nominal procedures are needed.

Recommendation: The NAS Operations Subcommittee recommends that the FAA engage in targeted Human Factors research aimed at integration of highly automated and increasingly autonomous Advanced Air Mobility concepts into the NAS, as well as utilization of increasingly automated controller assistance technologies. This research should be reflected as part of an integrated roadmap of Human Factors research which identifies cross-leveraging, inter-dependencies, and targeted applications of the research outcomes.