Subcommittee on Environment and Energy | MINUTES

Meeting date & time *March 9-10, 2021*
Meeting location *Virtual Meeting*

Purpose	Develop Strategic Guidance for the FY2023 R&D portfolio
Facilitator	Jim Hileman, DFO
Note taker	Jim Hileman
Timekeeper	Jim Hileman

Minutes from Meeting

Presentation Welcome | **Presenter** *Jim Hileman*

Jim provided details on the meeting and went over the agenda. He noted that Laurence Wildgoose, the Assistant Administrator for Policy, International Affairs, and Environment would be joining the meeting.

Presentation Chair Opening Statements and Introductions | **Presenter** *Ian Redhead*

Ian Redhead welcomed everyone, and then each of the Subcommittee members introduced themselves.

Presentation Introduction | **Presenter** *Laurence Wildgoose*

Laurence began by noting that it is great to see so many people engaged with the research efforts being led by the Office of Environment and Energy (AEE). He thanked Ian (Redhead) for his leadership in chairing the subcommittee and Steve (Alterman) for his past efforts chairing this subcommittee as well as his current efforts with the MAC. He continued by highlighting that on February 25 the Secretary issued a joint statement with his counterpart from Transport Canada on the nexus between transportation and climate change. In the statement, the secretary committed to working with Canada on a shared vision toward reducing the aviation sector's emissions in a manner consistent with the goal of net zero emissions for both economies by 2050. The statement also specifically mentions the ASCENT Center of Excellence and the important role it has played in developing sustainable aviation fuels (SAF). Laurence continued by stating that to make progress on reducing the climate impacts of aviation, we will need to take a holistic approach to de-carbonizing aviation, including domestic actions to support sustainable aviation fuel deployment, aircraft technology development, and operations modernization and that we will also need international leadership from the United States (U.S.) In addition to climate change, the challenges posed by aircraft noise and emissions affecting air quality will need to be addressed and in a way that delivers environmental justice to communities across America. The Assistant Administrator continued by noting that to address these varied environmental issues we need a

robust R&D program. This will ensure that decision-making is informed by sound science and that the aviation sector can tap into its long history of innovation to address the climate crisis and the other challenges facing aviation. Laurence closed by thanking all for taking time out of busy schedules to review the environment and energy research portfolio, develop findings on AEE's work, and make recommendations to the Agency on the future direction of the portfolio. He noted that it is important to have leaders in the field providing advice on what FAA is doing, and in particular on this portfolio. He concluded by saying he is looking forward to seeing the committee's findings and recommendations from this meeting.

The Chair thanked Laurence for taking the time to join the meeting.

Presentation FAA AEE Update | **Presenter** *Kevin Welsh*

Kevin Welsh started by stating that AEE were able to continue to do the work of the Environment and Energy (E&E) portfolio thanks in part to the strong support of the Subcommittee. He added that now there is a change in direction with the new Administration and the Office will continue to need advice from the Subcommittee on what we are doing. Kevin continued by noting that he is seeing considerable enthusiasm across the government on aviation and is seeing a whole of government approach in action. He said that AEE are very busy but that it is very good.

The Chair noted that he is also seeing increased interest from the U.S. government and that he has been approached for the first time by individuals in Congress to learn more about the program. The Chair also noted that the FAA and NASA have done an exemplary job of collaborating on work and are clearly working in partnership. He also stated that the FAA have received tremendous value from the partnerships that have been formed by the ASCENT Center of Excellence and the CLEEN Program.

Presentation Update on ICAO and CORSIA Implementation | **Presenter** *Dan Williams*

Dan Williams presented an update on what has transpired since the last Subcommittee meeting with respect to International Civil Aviation Organization (ICAO) and the implementation of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). He started with an update on ICAO, which included some insights on the CORSIA review and the work to evaluate the feasibility of the long-term aspirational goal for international aviation CO2 emissions. A Subcommittee member asked about the new baseline year for CORSIA, which is now 2019. Dan continued with a summary of major outcomes from the 2020 ICAO Committee on Aviation Environmental Protection (CAEP) Steering Group meeting as well as providing some insights into the coming 2021 Steering Group meeting. This included efforts to update the annex on aviation engine emissions and work to advance how lower carbon aviation fuels will be included in CORSIA. He also discussed upcoming ICAO events: the 2021 ICAO Stocktaking of in-sector CO2 emissions reductions (Aug/Sept 2021), the CAEP 12 Meeting (Feb 2022), a planned High-Level Meeting (Q1 2022), and the 41st General Assembly (Sep/Oct 2022).

He briefly noted that domestic airlines have provided the emissions reports that are needed for the implementation of CORSIA and that the program is working well.

Presentation Industry Perspective | **Presenter** *Steve Alterman*

Steve Alterman began by noting Laurence had covered much of what he would say. He continued by saying that the industry has a strong track record on improving in terms of sustainability, but more is needed and research is critical to enabling continued progress. In addition to carbon dioxide emissions and climate change, noise continues to be a concern. He participated on a panel at the recent UC Davis meeting alongside other members of industry and based on the questions that were asked, it is obvious that there are many people concerned about noise and these people are not necessarily near the airport runways. He therefore welcomed the fact that FAA asked people for their inputs on the noise R&D program on January 13. Steve continued by saying that we need to think not just about noise, but also climate. The UC Davis meeting only considered noise and that only handles part of the issue. Steve also touched on SAF and the industry-wide efforts to advance them. SAF are a priority for the industry to achieve decarbonization and he is hopeful that this Administration will push for more research as it is very much needed.

Melinda Pagliarello intervened by noting the needs from an airports perspective and indicating that airports are currently experiencing a very challenging financial situation. She continued by also stressing the need to enable SAF and electrification at airports. She concluded that PFAS will be a concern and a financial challenge for airports.

David Hyde noted that this administration is tackling climate in a different way and industry appreciates it and would like to work with them. He added that this subcommittee has an important role on advancing work on aircraft technology, SAF, and operations. He ended with he hopes there will be some solid recommendations on these subjects.

Tim Pohle mentioned Steve's points were very cogent and that he agrees any given environmental issue cannot be taken in isolation, but instead emissions and noise need to be handled together. He stated that SAF are an important element and need to be stood up as quickly as possible. In his view, REDAC is critical to the effort as we need to be able to address aviation technology and fuels. He concluded by stating this is very important work.

Laurence noted that he is looking forward to working with everyone in a collaborative manner. Based on a comment from Steve, the FAA added that we are in the process of extending the Noise Register Notice (FRN) comment period by 30 days and that the extension to be announced later this week. The extended comment period will end on April 14, 2021.

Presentation Budget | **Presenter** *Beth Delarosby*

Beth Delarosby began by giving an update on the RE&D budget for FY21. The FY21 budget was enacted on December 27, 2020 and the FAA received $198M for RE&D funds. She provided a detailed comparison of the Operations, F&E, Grant-in-Aid, and RE&D accounts among the President's budget, subcommittee markups, and the final conference language. Beth continued by noting that we are waiting for the U.S. Office of Management and Budget (OMB) pass back for the FY22 budget and that the President's budget submission date has not been set. The FY2023 budget will be developed after the FY22, and at present the FAA does not have targets for FY24 and the out-years. Beth

concluded by reminding the committee that the current Authorization signed by the president on Oct 5, 2018 extends the authorization through 2023.

The Subcommittee Chair noted that the out-year targets are unchanged from March.

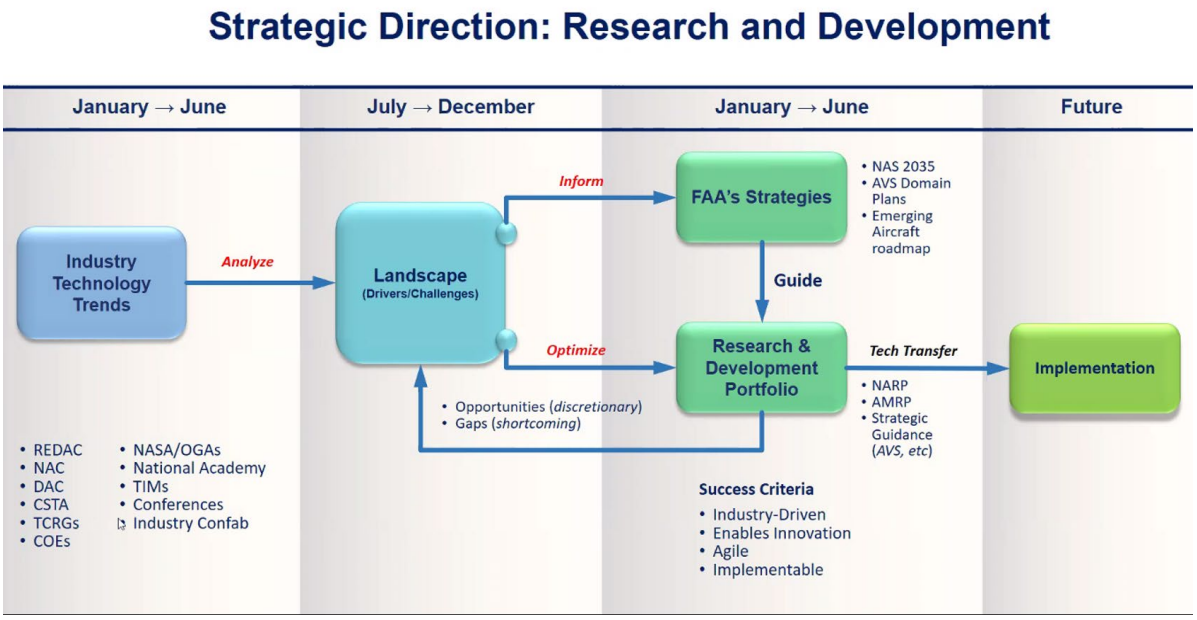
Presentation Responses to REDAC Recommendations & Actions | **Presenter** *Jim Hileman*

Jim Hileman walked through the action items from previous meetings and the open action items are listed below. He then walked through the existing findings and recommendations from the spring and fall 2020 meetings. All of the recommendations were closed. Based on a request from several Subcommittee Members, Jim agreed to share a briefing he provided on the use of hydrogen in commercial aviation.

Action items	Person responsible	Deadline
Share ASCENT NFO with REDAC E&E Subcommittee (on an annual basis)	J. Hileman	Ongoing
Leverage "right-to-left" thinking in developing roadmaps wherein we start by thinking about the endpoint (goal) that is desired and decide how to get there	J. Hileman	Ongoing
Develop a means to communicate successes from E&E Portfolio summary slide	J. Hileman	Ongoing
Leverage the road mapping efforts at NASA and FAA to update the White House National R&D Plan	J. Hileman	On hold

Presentation FAA Research and Development (R&D) Update / COVID impacts & Aviation Industry directions and challenges | **Presenter** *Shelley Yak and Ian Redhead*

Shelley Yak thanked everyone for joining the meeting. She introduced members of her team, including Jon Schleifer who is joining all of the Subcommittee meetings. She noted how various aspects of the R&D program have been supporting the overall response to the COVID pandemic and also shared efforts by the Tech Center on the aviation STEM efforts with students. She continued by providing information on the landscapes effort and how it ties to other organizations in the FAA. She shared a flow chart (copied below) that shows how the FAA will use the landscape document to inform the development of FAA's strategies and the FAA R&D portfolio. Based on a question from a Subcommittee Member, Shelley noted that people at higher levels in the FAA are talking about the FACAs in the FAA. These people are asking about the roles of the Subcommittees within the REDAC and whether there should be changes.



The Chair noted that the Subcommittee have discussed this before and find much value in its current structure.

Shelley then shared the questions that have been posed to them.

A member asked if the inputs for the Landscapes should be limited to environment and energy or if everything should be covered. Shelley noted that the individuals within the Subcommittee should feel free to cover everything they want, but she also asked that they be sure to cover environment and energy as that is the focus of this subcommittee.

Another member noted that the airlines had lost $46 billion in 2020, but that air cargo has reached an all-time high. While economist with the airline industry do not expect travel to return to pre- COVID levels until 2023-2024 and it will take many years for the industry to pay off the debt it is currently taking on, the industry is still investing in sustainability. She continued by highlighting recent studies on the transmission of COVID on flights and shared the following links to the studies and COVID related data:

- Harvard Reports on COVID transmission are available here: https://npli.sph.harvard.edu/resources-2/aviation-public-health-initiative-aphi/
- A4A's economic assessments on COVID's impact are available here: https://www.airlines.org/dataset/impact-of-covid19-data-updates/#

Another member added that, including all the costs associated with prevention, airport losses are estimated at $23 billion for March 2020-March 2021, and another $17 billion loss is estimated from April 2021 to March 2022.

Another member provided additional details on airports and how they are responding to COVID in terms of new technology and spacing to present COVID spread. Additional details are available here:

- https://airportscouncil.org/wp-content/uploads/2020/06/ACI-NA-AIRAP-COVID-19-Recovery-Recommendations.pdf

Another member indicated that information from Boeing on COVID transmission can be found at the following link:

- https://www.boeing.com/confident-travel/

Another member noted that communities have grown accustomed to change in the environment from reduced traffic volume and it will be interesting to see how these communities respond as traffic picks back up. The DFO recommended that this topic be revisited during the noise and emissions briefings.

Another member discussed the fact that COVID could impact the introduction of new technologies due to reduced funding and challenges in doing research. The member also noted that other nations have invested heavily in technologies to address environmental challenges.

Another member added that the challenges industry is having in advancing new technologies into future aircraft are due to the focus on today's challenge and the lack of investments taking place in the U.S.

Another member added that business aviation has been hit hard as well and that it is not just commercial airline development being affected.

Another member highlighted that we are seeing accelerated retirements of older aircraft and that she is interested in seeing the resulting impacts on noise and air quality. However, even with those anticipated benefits concerns remain about community reactions to noise as air traffic recovers to pre-COVID levels and she noted that communities seem to be as concerned as ever.

The FAA noted that we are interested in seeing a return to growth, but want this to happen in a way that avoids growth in emissions and noise. This is an important question for this Subcommittee as we recover from COVID.

Another member agreed with the FAA and said that we need to avoid being on the wrong slope in terms of noise and emissions. He said that he does not have any solutions, but we need to find a different slope to avoid a negative community response to aviation growth as there has been a new normal over the last year.

Two members agreed on the need for a green recovery, but they did not know how to get there either. They noted the need to do more great work and do it faster.

A member discussed the need to better understand the introduction of new entrants and their environmental impacts before the communities become concerned. He also noted that the freight sector is actually doing very well financially and is making investments to reduce their climate impact.

The members agreed that new entrants need to be considered, but it is also important to continue work on commercial aircraft.

Shelley thanked everyone for their inputs.

Presentation E&E Research Update | **Presenter** *Jim Hileman*

Jim Hileman provided an update on the efforts of the E&E Research Portfolio. The briefing included background on the AEE, an overview of the E&E Research Portfolio, a summary of activities of the ASCENT COE, the

budget profile for the E&E Research Portfolio. He concluded with a summary of accomplishments.

The briefing started with the organization chart for AEE as well as the E&E strategy being pursued. The overview of the E&E Research Portfolio provided high-level details on the various aspects of the portfolio, namely research related to aircraft noise, aircraft emissions, SAF, aircraft technology, and analytical tools development. Jim provided a number of highlights from the portfolio and pointed to the websites that have additional information on the efforts supported. Jim continued with an update on the ASCENT COE. He highlighted that AEE have stood up 30 new ASCENT projects in the last 12 months and that the office has spent $34.1 million over that time frame on 84 separate ASCENT grants. Talking about the budget profile, Jim discussed the two budget line items that are used to fund the E&E Research Portfolio and how funding has varied over the last four years. In addition to a high level view on how AEE uses the funds in the two budget line items, he gave a detailed breakout of how funding has been used over the last four years. Jim concluded the briefing with a list of recent successes that have been supported by the portfolio. He also provided an overview of the remaining briefings. Lastly, he provided three questions for the subcommittee members to ponder as they review the portfolio.

The chair thanked Jim for the briefing and, along with many other members, he commended AEE on the great progress made with the ASCENT COE in the last year.

A member stated that the FAA is taking an appropriate approach with its R&D program and the work being done is fantastic. He added that there are challenges in working the topic of hydrogen with the EU given their very strong interest in this technology. Jim noted that the FAA have been developing information on this and sharing it with everyone they can, including people in Europe and within ICAO. Another member commented that the people pushing hydrogen now used to push batteries. The member continued saying that there is the need to have good science and engineering show people what the right answer is even when it is not cool and exciting. A member noted that FAA have funded work at MIT and the FAA added that we have been supporting MIT with outreach to individuals who need to understand the challenges associated with hydrogen use in aircraft.

Presentation NASA Update | **Presenter** *Barbara Esker (NASA)*

Barbara Esker gave an update on NASA Aeronautics efforts. She started by providing an overview of the drivers moving NASA Aeronautics and the overarching programs that comprise NASA Aeronautics. She provided the budget profile for NASA aeronautics and the goals for the coming years. She discussed how NASA has dealt with the COVID pandemic. The briefing covered details on work related to supersonics, vertical flight, subsonic transports, and hypersonic flight.

She provided an update on the work of the Low Boom Flight Demonstrator, including vehicle manufacturer, acoustic measurements, and community testing, and how these will feed the development of international standards in ICAO where NASA is working with FAA. She followed by providing information on the advanced air mobility (AAM) mission. NASA have been continuing to press forward on analytical efforts related to safety and noise from these vehicles.

Barbara continued with a presentation on the four technologies being developed for subsonic transport technologies, namely electrified aircraft propulsion, small core gas turbines, transonic truss-braced wing, and high rate composites. She then provided additional details on the electrified powertrain flight demonstration project and gave an update on the acoustic measurements done with Boeing in the ecoDemonstrator program. With respect to hypersonic flight, Barbara said NASA have started two studies to understand the potential business case for these vehicles. She concluded with a discussion on the NASA University Leadership Initiative.

The Chair asked if NASA are able to do work as many employees are operating remotely. Barbara said that work has slowed, but it has not stopped, and that the work is being done by small teams that can ensure social distancing. The result of this approach is progress, but not at the pace that was pre-COVID. The Chair noted that it may be useful for NASA to show the goals that have been pushed to the future. The Chair noted that the DFO could share this information with Shelley as a part of her request.

Presentation Noise Research | **Presenter** *Don Scata, Sean Doyle, Muni Majjigi*

Don Scata and Sean Doyle walked through the recently released FRN on noise research and the national environmental survey (the Neighborhood Environmental Survey – NES) that was summarized therein. Sean provided details on the survey in terms of why it was done, an overview of the methodology used to conduct it, a short summary of the results, and where people can find more information. He also discussed how the FAA is using these results and the next steps with the federal register notice.

A member said that she is very happy with the website for the NES and FRN and that the FAA did a great job in conveying the information to a variety of audiences. Based on a question, the FAA noted that the NES provides data but does not change FAA policy. Instead, the FAA is initiating a review of our policy.

Several members thanked the FAA for being responsive to stakeholders and communities in terms of providing extensive briefings on the NES and FRN.

Another member complimented the FAA for the quality of the work. He asked a clarifying question about what the FAA knows about aircraft relative to the exposed populations. The FAA explained that there are very strict privacy requirements that restrict access to the location of the people responding and therefore the link between flight position information and responders' reactions cannot be necessarily made.

The Chair asked about the relationship between the Noise Complaint Initiative (NCI), its noise portal and the NES. Don responded that FAA needs to work through issues surrounding privacy to determine what we can be done with both sets of data going forward.

A member asked about what we have learned about metrics and annoyance to help the FAA going forward. Sean responded that these results are causing us to reconsider the equal energy hypothesis, which says that total acoustic energy is what drives annoyance.

A member asked how the PBN introduction affected the results. Sean noted that the data were taken before PBN was introduced at some airports and further that the goal was to create a national curve to capture national data and not focus on the local airport.

A member asked if non-acoustic factors would be considered in additional research as noise policy is being considered/reconsidered. Sean noted that the NES did not show the non-acoustic factors as not being a contributing element, but more research might provide a better understanding.

Sean walked through the research to examine the health and welfare impacts of aviation noise. This included a summary of AEE's current efforts, the relationship between noise impacts research and policy, and some gaps that have been identified by the FAA in terms of this research area. This led to a discussion among the members.

A member asked about the work being done by Boston University (BU) and whether or not this data could be used to examine the impacts of noise exposure on what is happening with respect to the COVID pandemic. The FAA noted that this is an interesting idea and that they will talk to the BU team, but reminded that the pandemic has led, and will lead, to many changes and it may be hard to tease out the impact of aircraft noise and emissions. The member noted that one can overcome some of these challenges with big data and following people over time and that the FAA should invest in this now.

Some members discussed challenges they are facing in terms of community expectations. The FAA noted they are reviewing policy based on these results, and that they want input through the FRN, but we do not have a timeline. It will be important for everyone to remember that changing noise policy will not necessarily change the noise level for communities.

A member stated that the FAA is on the right path in their work on health and sleep, and asked if more funding could get the work done faster. She also asked if additional research is needed to do cost-benefit analysis. The FAA responded that additional funding could get things done faster but that not all of the work is limited by it as, for example, the work on sleep is limited by the OMB approval process. The DFO noted that they have set aside funds to address ideas that come from the FRN. He also clarified that cost-benefit analysis tools (APMT-Impacts) is based on housing value and willingness to pay data and does not account for health and sleep impacts of noise and so more work is indeed needed on this front.

FAA noted that we have a vision to get to quiet and clean aviation. This led to additional discussion on the need to ensure we have good tools to aid airports and communities in planning and development efforts.

A member continued the briefing by providing background information on noise to provide context to the discussions on unmanned aircraft systems and AAM vehicles. He provided information to spur discussion, which included a summary of the work FAA AEE are doing on Unmanned Aircraft Systems (UAS) AAM noise research and gaps that have been identified and need to be filled.

The Chair asked if we have good engagement with industry on noise and Don responded that the UAS office has good relationships with industry, but that we are still having challenges in getting noise data. A member noted that NASA is doing considerable work on getting acoustic measurements and is sharing these data with FAA.

A member asked if FAA AEE is working the Association for Unmanned Vehicle Systems International and Don said that they are indeed doing so.

A member noted that an intern from Georgia Tech had joined the FAA AEE to work on this field even though it is not in her direct area interest and she was very impressed. He added that the intern ultimately decided to do her thesis on a related topic.

The Chair asked the Members to reach out to the manufacturers to help AEE gather as much noise data as possible on these new vehicles.

A member asked that the FAA share these questions and the briefing materials on AAM/UAS with the researchers at NASA who are also working on this.

A member asked if the FAA could examine the NES findings that aircraft noise is more "annoying" than similar acoustic levels from ground traffic. She added that researching the "why" behind that might be useful and might also inform research for UAS and AAM. The FAA noted that this is not clearly supported by the survey results.

Muni Majjigi concluded the briefing by discussing aircraft source noise reduction technology. He provided a list of efforts supported by CLEEN and ASCENT to reduce noise and noted that these programs have enabled significant progress in aircraft noise reduction thus providing a solid foundation for needed reductions of the future environmental footprint. He concluded by covering current gaps in terms of research needs for subsonic and supersonic aircraft noise reduction.

A member noted that one area that the potential commercial hypersonic industry members have raised concern about is the overland boom. She added that they have brought together their supersonics specialist with the hypersonics experts to have conversation on that topic.

Discussion | Lead *Ian Redhead*

Based on a recommendation from the DFO, the chair opened the discussion on findings and recommendations.

A member stated there is a potential recommendation related to the impact of COVID as it is hampering the ability of industry to invest in new technologies and therefore there is a need for public private partnerships.

Another member noted that the FAA is leading efforts at ICAO on the development of a long-term aspirational goal for international aviation CO2 emissions. He added that the work of ICAO CAEP is getting more and more complex and that while the FAA is well positioned, they will need continued support.

The Chair noted that SAF are also important to capture in the recommendations, as are the UAS/ AAM vehicle. The Chair asked about participation of other agencies. The DFO and multiple members discussed it noting Environmental Protection Agency (EPA) is invited to all Subcommittee meetings. The DFO concluded by reminding that AEE collaborations with Department of Energy (DOE) and U.S. Department of Agriculture (USDA) will be covered the following day.

A member said that he would be interested in hearing what are the issues facing the FAA such that the Subcommittee can provide direction in areas where it is needed.

Another member noted that the FAA faces challenges on environment and the DFO highlighted that there are two major items that could shift the direction of the program. The first is the focus of the new administration on climate change and the second is the release of the federal register notice and noise survey.

A member stated that there could be opportunities that build on the Biden administration push for significant carbon dioxide emissions.

The Chair closed out day 1 at 5:35 pm.

END OF DAY 1

Presentation Emissions Research | **Presenter** *Ralph Iovinelli, Daniel Jacob*

Ralph Iovinelli started the briefing providing an overview of the work being done with respect to emissions research including emissions measurements and volatile particulate matter modeling. Daniel Jacob continued with details on emissions measurements, which will lead to improvements in the non-volatile particulate matter (nvPM) standard, and details on the volatile PM modeling effort. He noted that we have had substantial delays in the measurements due to the COVID pandemic but the modeling work is on track.

The Chair asked for details on the collaborations that are assisting the work on emissions modeling and Daniel said the FAA is seeking additional partners on the work.

He continued with a discussion on the development of an aviation specific dispersion model that could be used to replace AERMOD and the air quality monitoring and source apportionment efforts to support the model development. He also provided details on efforts that are underway to measure emissions in the area around Boston Logan Airport. The preliminary measurements started before the COVID pandemic and then the researchers started doing detailed measurements in April 2020 during the period of reduced aviation activity. The researchers will continue to do these measurements as economic activities resume post-pandemic.

A member asked if the road and air traffic can be distinguished. The FAA replied that most of the researcher's monitoring sites are away from major roads and highways do to minimize the road traffic emissions reaching the equipment.

Daniel also presented the ongoing efforts to examine the emissions from supersonic engines. He noted that this is complementary to work being done on noise and that they are both informing efforts at ICAO CAEP. He proceeded by covering the work being done to quantify the impacts of various sources of emissions in the upper atmosphere and went over the schedule for when the researcher's efforts would be incorporated into the APMT-Impacts tools. He then continued with an update on new work that the FAA is standing up to develop a contrail avoidance decision support tool and related efforts to evaluate the overall impacts of aviation induced cloudiness. He noted that he has already reached out to NOAA and NASA to collaborate with us on this subject.

A member asked about the altitudes that would be examined by the work of Project 78 and was curious if it would also cover the attitudes being used by business aviation and supersonic flight. Daniel noted that the work would start with altitudes between 20,000 and 40,000 feet as these are the primary regions where aircraft fly. In the future, the work could also examine higher altitudes. The member noted that this is very important work and he strongly supports it and was seconded by another member of the committee.

The Chair asked whether the work needs to have increased funding to overcome the delays that have resulted from the COVID pandemic. The FAA noted that the pandemic has resulted in the emissions measurements research costing more as it has taken much longer for people to be able

to meet in person to conduct the work. The Chair noted that this is something to share with Shelley Yak to help with her request on the impacts of COVID on the industry.

The meeting continued with Ralph covering the work that is being done to develop CO2 trajectories for domestic aviation. Based on a question from a Subcommittee Member, the DFO provided more information on the overall efforts of the FAA, both domestically and internationally, to examine the future trajectory of aviation CO2 emissions. These efforts are informing the work of ICAO CAEP on the feasibility of a long-term aspirational goal for international aviation CO2 emissions as well as domestic discussions on future emissions. The DFO noted that we have had great interagency collaboration on this subject. The Subcommittee Members all agreed that this is important work and they are happy to see the FAA working on it.

Ralph also presented work that is being developed to assess the lifecycle emissions impacts of AAM and drones. He stated that these vehicles have been projected to be a cleaner form of transport for people and goods and that the FAA will be asking researchers to use a combination of life cycle data and models to investigate trades with other forms of transportation to understand relative benefits.

A member noted that she thinks airports in non-attainment areas will initially be most interested in the use of AAM. There may be related elements that could be worked into the research and is something for the FAA to consider in its work.

Ralph concluded with a summary of the work of the emission program and to highlight the annual Aviation Emissions Characterization meeting which takes place every May.

Presentation Sustainable Aviation Fuels Research | **Presenter** *Nate Brown and Anna Oldani*

Anna Oldani started the briefing with a reminder that the FAA does work on testing, analysis, and coordination. She then covered the benefits of SAF use by industry as well as the challenges to SAF that need to be addressed.

The Chair remarked that it is great industry has continued to upload SAF during the pandemic and that it is a credit to the work done by this portfolio to reduce barriers to their use by industry.

Anna continued by providing an overview of the ASTM International fuel qualification process and the work the FAA is doing to support it, including the ASCENT Clearinghouse. She continued by reporting on the current status of different fuels within the ASTM fuel qualification process and the amounts of fuel and time that have been required to get fuel approvals. She noted that we have had ongoing conversations with efforts funded by the EU and the United Kingdom (UK) to mimic the ASTM Clearinghouse that was established by the FAA so to ensure that the new efforts are supportive and not duplicative. She provided details on the status of new fuel approvals through the ASTM D4054 process.

A member noted that ASTM D4054 is determining whether the fuels are safe for use but not whether or not they are sustainable. This led to additional questions on sustainability which the DFO suggested be discussed later in the briefing as the slide deck has more information on the topic.

Anna showed how the efforts of the FAA to streamline the ASTM process have led to reduced fuel volumes and time being required to get fuel approved. She noted that the CHJ fuel required

additional time relative to other fuels that have been recently approved due to the wide range of paraffinic molecules within it. She concluded the testing portion of the briefing by discussing efforts that could be done to develop fuels that could be blended above 50%.

Based on a question from a member, Anna noted that low aromatics fuels are better for the environment in terms of emitting less non-volatile particulate matter emissions.

Nate Brown continued the briefing by discussing the analysis portion of the SAF R&D portfolio. This included an update on the efforts of the ASCENT Project 1 team, including tool development and publications that are planned. He provided details on the work being done to support decision making within ICAO CAEP to support efforts related to CORSIA and the long-term aspirational goal development which includes efforts to develop life cycle emissions data, sustainability criteria, and future fuel production volumes.

Nate updated the Subcommittee on the multi-agency initiative to implement the Federal Bioeconomy Initiative, known as the Biomass R&D Board. This included efforts within the recently formed Advanced Aviation Fuels Interagency Working Group (AAF IWG) that falls under the purview of the board. He noted that the Federal Alternative Jet Fuel R&D Strategy from 2016 is forming the basis of the work of the AAF IWG, but the group will be reviewing this document to see if and how it should be updated. He noted that there is the potential for several new initiatives at DOT-FAA, DOE and USDA as there is a lot of interagency coordination right now.

Nate then shared information on U.S. SAF use and noted that in 2020, 4.6M gallons of SAF were procured in the U.S., which is a 190% increase over 2019. He provided updates on construction of SAF facilities in the U.S. and global announcements of new facilities. The announcements represent over 1 billion gallons of annual SAF production by 2025. Additionally, he gave an update on the goals and priorities of CAAFI as well as plans for future meetings, including a virtual workshop planned for June 2021 and an in-person General Meeting for June 2022. He concluded by noting that FAA are working to establish the development of SAF as a key DOT and U.S. climate priority and gave next steps to enable this to happen.

A member commended Nate and Anna for their excellent presentation, the extent of efforts, and how they are lining up well. He gave his praise to the work of CAAFI and stated that he supports continued funding of CAAFI from the E&E portfolio. Based on a question from the Member, Nate noted that the work on fuel production will assess the infrastructure investments that will be needed and the minimum selling prices for the fuels are being captured. Anna continued with details on what is being done to capture the infrastructure issues associated with the potential use of hydrogen by commercial aviation.

The Chair repeated his being impressed with the work and the increased uptake of SAF during the pandemic.

A member noted that some business aviation aircraft buyers are now requesting that their aircraft be delivered with SAF in the tank, which further shows the industry commitment to these fuels.

Presentation Analysis and Tool Development | **Presenters** *Fabio Grandi, Joe DiPardo, and Sean Doyle*

Fabio Grandi gave an update on analysis and tool development. This covered data and tools infrastructure development implementation, Tools Development (the Aviation Environmental Design Tool (AEDT), Noise Screening, and the Environmental Visualization Tool (EVT)), and the ASCENT Projects that are supporting these efforts.

He discussed AEE's renewed vision on sharing resources, which is very important given the high visibility of environmental issues and is supported by the FAA's new policies and infrastructure. He continued by covering how the efforts are providing consistency across the FAA by using common data and methods. He also discussed continued efforts on the plan for Technology Welding and Deployment (TWD) with respect to data and tool development efforts.

Mohammed Majeed continued the briefing by giving an update on the status of the AEDT3d release. The new version of AEDT will focus on AEDT maintenance and usability improvements. Joe DiPardo continued the discussion on AEDT by discussing how the AEDT development process is taking external feedback from the AEDT User Review Group. Mohammed continued with the development plans for AEDT3e, which will incorporate improved modeling for aircraft performance, emissions and dispersion, and noise. Joe concluded by covering the plan for the AEDT 4 series, which will be released in 2023, and how FAA are using a broad range of research projects to advance the tool.

A member thanked the FAA for improving the multi-pollutant modeling while another member stated her appreciation for the addition of supersonic aircraft and followed up by asking what is being done with modeling of AAM, which are anticipated to serve for city-center-to-airport routes. Fabio noted that this would be covered later in the briefing with the effort of ASCENT Project 9.

Sean Doyle walked through the efforts to develop a new noise screening tool. This started with an overview of noise screening and then he continued by highlighting the new capabilities and data that are available to the FAA for this purpose. He also shared the proposed process for noise screening.

Based on a question from a member, Sean noted that this new process would replace the existing means of noise screening. Based on another question, Sean stated that we will be sure to communicate how the results from this tool compare to full AEDT analyses that are used for other purposes, such as the development of airport noise contours.

Fabio continued the briefing with an update on the development of the EVT. The EVT is a web-mapping application that will enable its user to quickly and easily create customized maps using uploaded or built-in data layers. This will support FAA Environmental Specialists in viewing and creating customized maps to assess environmental impacts.

He concluded the briefing with short summaries of several ASCENT projects that are supporting the tool development efforts. He provided details on ASCENT project 9, which will develop a novel geospatially driven noise estimation module to support computation of noise resulting from the operation of UAS and other upcoming vehicle concepts. He quickly covered several other projects as well that will support the development and improvement of AEDT.

A member stated how important it is to manage large amounts of data easily and he gave kudos to the FAA team for their work.

The DFO noted that Fabio, Sean, and others involved in this effort have done a great job in handling issues that have come up with AEDT development, but the more impressive aspect has actually been their work to develop a long term vision in how the FAA could leverage data and analytical capabilities to address a wide range of environmental issues. The Chair agreed and thanked the speakers for their work.

Presentation Aircraft Technology Update | **Presenter** *Levent Ileri and Arthur Orton*

Levent Ileri provided a summary of the first two phases of the CLEEN program as well as the plans for the third phase of CLEEN. This included a summary of all of the technologies that have been matured by CLEEN, the status of those technologies that are currently being matured, and the impacts of the COVID-19 pandemic on the timelines for a few technology maturation efforts. He highlighted a number of accomplishments that the CLEEN program has achieved in terms of technology maturation and shared results from the Georgia Tech work to assess the benefits of the CLEEN technologies. He concluded the CLEEN Program portion of the briefing with an update on Phase III of the Program, which is in the contracting stage, and the details for the coming CLEEN Consortium Meetings.

The Chair asked if the COVID pandemic would affect the benefits from the CLEEN Program, and the FAA noted that the impact would actually be small as the benefits accrue in the decades to come.

A member asked about the timeline for CLEEN Phase III and Levent noted that we are moving well now. The DFO noted that we now have a great team working the CLEEN awards and we are optimistic about having an announcement in the Spring.

Arthur continued the briefing by summarizing the new work on technology that is being done under ASCENT and details on each of the projects that are in the ASCENT Technology Portfolio. He also shared information on the work of the LTAG-TG within ICAO CAEP.

Levent concluded by stating that (1) CLEEN Phase II is executing its fifth successful year; (2) CLEEN Phase III will continue our efforts to accelerate maturation of environmental aircraft technologies into the fleet (2020-2025) with awards planned for Q2 CY2021; (3) new ASCENT projects continue to expand our aircraft technology research portfolio; and (4) the program is continuing to support the CAEP LTAG work across several projects.

Presentation Operations for Reduced Noise | **Presenter** *Chris Dorbian*

Chris Dorbian provided an overview of the research FAA is doing to develop operational procedure concepts to reduce noise in the Boston area through the FAA-Massport Memorandum of Understanding (MOU). He discussed both the procedures that are being developed as a part of the block 2 proposals as well as the use of the N60 metric to understand how different airport communities would be affected by changes in procedures. He presented some of the takeaways that are coming from this research effort that are potentially transferable to other airports. Chris also discussed the effort by MIT under ASCENT Project 44 to collect aircraft state and noise

measurement data to support validation of noise modeling for advanced procedure concepts and help identify low-noise behavior that could be replicated. He concluded by noting that we are seeing increased interest in identifying opportunities to reduce fuel burn operationally.

A member noted that there could be some runway use changes that will be proposed for Boston, and the FAA should be on the lookout for these as they could affect the work.

Another member asked if third party perspectives could be useful in procedure design, whether the best path forward is tool development, data development or procedure development. The FAA noted that that is a big question and the trade space is actually larger than what is shown in the briefing.

A member asked about the implications of the work using the N60 metric and how its use will impact the longstanding effort to reduce the number of people exposed to significant noise. The FAA replied that we are thinking about how this metric could be used to address community concerns.

A member asked if moving flights over water is always a solution. Chris noted that it has advantages in the Boston area, but it is obviously not universally transferable. He added that it is very hard to reduce noise from any given procedure, but we do know we can distribute noise.

The DFO stated that there is more to be learned from tool development, data development and procedure development, but there may not be much more to be learned from the work in Boston.

A member offered to help get information on the use of noise abatement procedures at different airports.

Open Discussion | Lead *Ian Redhead*

The Chair thanked the DFO and the AEE team for their presentations and said that the work is great and that it showed in both this meeting and the previous one. He stated that the AEE team has given the committee all that was wanted and had gone above what was requested. The Chair added that he is always impressed with what is accomplished every six months. The Chair thanked everyone at FAA for the hard work and said he sees an opportunity to educate people about what has and is being done and to guide them in their work. He stated the overall overview will be used to educate the incoming administration on what is being done in terms of ASCENT, CLEEN and their partners.

A member gave praise to what AEE is doing, in particular during the COVID Pandemic and stated that these meetings always make him think about things differently. He noted that we are in a unique point in history for AEE and the industry where the industry is having a crisis of historic magnitude while there is also an administration that is willing to take innovative approaches. He continued by saying that in the pandemic we have an experiment wherein people have seen what life is like without air traffic – both good and bad. With the major environmental agreements coming together that will affect aviation, he was thinking how FAA AEE has a very strong foundation with a steady direction and wondering if the alignment and opportunities give us an opportunity to think bigger. Could a vastly larger CLEEN program push the envelope further on technology? While some require more resources, he would not want to miss an opportunity to think bigger since the current conversation is different from the normal one.

Another member seconded what the previous member said and discussed the need for more work in CLEEN to support future CO2 emissions reductions. He added that even with the current tumult, more research is needed and this new administration is interested in getting the data to set these goals and we need to see how we get to a clean future.

Another member said that she also agrees that now is the time to think big and broad and that FAA is not in this alone. She continued saying that while we know the power of collaboration across government, industry and academia we need to determine how to tell the complete story of technology development in FAA, NASA, and elsewhere: if done right, then the whole is larger than the sum of the parts. She then complimented Nate in his briefing and added that as part of the original interagency coordination found that working together gave so much more. She concluded that under the banner of thinking big, more can be done on environmental technology.

The Chair continued saying that he completely agreed that alliances and collaboration have benefited all. He added that the committee needed to draft something that says the committee knows where AEE wants to go, that research is needed to get there and that Smart regulations required good data and knowledge. He concluded saying that SAF requires progress on many streams as well.

Another member supported what others have said. He stated that from a policy level, the ambition of the new administration can be seen and that this Subcommittee welcomes it. He noted that these are difficult problems and that working together is how they are solved. He then added that in terms of technology development and the ambition of the US, the Subcommittee should cite what is happening in Europe given that they are making large investments as well.

A member commented that he is extremely impressed by the work and the portfolio is very balanced, continues to improve, and it is very hard to find holes in it. He continued saying the Subcommittee needs to convey that this group is doing great work. He added that in some regards the U.S. are in competition with Europe as they are looking to spend tens of billions of funding on aviation. He noted that a message needs to be restated, namely that AEE has a very balanced portfolio and that if provided with more funding they know how to use it. He concluded saying that the industry needs to remember not to go crazy on something like H_2 with limited potential.

The Chair stated that AEE has been doing much with careful management of their resources.

A member commented that while AEE have been making steady progress there has not been steady growth of the program. He then stated that the key message is that there is an opportunity in which proven investment strategy should be expanded to augment the progress that has been made. He concluded saying that it needs to be stressed that this is a proven program and they are ready to move faster.

The Chair added that the program is providing international leadership and that it needs to continue

A member commented that the direction of FAA is positive and that she would love to see something more ambitious with CLEEN as the industry is currently cash-strapped. She added that she is supportive of the comments and that the AEE should build on the great momentum that we have seen. She concluded saying that the noise portfolio and its direction are really good, but that the expectations need to be managed on what could change in terms of what communities will see in the near term as they can be impatient.

A member also supported what had been said and like the original member's intervention. He agreed that this is a unique time for aviation and we should take advantage of this moment. He noted that budgets are always a challenge and that the program needs to continue to have strong partnerships. He concluded stating that the Subcommittee should educate the new administration on the successes of the Program and the solid management that has been in place with it.

The Chair noted that the prioritization has changed and the FAA have responded to the committee's asks on looking at new entrants. He then asked if there are any other drivers that the Subcommittee needs to consider.

A member remarked that the recovery will affect how people get to the airport, which could also have impacts. She added that while the previous White House did not consider these issues important, AEE continued to do its work and not the program is ready to go for the new administration.

A member remarked that a great deal of the research goes to health and environmental impacts associated with emissions, but that he hopes everyone would agree that research to develop technologies to reduce emissions and noise helps that as well. He noted that to meet our climate goals aviation is going to need many technologies in addition to SAF and that these could help on the health front. He concluded saying that if the Subcommittee is looking at an expansion, then he hope it will focus on reducing noise and emissions and not on assessing impacts.

The DFO highlighted that the impacts work is a relatively small part of the portfolio and referred the committee to slide 24 of his Portfolio Overview presentation to demonstrate it.

A member commented that the FAA needs to maintain their leadership on energy issues, including hydrogen. With respect to the ASTM specifications, he remarked that the U.S. should have an active position on defining what is sustainable in terms fuels. On the topic of thinking bigger, he noted that potentially it will require thinking about things differently and also that the program will need to ensure the right metrics are in place to measure the success of the portfolio.

Following on the topic of measuring success the DFO shared the final slide of his overview deck as the program's rubric of success. Additionally he provided more information on sustainability criteria for SAF.

A member commented that hydrogen is a potent indirect GHG in its own right and that it is a very slippery molecule hard to keep from leaking and he offered to share more on this topic with the FAA. He then added that he agrees it is hard to do metrics on success, but that mapping the program into the national defined contributions for aviation CO2 emissions would be a great means to do so.

The FAA noted that the program reflects the dedication of the REDAC and that there is a need to figure out how to maintain the synergy for the environmental portfolio. He continued saying that FAA is one piece of a broader effort, a partnership within the USG and internationally, and AEE knows it is an important piece in the puzzle.

The Chair remarked that a variety of international entities have been reaching out about partnerships, which is helping ensure U.S. leadership. He added that people around the world see value in what AEE is doing and are working to partner, which he thinks is the right path.

A member added that if not for the US leadership, the work of CAEP would not happen.

In reaction to what one member said in linking the program to specific goals, a member noted that he would want to ensure that what can be delivered in the near term is not oversold. He stressed all should be clear-eyed about the level of challenge faced and while putting more resources to these programs can provide progress and is needed quickly, the uncertainties about the near-term results should be clear. He concluded saying that more resources are needed because of the degree of the challenge. Another member agreed that this was a good way of stating this.

A member noted to take a moment to imagine a CLEEN 3.5 with five times the funding of the current CLEEN Program, but with a trajectory that leads to a distinct improvement. He continued that he would want to ensure to take advantage of this moment to get onto the right glide slope for 2050, which would need a much larger CLEEN and a bigger partner in NASA. Several members agreed and the original member stressed that the Subcommittee needs to be explicit there is need for quicker action, that the recommendations are a conduit to the administrator, and that the opportunity will be gone soon. The Chair agreed that the window is here and it needs to be used to set the right trajectory

The Chair noted that a lot of good input was provided and that he will take it and put together the recommendations by the following week.

A member complimented and thanked the Chair remarking that virtual meetings on Zoom are tough, but this meeting was done very well.

The Chair concluded saying that he is always amazed by what he learned from these meetings and stated that he is happy and honored to lead this effort.

Meeting Close-Out | Lead *Ian Redhead*

Ian thanked everyone for their participation. The dates for the coming meetings were shared as was the deadline for findings and recommendations from the meeting (September 30, 2020).

Subcommittee Discussion of Open Recommendations (Discuss status of FAA response and decide to close or remain open)

All of the recommendations from the Spring 2020 meeting were left open.

Next Meetings – Date/Location/Agenda Items to be Included

September 14-15, 2021 (virtual - zoom)

March 22-23, 2022 (location/format TBD)

Adjourned at 3:30 pm on Thursday, September 17, 2020

Attendance

Day 1	Day 2
Alonso, Juan J.	Alonso, Juan
Alterman, Steve	Alterman, Steve
Borener, Sherry	Borener, Sherry
Bradley, Veronica	Bradley, Veronica
Brown, Nate	Brown, Nate
Cohen, Abby	Cohen, Abby
Dassa, Ira	Cowan, Durre
Delarosby, Beth	Dassa, Ira
Dipardo, Joe	Dipardo, Joe
Dorbian, Chris	Dorbian, Chris
Doyle, Sean	Doyle, Sean
Dudebout, Rudy	Dudebout, Rudy
Ehudin, Mark	Ehudin, Mark
Elmore, Eric	Elmore, Eric
Esker, Barbara	Esker, Barbara
Etter, Charles	Etter, Charles
Fleming, Gregg	Fleming, Gregg
Grandi, Fabio	Grandi, Fabio
Hamburg, Steven	Hamburg, Steven
Hawthorne, Rangasayi	He, Bill
He, Bill	Hileman, Jim
Hileman, Jim	Hobbs, Chris
Hobbs, Chris	Iovanelli, Ralph
Iovanelli, Ralph	Kosanchick, Melvin
Jacob, Daniel	Lancaster, Sandra
Kosanchick, Melvin	Majeed, Mohammed
Lancaster, Sandra	Majjigi, Muni
Locke, Maryalice	Mavris, Dimitri
Maijjigi, Muni	McKoy, Jenine
Majeed, Mohammed	Moores, Roxanna
Mavris, Dimitri	Murphy, Andrew
McKoy, Jenine	Oldani, Anna
Moores, Roxanna	Orton, Arthur
Murphy, Andrew	Pagliarello, Melinda
Oldani, Anna	Pitman, Brian
Orton, Arthur	Preston, Katherine
Pagliarello, Melinda	Price, Laura

Pitman, Brian	Redhead, Ian
Preston. Katherine	Riley, Rick
Price, Laura	Roundtree-Coleman, Chinita
Redhead, Ian	Sabnis, Jayant
Riley, Rick	Scata, Don
Roundtree-Coleman, Chinita	Tan, Sam
Sabnit, Jayant	Tan, Samuel
Scata, Don	Upadhyay, Jeet
Schliefer, Jon	Van Zante, Dale
Shaw, Cecelia	Vitagliano, Lauren
Summer, Steve	Wahls, Rich
Upadhyay, Jeet	Walker, Judith
Wahls, Rich	Welsh, Kevin
Welsh, Kevin	Williams, Dan
Williams, Dan	Wuebbles, Don
Wuebbles, Don	Zelina, Joe
Yak, Shelley	
Zelina, Joe	