Subcommittee on Environment and Energy | MINUTES

Meeting date & time *September 12-14, 2023*
Meeting location *Federal Aviation Administration Headquarters, Washington, DC*

Purpose	Develop strategic guidance for the FY2026 R&D portfolio
Facilitator	Fabio Grandi, DFO
Note takers	Fabio Grandi
Timekeeper	Fabio Grandi

Minutes from Meeting – Day 1

Presentation Welcome | **Presenter** *Fabio Grandi*

Fabio Grandi provided details on the logistics of the meeting. He then proceeded to introduce Laurence Wildgoose, the Assistant Administrator for Policy, International Affairs, and Environment for his welcoming remarks.

Laurence thanked the committee members for coming to the meeting and for their support and guidance to the work being done by the Office of Environment and Energy (AEE). He then proceeded to thank them for the input that was provided by the committee through their Finding and Recommendation and addressed a couple of concerns, namely staffing for the Office and current losses, and the length of time it takes to award grants for the ASCENT Center of Excellence (CoE). In his remarks about staffing, he noted that the office is proceeding as quickly as possible to fill the vacancies in the management positions. Regarding the grants process he remarked how DOT has taken steps to clarify and streamline the process and that will continue to work to make improvements.

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

Ian Redhead welcomed everyone to FAA headquarters and thanked for joining. He then proceeded with the roll call of the attendees of the Subcommittee meeting.

Presentation FAA R&D Update | **Presenter** *Eric Neiderman*

Eric Neiderman began the R&D update by addressing the issue of the FAA Reauthorizations and the budget. At this point the R&D office is hoping for the reauthorization to be passed while on the issue of the budget they hope for at least a Continuing Resolution. He followed by providing an update on the topic of Covid and noted that FAA operates laboratories and so people must be there in person. The discussion then moved to the topic of Advanced Air Mobility and he noted how the Government is approaching the integration of these new vehicles as a whole-of-government problem, which show its strong commitment. For FAA the primary goal in this

effort is safety, but in addition to that it is tackling the topics of global leadership, economics, certification, and environmental sustainability.

Eric then discussed the FAA's Research and Development (R&D) domain areas, and how the story is related to the outside public. He noted that this work helps ensure funding provided for R&D is properly allocated. In relation to that he then asked the committee to thing about the Strategic Outlook for Research (SOR) charts that were presented and discussed at the last meeting and how they are to provide the long-term view of the research to be pursued.

The Chair remarked that Unmanned Aircraft Systems/Advanced Air Mobility (UAS/AAM) have been one of the priorities for the last several years, and Eric noted that the issue has been accelerating and expanding. Ian then observed that there are challenges with the type of research needed on this topic and input is needed from industry, he also highlighted how airlines are now partnering with some of its members. Topics of serious considerations being certification issues and the interfacing with the National Airspace System (NAS).

Anna Oldani then asked about the Joint University Program at the Center and if there might be some overlap on research with other ongoing research activities. Eric explained that the program has been active since 1972 and involves NASA, the Massachusetts Institute of Technology, Ohio University, and Princeton University. He then concluded saying that the program holds reviews every quarter and that he will provide further information to AEE's Acting Chief Scientist.

Action items	Person responsible	Deadline
Provide further information about the FAA Joint University Program to Fabio Grandi.	E. Neiderman	Spring Meeting

Presentation FAA AEE Update | **Presenter** *Julie Marks*

Julie Marks started by providing a brief overview of her professional experience with FAA. She noted that over her career at the Agency she has covered a variety of positions at different Offices and that everywhere she went she was able to bring awareness of the environmental issues associated with aviation. She then addressed the matter of vacancies at AEE and provided an update on the process and status of the current hiring efforts. For staff position she also noted that the Office is looking to take advantage of the pool of talent being developed by the ASCENT CoE and bring in student as interns or full-time employees. She then remarked that she was thankful for those AEE employees that are currently performing multiple duties while the process of filling vacancies takes its course. Julie concluded noting that the office continues to work on the issues that are its priorities, which include continuing the work on further developing Sustainable Aviation Fuels (SAF) and environmentally advantageous technologies, the establishment of the Inflation Reduction Act funded Fueling Aviation's Sustainable Transition (FAST) grant program, and the research that is used to inform policy.

The Chair asked specifically how the search for a new Chief Scientist was progressing, to which Julie indicated that it was progressing, and it should be completed very soon. Ian then remarked that the AAM industry is growing very quickly with a lot of funding being provided to it and that FAA will therefore need to be ready for it. July indicated that the FAA Office of NextGen (ANG) is leading on that effort while the UAS Office is tackling that other sector. She noted that

work on AAM if further ahead and there are lessons to be learned on coordination, which our office has been acting on. Ian then continued that there is the need to make sure everyone is aware of ongoing research so that no duplication happens, and funds are maximized. Fabio concluded by remarking the Office will make sure it is made aware of activities by other offices and that it is also integrating across the government especially on AAM. Sabrina Saunders-Hodge intervened by assuring the UAS shares research information with the AEE office.

Presentation NASA Update | **Presenter** *Jim Heidmann (NASA)*

Jim Heidmann began by introducing himself and providing some information about his background at the Agency and noting that they have had a lot of people in acting roles for a while as well. He then proceeded to introduce his colleague Jesse Quinlan and provide some of his background.

Jim began his presentation by giving an update on NASA Aeronautics efforts. He started by covering the 3 mega-drivers for aviation: global mobility, sustainable aviation, transformative technology research and the strategic thrusts that guide the work of NASA Aeronautics. He noted that the presentation will be focused on the 3 thrust related to the vehicle. He touched on the four missions noting how managers make sure to work across missions and remarked how on the issue of AAM NASA coordinates substantially with FAA. Lastly, he covered the NASA FY24 budget and the foci of the various divisions under Aeronautics.

Jim continued his presentation by providing an overview of the Quesst Mission, which is focused on building an aircraft the is representative of future vehicles and support assessing technologies that could result in acceptable sonic boom signatures. The project is progressing on 3 concurrent Phases, which Jim briefly outlined. Phase 1, aircraft development, is in progress, but with some risk on the schedule for the first flight. Phase 2, acoustic validation, is working on the ground and airborne measurement capabilities while Phase3, Community Response Testing, is working on the community survey and on how to avoid bias. Work is also ongoing on the international area at the International Civil Aviation Organization (ICAO) Committee on Aviation Environmental Protection (CAEP) with coordination on proposed en-route standards and potential international test collaborative framework. Research is continuing Landing and Take-Off (LTO) noise to ensure it meets acceptable limits. They are using both wind tunnel and some flight testing to look at jet and fan noise to improve modeling tools with an update expected in October.

Jim touched on NASA's work on AAM, which has a strong focus on safety. He noted that they also have a lot of expertise in both design and noise and then provide an overview of the objectives of the work. Jim then provided an overview of the Revolutionary Vertical Lift Technology (RVLT) by touching on the 5 different aspects of the program with recent progress being focused on safety aspects and informing tools. Lastly, Jim covered the work being done on subsonic airliner technologies by providing an overview of activities and schedule.

At the conclusion of the presentation Sandy Lancaster asked if the survey being conducted by NASA was focused only on the supersonic boom, which Jim confirmed. Dave Senzig then asked about the limits of the Transonic Truss Braced Wing design and Jim replied that they might require folding wingtips and that NASA is thinking of building a smaller aircraft.

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

Dan Williams started by providing a status summary of the ICAO work and the role of CAEP. He continued by highlighted the upcoming Third ICAO Conference on Aviation and Alternative Fuels (CAAF/3), an outcome from the assembly of FY22 on framework on SAF development. He noted that while the conference might be taking place too soon, it will provide an opportunity for everyone to further focus on SAF and send a signal that might help shape of investments and support international collaboration. The U.S. is already furthering such collaboration through the FAA ASCENT Center of Excellence Project 93, which has the goal to share knowledge and expand collaboration. Dan then touched upon the CAEP activities, how Kevin's departure has created some issues, how the Office if working to get Julie Marks officially named as the CAEP member, and then provided a summary of the CAEP activities. The REDAC Chair asked what has happened to the CAEP chair position that was held by Kevin Welsh and Dan replied that CAEP agreed to have Urs Ziegler from Switzerland come back as the chair for this one meeting since the two co-chairs did not express an interest in taking the position.

Dan continued his presentation by discussing the Dual-stringency work being conducted under CAEP and how currently the biggest issue is the sanctions against Russia because of their effects on data sharing. However, he noted that the situation will be resolved very soon as these sanctions will be made to no longer apply to CAEP activities. He continued by explaining how the upcoming second Steering Group meeting (SG2) is a status check on activities, noting that ICAO will be needed to set up AAM standards, and remarking that effort have began on setting up the work for the next cycle. Dan concluded his remarks by provided an updated on the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and noting that the U.S. have not yet fully implemented CORSIA since it only has a voluntary reporting program out to 2026, but not a regulation to require offsets yet.

Andrew Murphy asked about New Type certification given the challenges with work and data restrictions leading to some questions. Ralph Iovinelli remarked that the input package is offered before the output are provided. Members have also made clear that New Types are most important. Andrew than ask a clarification of what makes a New Type to which Ralph replied that Certification experts are now rethinking how that is considered based on how manufacturers are updating their types. New updated rules might be required based not only on the technology but also the time and number of changes being done. While industry confusion might be understandable, a new line between derivative and new needs to be set. While these topics are being addressed, there is no final answer yet and more information can be gathered by talking to aircraft certification people. Ralph then concluded by stating that he will provide Andrew with the appropriate Point of Contact.

Action items	Person responsible	Deadline
Provide Andrew Murphy a Point of Contact for aircraft certification information.	R. Iovinelli	Spring Meeting

Presentation Industry Perspective | **Presenters** *Melinda Pagliarello and Brandon Graver*

Melinda Pagliarello began her remarks noting that a lot NEPA work is being done and that it is causing a lot of frustration and that there is an increase in attention on sustainability from the point of risk when getting capital. PFAS also continues to be a big issue for airports, and they are waiting for DOD and remediation requirements. On the topic of electrification airports are tackling with fire suppression requirements and requirements for structural elements for parking garages since Electrical Vehicles (EV) are much heavier.

Sandy Lancaster joined the discussion by remarking that there has been an incredible growth in passengers, that there have been so many regulatory changes right in the middle of the NEPA study, and that monetization of the social cost can be big number that raise concerns with the legal groups. She then noted that her airport just kicked-off a new electricity plant that will help towards their goals and a new project looking on the requirements from the electrification of rental cars. Ralph then asked if that meant airports would want to bring power generation at the airport to which Sandy replied that they are adding a new substation trying to be 100% renewable (from wind) and looking at solar. She then added that right now they are trying to optimize the use of boilers as well as chill water off peak hours, and in general, looking at the problem wholistically.

Melinda continued remarking that all airports are looking to increase their available power using different approaches. Ian added that at his airport they are investing into solar panels and now have multiple feeds from different sources. However, Missouri does not buy back the energy, so that is not an incentive to solar panels, but not all States approach this aspect the same way. On PFAS he added that the states are the ones that will need to specify what remediation is required, for example how to clean the trucks, to which Melinda remarked that she worked with the EPA APO but that there is no unified approach, and that DOD requires a single rinse because FFF still needs to be contained.

On the topic of sustainable energy Ralph asked if the FAA guidance on installation has been useful and if it needs updating. Ian replied that they had to consider it when installing system and Melinda added that she has not heard of any concerns. Katherine Preston noted that her company has helped airports and that there is an update. She also added that they have been hearing about interest in more information on health research, carbon removal technology, and energy and infrastructure issues as they pertain to AAM. Jim asked if airports are thinking about liquid Hydrogen. Melinda stated that she has spent a lot of time on this and has been watching what the Europeans are doing, which showed that it is an extreme challenge. Boeing also talked about a non-drop-in and the concern is about having to add an additional fuel farm and the related power needs challenges. Ian noted that infrastructure requirements are very concerning from the point of view of safety and that starting to look at such infrastructure is further out. Melinda then added that hydrogen aviation also poses operational challenges, but that it could be used for powering supporting equipment, like in cold climates. Anna chimed in noting that eventually transitioning to non-drop-in fuels is important in order to move away from aromatics and that airports should start to understand where changes will be needed to accommodate those fuels. Melinda concluded the discussion remarking that this is a good topic for office of airports as that infrastructure should be AIP eligible.

Brandon Graver continued the session by providing the Airlines' prospective on several issues. He started that they are interested in the issue of PFAS and that of the electrical infrastructure, on the latter noting that not all equipment is equal. On SAF he remarked about the excitement about the new FAST-SAF grant program and how they want to leverage SAF and that its availability will have to be brough up to scale. He also added that they recognize the importance of the Department of Energy (DOE) Greenhouse gases, Regulated Emissions, and Energy use in Technologies model (GREET) and that its data and computations must be kept up to date. Brandon than noted that Non-CO_2 emissions are getting a lot of attention from both the airlines and the public and that continuing research on the topic is important as that is the next step towards sustainable aviation and continues to have collaboration by the Airlines. Funding should also be provided to the development of new technology to reduce fuel burn and noise, especially given that the MAX and NEO aircraft are now being delivered. He then concluded by remarking that it is vital for the Aviation Environmental Design Tool (AEDT) model to include the most up to date data.

Jim continued the conversation by remarking how data on contrail is needed and Ian asked why the topic is now so popular. Ralph responded that we now understand what causes their creation and also how we better understand what makes them persistent. This gives us even more incentives for the development of SAF and of radar technologies that could be used to detect supersaturation in the atmosphere in order to avoid their formation in the first place. Now we understand that only 10% of contrails are a problem, which represents a significant change in scope that makes a solution closer in reach. The growth in interest on the topic by the public is simply because of the increased awareness of climate change.

Presentation FY24/FY25 Budget Update | **Presenter** *Tennille Blackwell*

Tennille Blackwell began her presentation by covering the reviewing the FY 2023 budget. She then continued by providing an overview of the FY 2024 House appropriations and especially highlighting for the committee that the two Environmental budget line items (BLIs) have been reduced to zero. Her presentation continued with an overview of the Senate appropriations, in which she highlighted that this version the two Environmental budget line items are somewhat lower than the request in the President's Budget but matching exactly the FY 2023 numbers. Here she also covered the additional Senate language associated with the two BLIs which specifically sets aside funding for both ASCENT Center of Excellence and the continuous lower energy, emissions, and noise (CLEEN) program and provide direction on their use. Tennille concluded her presentation by reviewing the FY 2025-2029 targets as currently envisioned and reminding that the FAA Reauthorization is set to expire on September 30, 2023.

Presentation Responses to REDAC Recommendations & Actions | **Presenter** *Fabio Grandi*

Fabio Grandi stepped through the slide with the records of actions from the last meeting. He reported that the first three actions had been completed. The action that had been assigned to Dr. Jim Hileman at the prior meeting was instead still pending and it was decided that it would have

to be resolved by the next meeting[1]. Lastly, Fabio noted that the action to invite DOE's Bioenergy Technologies Office (BETO) was underway and a presentation will be provided at the next meeting in the Spring.

Action items	Person responsible	Deadline
Extend Industry Prospective agenda item to 30 minutes	F. Grandi	Closed
REDAC sub-committee members please provide feedback on SOR questions posed by Eric Neiderman as they relate to the E&E SOR chart	E&E Committee	Closed
Clarify statements pertaining to the results on noise and sleep derived from the NHS data	D. Scata	Closed
Send OSTP document/link to REDAC participants	J. Hileman (Now F. Grandi)	Pending[1]
Invite Jay Fitzgerald to the next meeting to provide a presentation on DOE's work	F. Grandi	In progress - Participation secured for the Spring meeting

Presentation E&E Research Update | **Presenter** *Fabio Grandi*

Fabio Grandi started his briefing with background information on the Office of Environment and Energy (AEE), including highlights on its organizational changes and updates on its staffing. He then provided an overview of the overarching Environment and Energy (E&E) Strategy guiding the E&E R&D Portfolio, its research domains, the integration between Research and Development (R&D), data and tools, and a summary of recent successes.

Fabio provided a summary of the current and expected upcoming funding by budget line and an overview of the type of activities funded by each. He followed with several highlights from the ongoing R&D program across all of the areas that will be presented during the meeting and then switched focus to the individual divisions.

[1] The report that is the subject of this action is the White House Office of Science and Technology Policy (OSTP) report on the National Aeronautics Science & Technology Priorities, which can be found at the following link: https://www.whitehouse.gov/wp-content/uploads/2023/03/032023-National-Aeronautics-ST-Priorities.pdf

Fabio started with the activities under the Noise division (AEE-100) by providing a list of the current staff and followed it with a brief high-level description of the current concerns related to aircraft noise, how it evolved and changed over time, and how the Office is currently performing a comprehensive review of its efforts on the topic. Lastly, he updated the committee on the activities directed towards addressing Unmanned Aerial Systems (UAS), Advance Air Mobility vehicles (AAM), supersonic civil, and helicopters.

The Technology and Operations division (AEE-200) was covered next starting with a list of its members. The presentation then focused on the importance of technology evolution in the context of the expected long life of the vehicles in the fleet and how FAA, NASA and industry have established the Sustainable Flight National Partnership (SFNP) to accelerate the maturation of aircraft and engine technologies that enable a step-change reduction in fuel burn, emissions, and noise.

This was followed by the introduction of the Emissions division (AEE-300) staff and a summary of the efforts being undertaken to understand, reduce, and mitigate aviation emissions. The presentation continued by addressing the Eliminate Aviation Gasoline Lead Emissions (EAGLE) program, which has the goal to eliminate lead from aviation fuels for piston-engine aircraft, and concluded by touching on the potential mitigation measures for aviation induced cloudiness, what are the issue that need to be weigh in their implementation, and an overview of the ongoing efforts by the FAA as well as other domestic and international entities.

The portion dedicated to the individual divisions concluded by covering the new Energy division (AEE-500) and its staff. The presentation focused on the evolution of the aviation goals on addressing Climate Change and an overview of the projected domestic and international aviation CO2 emissions out to 2050 and the relative contribution of each available mitigation measure to meeting the net-zero goal by 2050. It was then followed by an overview of the SAF grand Challenge roadmap and the kay activities the AEE office is undertaking to build the foundations necessary to enable the scaling up of SAF production to the level required to meet the grant challenge goals.

Fabio then shift the focus to the ASCENT Center of Excellence (CoE) by first providing background information about the CoE and highlighting key metrics showing its performance since its inception. He followed by listing the centers ongoing projects grouped by topic and highlighting which projects were concluding and what projects were going to start with the upcoming round funding. Finally, he listed the status of approval of the FY 2023 and upcoming FY 2024 packages as well as the ASCENT meetings schedule.

The presentation concluded with the review of the upcoming presentations and the acknowledge of the staff in the additional AEE divisions (AEE-5 and AEE-400) that provide the R&D program with extremely valuable support.

Presentation Sustainable Aviation Fuels Research | **Presenter** *Anna Oldani and Prem Lobo*

Anna Oldani began the briefing by provide a high-level update on SAF related activities and followed with highlighting opportunities and challenges. On the latter topic she highlighted the issues of infrastructure, feedstock supplies, and bland limit. Jim asked if we are looking at land use and Anna responded that we are working with the U.S. Department of Agriculture (USDA) and DOE. She concluded with an overview of the FAA SAF program foci on testing, analysis, and coordination and how these activities are integrated in AEE's other activities.

The discussion then moved to testing and the status of activities in the ASTM process. Anna reported that the Swedish Biofuels fuel is currently slated to be added to Annex 8 at the June meeting and that Global Bioenergies' fuel based on new feedstock isobutane will be added to Annex 5. She noted that D1655 covers conventional fuels so new feedstock for co-processing go there and that for the IRA tax credit only Fischer–Tropsch process is called out, something that certain SAF producers are against. She concluded the topic reporting that the other fuels currently under testing are moving along through the process. Lastly Anna highlighted the work being done under project 88 on the impact of SAF on materials; project 89 looking at the fuel Dielectric properties, which are key for the proper functioning of fuel gages; and then project 90, that aims to survey worldwide fuel composition starting with the U.S. which is important because airlines use it for their planning and the survey was done in 2006. On the latter Brendon enquired on the expected timeline of the work to which she replied that the data should become available in the first half the next year. Jim than asked how quickly fuel composition can change over time and she responded that it can happen very quickly.

Prem Lobo continued the presentation by first touching on the topic of Analysis and the work being done under ASCENT project 1on SAF supply chain analysis. He remarked on the types of analyses being performed as well as all the work to support ICAO's Fuels Task Group (FTG) and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) implementation. He then moved on to cover ASCENT project 93, which aims to establish a collaborative research network for global SAF supply chain development. He noted that that while it started only at the beginning of the year a lot of work has already being done. The project works operates in collaboration with the World Bank to provide support with scientific and financing questions. Its objectives are to look at global feedstock availability, production optimization, infrastructure and logistical requirements, and to work with universities and students in the regions of interest to extend supply chain analysis techniques and tools (and training modules). Work to date included a very successful workshop in Bangkok and one in the Dominican Republic, which provided many insights that will be incorporated in the upcoming training materials. He then concluded that there will also be a workshop in Kenia this week.

Anna followed on with a discussion of the ongoing coordination efforts within ICAO, domestically, and with industry. She began by providing a summary of the FTG subgroups, which in most cases have FAA or DOT co-leads with EU or Brazil as the other co-leads. Ongoing work has been on Core Life Cycle Analysis (LCA) with very specialized and difficult to replace support being provided by resources under ASCENT. She then concluded with a review of coordinating activities.

Prem moved the presentation to the domestic activities under the SAF Grand Challenge (SAF GC). He gave an overview of the timeline and aims noting that task credits help spur activities.

He then provided more details on the SAF GC covering the roadmap structure, the federal implementation approach, the website, and next steps in the work.

Anna followed by touching on the coordination under the new SAF Lifecycle Working Group which provides the technical expertise needed for questions on blender tax credits and works with DOE, the Environmental Protection Agency (EPA), and the Treasury department.

Prem continued the discussion updating the committee on recent activities under the Commercial Aviation Alternative Fuels Initiative (CAAFI). He then discussed the latest data on SAF procurements, the potential for the Tax Credits to result in a significant ramp up, and a review of the projected growth of future production based on a conservative assessment of announcements.

Anna concluded the session by covering the Tax Credits established under the Inflation Reduction Act (IRA) and providing details on the Blenders Tax Credit (BTC). She then reviewed the SAF focused component of the Fueling Aviation's Sustainable Transition (FAST-SAF) grant program also established under IRA in section 40007. Lastly, she reviewed the challenges associated with SAF which include production cost, qualification, blend limits, sustainability, and incentives all of which are currently being addressed in the appropriate fashion.

The Chair asked if there is a list of consumers and Anna replied that the information is not liked to the actual purchasers. Jim then asked if the fuel goals reflect fuel burn improvements, to which Anna replied that they are.

Discussion Findings & Recommendations | **Lead** *Ian Redhead*

The Chair began the discussion about the Finding and Recommendations by touching on the topics of most interest starting with SAF, global leadership, and public/private partnerships. On the topic of grants processing Ian noted that to date there has not been progress on the latest package of ASCENT grants and that things are still taking too much time. The length of the process is a concern for the upcoming FAST grants program also because it is a highly scrutinized Tier 1 program. On the topic of UAMs and commercial space integration in the NAS, he remarked that the research needs to be expedited as these two areas are growing quickly. The Chair then touched on the topic of the collaboration with NASA, noise, and dual stringency. He concluded by noting that findings need to be actionable and that they should also add something about Kevin Welsh's departure as the Director of AEE as well as the retirement of Steve Alterman from the position of President of the Cargo Airline Association. Sandy Lancaster then added that the committee should also add a remark about the way AEE has handled the changes in its leadership even while being short-staffed.

The Chair closed out day 1.

END OF DAY 1

Minutes from Meeting – Day 2

The Chair started Day 2 with a quick overview of the agenda.

Presentation Aircraft Technology Research | **Presenters** *Arthur Orton and Christopher Dorbian*

Arthur Orton opened the session by providing an overview of three Phases of the CLEEN program followed by a discussion of the technologies include in the second phase. The Chair asked if the Fuel Burn (FB) goals are in addition to those from the prior phases and how they related to the CAEP requirements. He remarked that in the next presentation the relationship to the reference should be clear in the slide. Arthur then reviewed the work on the assessment of the CLEEN technologies benefits performed by Georgia Tech. Ian commented that the accomplishments should also be shown where possible. Ralph noted than reminded the group that those gains do not result only from CLEEN technologies since the Original Equipment Manufacturers (OEM) also added technologies of their own development. Mark Ehudin remarked that GAMA would be willing to inform Congress of those gains and that any data they could cite would be very helpful. Arthur added that the chart on Fuel Burn savings is important also because it shows the whole picture.

Arthur continued with a review of the CLEEN III program status and accomplishments. He noted that the program has a very good synergy with the ASCENT schools, that it is an exciting time of the program since it is moving into the fabrication of prototypes, and that they are making sure all the technical risks are identified so that the technology will be viable more quickly. He then covered how Phase III is being expanded by exercising its options and that if the FY 2024 budget remains consistent, they will finish Phase III and start Phase IV, for which we the Office is currently doing a market survey and planning on the solicitation.

The discussion then moved on to an overview of CLEEN Phase IV and how new partners could be also added. Arthur described how while it has similar scoping to prior phases in terms of having individual goals and aiming to advance SAF, the order of preference has, however, changed from the Noise, FB, Nitrogen Oxides (NO_x), Particulate Matter (PM) priority order of Phase III to FB, Noise, NO_x, and PM. He also noted that the Energy Efficiency/FB Reduction Goal has been expanded to say "and/or reduce aviation's climate impacts", the NO_x Emission Reduction Goal now includes "and/or reduces absolute NO_x over the aircraft's mission" in order to recognize the importance on cruise NO_x emissions, and that the PM Reduction Goal now provides a stated target since the new standard is now in place.

Arthur continued his presentation by covering the ASCENT projects focused on Technology. He provided an overview of the ongoing projects and then highlighted the new Fy2024 projects focusing on use Fuel cells on BizJet to reduce fuel burn (95); looking beyond the 2050 timeframe and include projected fleets, vehicles, missions, and demand (96); Assessment of the FAST-TECH grants program technologies (97); and the General Electric (GE) technology to reduce Non-Volatile Particulate Matter (nvPM) which is an evolution of ASCENT project 74.

Christophe Dorbian began the session on the FAST grants program by providing a summary of the program and funding, giving a description of the details of the program as set forth in section 40007 of IRA, and addressing how the work under this grant program will be complementary to the Office's current activities under ASCENT, CAAFI, and CLEEN. He then focused on the

details of the technology side of the FAST program (FAST-Tech) by providing an overview of its specifics and the range of potential projects that it could cover.

Arthur then address AEE's current effort on interagency coordination with NASA and the Department of Defense (DoD), specifically noting appreciation for the tight coordination with NASA. An action was called out by the group to add a bullet covering inter-agency collaborations to the AEE Tri-fold. He then provided a summary of the technology programs, describing the differences, how they are complementary, and how FAST is limited in focus to only FB and CO_2 emissions. He then concluded the presentation with a set of final remarks.

The Chair asked confirmation that CLEEN has to meeting per year, which was confirmed, and Juan Alonso asked in moving to CLEEN IV there is room to broaden the Technology Readiness Level (TRL) as it would help with maturing lower-level technologies. Arthur replied that the level selected depends on the projects and that the bounds are not fixed to which Juan responded that he like the new phase includes climate impact and that was why he was thinking of a lower TRL target. He then asked if there a reason why the projects are targeted to 5 years and if shorter projects could be staggered. Chris responded that while that is a good point there are some contractual reasons for the selection of the participants at the beginning of the 5 years, but that options can be added to the contract. Juan followed by asking how the Office is faring in managing all the programs and the new FAST with the limited staff, to which Arthur replied that AEE is in the process of hiring and that in the meantime we are also working across the AEE-200 and AEE-500 divisions. Juan concluded remarking that the office should also advertise all the work being done under the CLEEN program. Lastly Steve asked how will we ensure that work under FAST is not duplicative and will not counteract efforts in other areas, to which Arthur replied that the AEE-200 team will make sure of that.

Action items	Person responsible	Deadline
Add a bullet covering inter-agency collaborations to the AEE Tri-fold.	F. Grandi	Next Release of the AEE Tri-fold

Presentation Addressing Climate Impacts in Cruise via Operations, Technology & SAF| **Presenters** *Nicole Didyk-Wells and Chris Dorbian*

Chris Dorbian began the session remarking how project 58 showed the impact of full flight emissions (CO_2, Non-CO_2, and NO_x) on both Air Quality (AQ) and the climate. He discussed how the primary contributors to radiative forcing are CO_2 and cirrus clouds formed from condensation trails (Contrails), but noted the latter has a larger uncertainty range given that with Aviation-Induced Cloudiness (AIC) the magnitude and sign of the impact depends on many variables and can last between minutes and hours (as opposed to centuries as with CO_2). He then continued by covering what is FAA doing to understand & mitigate the impact of aviation contrails on climate and by discussing how SAF might provide an overall benefit depending on the balance between the lower aromatic content, more water vapor, other nvPM that might be produced, which is being investigated.

Nicole Didyk-Wells too over the discussion by cover the work currently being done under ASCENT project 2 which is looking at nvPM, PM, and NO_x testing starting at combustor level

and all the way to in-flight. She discussed how based on test results in Europe newer technologies and SAF might be producing more contrails and how maintenance oil might have a big impact. Since sulfur content is very variable in fuels project 2 we will look at very low sulfur fuel (10ppm), although ASTM at 100ppm. Since contamination along the process might also affect the results, with the wing being especially difficult to clean, the team is also developing new protocols for the testing. The project also aims to use 100% SAF to really understand the benefits, but it will need approval from OEM and the Airlines involved. Joe Zelina as whether just 10ppm of sulfur could be causing the increase showed in the results and Nicole replied that the team is working to do testing at all levels to see were things change along the way and that it will also be able to look at the differences in engine operation both on the ground and at cruise.

Nicole then began discussing the measurement campaign starting with how the ground emissions measurements will now be taken much closer to the engine (as opposed to more than 30m as before). Flight emissions measurements will be difficult to schedule as the old DC-8 test aircraft is being retired and the new 777 will take some time to come online. In flight near-field measurement will also be difficult as some chase aircraft cannot keep up with the test aircraft; however, Canada has an aircraft that can provide such capabilities, but it is not available yet as it needs a new ejection seat. Joe then noted that because of the speed issue the testing will have to be performed not under the optimal engine conditions.

She then continued the conversation focusing on the current campaign noting that it might be affected by the government shutdown. Nicole discussed how testing will use blends that will be the same SAF at different bland levels with the DC8 running on JetA. Jayant Sabnis then asked why there is all this interest on contrails since there a large uncertainty and the duration is short to which Nicole replied that most of the world sees them and are concerned and that aviation ca address their formation without affecting fuel burn. Jim remarked that future electric engines will allow using the right engine at the right time and Juan added that while there is uncertainty the large impact is potentially there. Joe noted that only 10% of contrails have a negative impact and Ralph added that this problem is becoming less uncertain as we gather data and improve our understanding and that DOE is investing significant funding on predictive technology that could be used to foresee where contrails will be formed. Jim then added that we need to drive down uncertainty and then find the solutions. Brandon remarked that Europe is pushing this issue and airlines want more out of the US government to make sure we have very good predictions given that to them unnecessary avoidance rerouting would mean burning more fuel. Nicole then added that Europe is thinking about charging for contrails, but we do not think we know enough to take such an approach and that our testing will use humidity sensors to get the data to validate the models and reduce the uncertainty band.

Nicole than moved on to contrails modeling and tools starting with an overview of the workplan for project 78 which aims to develop the Contrail Avoidance Support Tool (CAST) that could help airlines with their flight plans. Brandon than noted that A4A has talked to other people doing the same sort of modeling activities and Nicole replied that FAA participates to the taskforce and are working with the German Aerospace Center (DLR) to setup a data exchange, but that the Massachusetts Institute of Technology (MIT) tool is different than the DLR's in several methodologies including that it does not use a gaussian distribution in plume formation, which is a fundamental difference. Nicole then concluded the topic by covering MIT's Aircraft Plume Chemistry, Emissions, and Microphysics Model (APCEMM) which will be the basis for the Contrail radiation module.

Chris continued the presentation discussing the operational implications of contrails avoidance starting with participation in multiple different groups to understand the different models. On important aspect is the role of Air Traffic Control (ATC) and AEE has started outreach with FAA's Air Traffic Organization (ATO) and ANG to initiate more focused coordination efforts as MIT has developed a proposal for a trial. He then ended by noting that there is a new ascent project aimed at improving fuel efficiency in coordination with Georgia Institute of Technology (GT), ANG, and Delta Airlines.

Nicole concluded the session by covering collaboration with other agencies and how the Office is coordination meetings to create a summary document that lays out where each agency is working and where more coordination is needed.

Presentation Emissions Research Activities | **Presenter** *Ralph Iovinelli*

Ralph Iovinelli started the briefing by showing the overall structure of the emissions research roadmap and then moved to addressing specific topics. He began by discussing Micro-physical modeling of volatile PM (vPM) noting how the goal is to update and validate the First Order Approximation 4 (FOA4) Volatile Particulate Matter Modeling Methodology that will be implemented in AEDT and included in ICAO Doc 9889 and how the work is leveraging the very sophisticated model developed by Aerodyne. He then touched on the work being done under ASCENT project 69 on the validation of the nvPM mass calibration methodology which aims to increase accuracy and reduce the cost of the measurement systems since annual calibration, which is very important for the data quality, currently is expensive and takes a lot of time.

Ralph followed that with an overview of the dispersion modeling and research being performed under ASCENT projects 19 and 18. Under project 19 the office is working closely with the EPA to improve their model to add plume rise in aircraft modeling, which will be available in beta version by October or November and will be later become EPA's official version. Under project 18 measurements that had been performed captured the reduction due to covid and then the resuming of the operations back to normal, which made clear the aviation contribution. The final report is currently being written and the data shows the effects of aircraft operations on surface concentrations. This information has been shared data with the Massachusetts Port Authority (Massport) and the communities, but it will also help clarify aviation's contribution around airports in general, which will be helpful given the ongoing lawsuits on Ultrafine particles (UFPs) around the country. The data will also help with modeling validation and future work will include performing the same research at different airports (Dulles Airport being one) and using drones to do some of the measurements in the flight path.

Next Ralph discussed the Office's research on the impacts of high-altitude emissions. He touched on the work under ASCENT projects 58 and 22 discussing how we are undertaking an initial effort on detailed modeling for rocket operations in collaboration with NASA. For project 58 NASA provided the model to be run alongside GEOS-Chem and collaborated on the scenarios to be run, with the results being ready by REDAC's spring meeting. He continued by covering projects 91A and 91B which are looking at 4 scenarios and different propellants to assess their impacts on climate, which is important given that the sector is growing fast. Ralph then concluded by reminding the committee that additional areas of research and collaboration are covered in the backup slides section of the presentation, noting that project 74 is now looking

at the subsonic application of the low emissions premixed combustion technology, and that we are also looking at AAM in terms of LCA of emissions, even if they do not emit directly, and that at a later date we could also provide input on the impact of hybrid vehicles.

Ian then asked if given that batteries' useful life is limited their disposal is also an issue. Ralph responded that our Office currently does not look at that, but that it could be considered. Jim then intervened noting that DOE has funding being dedicated to this issue and Fabio remarked that our research could reference research from other sources this avoiding duplication of efforts. Ian lastly notes that emissions from space vehicles are of interest and asked if there will be a paper on the results from project 19, to which Ralph replied that the report is currently being written.

Presentation Noise Research, Briefing and Discussion | **Presenter** *Dave Senzig and Muni Majjigi*

Dave Senzig began the presentation with an overview of the key areas of the FAA noise research program: the effects of aircraft noise on individuals and communities; modeling, metrics and data; and reduction, abatement and mitigation. He continued by covering the work being done under ASCENT project 3 on evaluating potential links between health outcomes and aircraft noise exposure. The study has shown some correlation with hypertension which, however, cannot be generalizable due to the available demographic characteristics of the Nurses Health Study (NHS) longitudinal health cohorts used in the study. The study was also not able to find any correlation between aircraft noise exposure and cardiovascular disease but noted that only a small number of cases in the cohorts were found in the data encompassed by the noise contours levels been assessed. Lastly, on the association between noise and sleep insufficiency and quality the study found an increase in sleep insufficiency at higher aircraft noise exposures, but no relationship between noise and sleep quality. Steve Alterman then asked a difference had been seen between individual loud events and multiple flights in a close sequence, the answer to which was that the data did not have the detail level necessary to support such type of observation.

Dave continued by providing an overview of the ongoing National Sleep Study (NSS) and a status update in its progress. He followed by covering the work being done under ASCENT project 86, which is looking at the efficacy of broadband noise in mitigating sleep disturbance by aircraft noise. He then concluded providing an updated on the work of project 62 on the AEDT model validation.

Muni Majjigi continued the session with updates on noise technology related activities on the international stage. He covered ongoing work under ICAO CAEP on the CO_2 and noise dual standard for subsonic aircraft by reviewing AEE leading role and technical support, remarking on the challenges faces to sate, and providing an update on the current status of the work. He then covered activities on the LTO Noise Standards And Recommended Practices (SARP) for Supersonic Aircraft, en-route noise ("Sonic thump") SARP for Supersonic Aircraft, and the activities on understanding Emerging Technology Aircraft (ETA). For the domestic stage, Muni remarked upon the very good coordination between FAA and NASA on topic such as sustainable and scalable AAM operations and the support of new aircraft technologies, and FAA's participation to events across Agencies and Organizations.

Muni concluded his presentation by discussing the challenges associated with developing new aircraft noise technologies, covering the motivations and range of the ASCENT technology projects, and reviewing those projects focusing on issues related to noise. Lastly, he focused on the opportunities arising from the close engagement with NASA and the potential of the FAST-TECH grant program having elements that might also benefit addressing noise issues.

Presentation Noise Research on UAS and UAM | **Presenter** *Dave Senzig*

Dave began the discussing the research that is needed to support noise certification and environmental review of UAS and AAM. On noise certification he began by remarking that General Aviation (GA) aircraft are certified based on measurement during take-off (TO) while Helicopters are certified based on overflight measurements if weighting less than 7,000 pounds, and based on TO, overflight, and landing measurements if above that weight. Since AAM will operate at lower altitude and closer to people the thought is that we will have to assess what the noise at hover is and have been asking for these data from the manufacturers. We measure these vehicles at lower altitude than helicopters, but it is difficult to ask for more certification data for this type of aircraft given that we do not so for helicopters. Modeling using AEDT will also be an issue as AEDT modeling is deterministic, while the operations are expected to be unpredictable. The Chair asked if we are working with the providers since these vehicles will be more of a nuisance than a DNL level type of impact and Dave said that right now we are using DNL, but that is a question. Jim then added that NASA is doing a lot of work on psychoacoustics for these aircraft to help answer that question.

Dave continued the presentation by discussing ongoing work on UAS measurement and analysis noting that we are continuing analysis of measurement campaigns and supplemental noise type certificate measurements to assess environmental impacts and that we are working with applicants to expand their own capability to perform this work. The next steps on this work are to perform statistical analysis of past campaigns to understand source of variance in noise type certification metrics and to perform a cost/benefit analysis of elevated microphone setups. Steve asked where FAA is on certification for AAM and if it will be ready for their entry in operation to which Dave answered that they currently are tiltrotors for which we have a standard. Steve then asked what is missing and Dave replied that Hover is missing and that there are performance limits in 14 CFR Part 36 Subpart K that electric vehicle cannot meet and so we will have to make some modifications. Steve noted that while FAA is expecting these vehicles by 2028 industry is saying that they will arrive by 2025 and FAA should not risk a delay that could jeopardize the industry. Dave noted that airworthiness certification is likely going to be the long pole in the tent and Muni added that if needed we could use the rule of particular applicability, instead of general applicability, since all these aircraft are of very different design.

The presentation continued with an overview of several ASCENT projects: Rotorcraft Noise Abatement Procedure Development (38); Urban Air Mobility Noise Reduction Modeling (49); Measurements to Support Noise Certification for UAS/UAM Vehicles and Identify Noise Reduction Opportunities (77); Noise Modeling of Advanced Air Mobility Flight Vehicles (84), which will be using NASA develop tools; and GIS Based Probabilistic UAS Trajectory and Noise Estimation Tools and Methodologies for Upcoming Vehicle Concepts (94). Dave then provided a list of other programs in which FAA is involved, including several in collaboration

with NASA, those with industry, and those at the international level. Lastly Steve remarked that FAA's UAS/UAM/AAM acronyms definitions should be made very clear in the presentations.

Presentation Analysis and Tool Development | **Presenters** *Joe Dipardo, Mohammed Majeed, Adam Scholten, and Fabio Grandi*

The presentation began with Mohammed Majeed covering the AEDT software version 3f current development status. On maintenance he highlighted that the ESRI GIS software component update of the Airport Designer will take longer than originally expected. He then provided a status update on the various emissions and dispersions modeling features under development noting that the EPA AERMOD.AERMET v.23 updated was awaiting the release by EPA. The Chair asked if confident that AERMOD will be released as expected to which Mohammed responded that we are expecting a timely delivery as the EPA had posted a Federal Notice related to the release. He then concluded with the latest software enhancements implemented for Green House Gasses (GHG) emissions calculation and reporting.

Joe Dipardo continued the presentation by covering external development feedback activities. He noted that User Review Group (URG) meeting was upcoming and that the group will be providing review tasting of the AEDT 3f features and discussing future enhancements for track creation to see why users still depend on the legacy software (Integrate Nosie Model – INM) and see what can be done to meet the need in the current tool. Joe then concluded by providing a summary of the AEDT 4a development plans noting that we will try to be flexible on release date and that the new version will have a new Delay and Sequencing Module replacement developed based on work from a recently concluded ASCENT study.

Adam Scholten followed with an overview of the ongoing annual U.S. Inventory of noise, fuel consumption, and emissions. He covered details about the output from the analysis noting that the census data used for the computation of the noise population exposure is update every year using the census yearly revisions. After he discussed the annual trends graphics for both noise exposure and fuel consumption Brandon asked that since AEDT is used for the CO_2 why not use the data reported to the Bureau of Transportation Statistics (BTS) by the airlines. Jeetendra Upadhyaya that for this analysis we use using operational data as opposed to reported and Brandon what the percentage difference there is between modeled and reported. Ralph then specified that the inventory does not include only commercial service but covers everything and therefore there will always be a difference. An action was taken for AEE to look at the providing the percentage difference between modeled and reported CO_2 (note that Brandon asked only the commercial portion). Adam concluded is portion of the presentation by reviewing the improvements implemented for the 2022 analysis and the scheduled expected to be maintained in processing the inventory data in quarters. He lastly noted that quarterly processing allows to identify data issues in a timelier fashion and that we now compare noise contours outputs between years computationally which allows us to flag inconsistencies more rapidly and efficiently.

Fabio Grandi concluded the presentation with an overview of the latest release of the Environmental Visualization Tool (EVT) which now also allows to develop three-dimensional (3D) maps. After discussing the advantages of this Geographic Information System (GIS) application as a resource to its users he provided more details of the recent addition of the

capability of uploading user-developed data layers including 3D flight paths, data from modeling tools, and external GIS, tabular, and structure text data. Fabio concluded with an overview of the various visualization capabilities of the tool the user can use in communicating their data.

Action items	Person responsible	Deadline
Provide the percentage difference between modeled and reported CO2 for commercial operations.	J. Upadhyaya	Spring Meeting

Meeting Close-Out | Lead *Ian Redhead*

During the final discussion Jayant asked whether the people submitting projects under CLEEN are specifically told they their proposed technology cannot improve on one environmental aspect while negatively affecting another. The response was that the project proposals review and selection process include the consideration of issues associated with interdependences.

Sandy then asked if there some value for committee to emphasize the value of the environmental programs being conducted by AEE. The Chair agreed that they will add that point to the preamble of the committee's Findings and Recommendations and added that of major concern is the fact that the House budget had zeroes the funding for this Office.

The meeting concluded with the agreement that Spring meeting will take place on February 23 and 24 and that a poll will be distributed for the Fall meeting dates that will include:

- July 23 – 24, 2024
- August 27 – 28, 2024
- September 9 – 10, 2024

Action items	Person responsible	Deadline
Issue Poll for the Fall meeting dates to include: • July 23 – 24, 2024 • August 27 – 28, 2024 • September 9 – 10, 2024	F. Grandi	Spring 2024

Adjourned at 5:00 pm on Wednesday, September 13, 2023

Attendance

Day 1		Day 2	
Steve	Alterman	Arshan	Aga
Nicole	Didyk-Wells	Steve	Alterman
Chris	Dorbian	Nicole	Didyk-Wells
Mark	Ehudin	Chris	Dorbian
Gregg	Fleming	Mark	Ehudin
Ana	Gabrielian	Gregg	Fleming
Brandon	Graver	Joshua	Glottmann
Bahman	Habibzadeh	Ana	Gabrielian
Jim	Heidmann	Brandon	Graver
Ralph	Iovinelli	Bahman	Habibzadeh
Sandy	Lancaster	Mark	Hale
Mohammed	Majeed	Jim	Heidmann
Monique	Moore	Christopher	Hobbs
Andrew	Murphy	Ralph	Iovinelli
Anna	Oldani	Sandy	Lancaster
Arthur	Orton	Mohammed	Majeed
Alexandra	Papantoniou	Muni	Majjigi
Katherine	Preston	Monique	Moore
Jesse	Quinlan	Anna	Oldani
Ian	Redhead	Arthur	Orton
Chinita	Rountree-Coleman	Alexandra	Papantoniou
Jayant	Sabnis	Michael	Patterson
Jon	Schleifer	Katherine	Preston
David	Senzig	Jesse	Quinlan
Joe	Zelina	Ian	Redhead
		Chinita	Rountree-Coleman
		Jayant	Sabnis
		Jon	Schleifer
		Adam	Scholten
		David	Senzig
		Susumu	Shirayama
		Joe	Zelina

FAA REDAC Subcommittee on Environment & Energy
Fall 2023 Meeting Agenda
Virtual Meeting

Purpose
- Develop strategic guidance for the FY2026 R&D portfolio
- FAA provides deep-dive briefings on topics of interest to develop strategic guidance
- E&E REDAC to provide recommendations on R&D portfolio and direction

In Person Participation (must RSVP)
FAA Bessie Coleman Conference Center
2nd Floor, FAA HQ (Building 10A)
800 Independence Avenue, SW
Washington, DC 20091

Remote Participation
Click to Join
https://faavideo.zoomgov.com/j/1607938404
- Passcode: 238515
- If prompted, accept the Zoom application as instructed.

Mobile Device
- Download the 'Zoom Cloud Meetings' App.
- Select 'Join a Meeting' and enter Meeting ID: 160 793 8404
- Passcode: 238515

Phone Audio Only
- Call 1-888-924-3239; enter Meeting ID: 160 793 8404
- Passcode: 238515
- Unmute or mute yourself by pressing *6.

Traditional VTC Room System (Via Polycom, Tandberg or Cisco)
- Eastern US Dial/Call the following: Meeting Number 759 160 793 8404 (No Spaces)
- Western US Dial/Call the following: Meeting Number 759 160 793 8404 (No Spaces),
- Press 1 to bring up the menu to unmute, mute, change the view and additional features

Agenda

Tuesday, September 12, 2023			
Time	**Duration**	**Title**	**Presenter**
8:30	0:20	Check-In	
8:50	0:05	Welcome	F. Grandi
8:55	0:10	Chair opening statement & Introductions	I. Redhead
9:05	0:15	FAA R&D Update	S. Yak / E. Neiderman
9:20	0:15	AEE Update	J. Marks
9:35	0:15	Industry Perspective	S. Alterman
9:50	0:30	NASA Update	J. Heidmann
10:20	0:15	Update on ICAO and CORSIA implementation	D. Williams
10:35	0:15	Break	
10:50	0:30	FY24/FY25 Budget Update	T. Blackwell
11:20	0:30	Responses to REDAC Recommendations & Actions	F. Grandi
11:50	1:10	Lunch	
13:00	1:15	Environment and Energy Research & Development Portfolio Overview	F. Grandi
14:15	1:00	Sustainable Aviation Fuels Resarch, Briefing and Discussion	A. Oldani, P. Lobo
15:15	0:15	Break	
15:30	0:30	Discussion on Findings & Recommendations	I. Redhead
16:00		End of Day-1	

Wednesday, September 13, 2023			
9:30	0:30	Check-In	
10:00	1:00	Aircraft Technology Resarch, Briefing and Discussion	A. Orton, C. Dorbian
11:00	0:45	Improving Cruise Efficiency and Addressing Climate Impacts from Aviation Induced Cloudiness via Operations, Technology and SAF	C. Dorbian, N. Didyk-Wells, P. Lobo
11:45	0:45	Emissions Research, Briefing and Discussion	R. Iovinelli
12:30	1:00	Lunch	
13:30	1:00	Noise Research, Briefing and Discussion	D. Senzig
14:30	0:30	UAS/AAM Research, Briefing and Discussion	D. Senzig
15:00	0:15	Break	
15:15	0:30	Analysis & Tool Development (Including AEDT), Briefing and Discussion	F. Grandi, J. Dipardo, M. Majeed
15:45	0:45	Discussion on Findings & Recommendations	I. Redhead
16:30		End of Day-2	