Independent Review of FAA's Energy-Related and Environment-Related Research Programs

June 2013

Independent Review Panel:

Chair, Prof. Juan J. Alonso, Associate Professor, Department of Aeronautics & Astronautics, Stanford University
Mr. Steve Alterman, President, Cargo Airline Association
Dr. John Cavolowsky, Director, Airspace Systems Program, NASA
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Mr. Zia Haq, Lead, Defense Production Act Biofuels Initiative, Department of Energy

Executive Summary

In Section 912 of the FAA Modernization and Reform Act of 2012 , Congress directed the FAA Administrator to enter into an arrangement for an independent external review of FAA energy-related and environment-related research programs to assess their performance against a number of key metrics relating to their objectives, coordination with other government agencies, allocation of resources, and mechanisms for transitioning research results.

This document contains the independent panel's assessment of these programs organized by the four specific areas to be addressed in accordance with Section 912. The panel's review is based on the program details presented and discussed at a January 25, 2013 review meeting at FAA Headquarters, follow on information exchanges, and the panel members' knowledge of the status and needs related to environmental protection and energy for sustained aviation growth.

In summary, the independent review panel finds that:

1. FAA's environment and energy research programs have well-defined, prioritized, and relevant research objectives. The management in FAA's Office of Environment and Energy has consistently applied a well-thought-out, five-pillar strategy to manage research objectives and priorities in evolving national and international environments. The review panel recommends that this strategy be maintained.
2. FAA has properly coordinated its environment and energy research programs with other relevant agencies including, but not limited to, NASA, NOAA, DoE, DoE, EPA, and USDA as well as other portions of the FAA. In addition, the review panel finds proper coordination with the aerospace industry and a large number of academic institutions. Given the magnitude of the research challenges facing FAA, it is important that this coordination continue at the same or higher level so as to minimize overlap and maximize leveraging of resources.
3. Funding is, and will continue to be, a major constraint on the ability of the FAA to achieve its energy and environmental goals. The review panel finds that, at current levels of funding, the programs have allocated appropriate resources to achieve research objectives. However, the review panel has concerns that, given potential reductions in future funding levels, the achievement of research goals may be put in jeopardy. The review panel recommends that, if funding levels change in the future, changes in the content of the research programs be made to ensure that the efforts that are retained in the portfolio have a high likelihood of transitioning into actual use.
4. FAA's Office of Environment and Energy has made significant efforts to ensure transition of research results to other parts of the FAA, and there are a good number of success stories to illustrate this point. However, the consensus of the panel is that, in this area, some additional attention could be

paid to the specifics of the research transitions and some ideas can be borrowed from best practices at other agencies.

Charter and Review Process

The charter of the independent review panel is clearly outlined in Section 912 of the FAA Modernization and Reform Act of 2012. The text of Section 912 is reproduced below to provide the context for the remainder of this report.

SEC. 912. REVIEW OF FAA'S ENERGY-RELATED AND ENVIRONMENT-RELATED RESEARCH PROGRAMS.

(a) REVIEW.—Using amounts made available under section 48102(a) of title 49, United States Code, the Administrator shall enter into an arrangement for an independent external review of FAA energy-related and environment-related research programs. The review shall assess whether—

(1) the programs have well-defined, prioritized, and appropriate research objectives;

(2) the programs are properly coordinated with the energy-related and environment-related research programs at NASA, NOAA, and other relevant agencies;

(3) the programs have allocated appropriate resources to each of the research objectives; and

(4) there exist suitable mechanisms for transitioning the research results into the FAA's operational technologies and procedures and certification activities.

(b) REPORT.—Not later than 18 months after the date of enactment of this Act, the Administrator shall submit a report to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate containing the results of the review.

The full process of the review followed a number of steps that are briefly described below:

1. During the fall of 2012, Prof. Alonso was contacted by FAA with a request to undertake an independent external review of FAA's environment and energy research programs and to serve as Chair of an independent review panel. The request was accepted.
2. Prof. Alonso proceeded to secure the participation of four additional members for the independent review panel to ensure full expert coverage of all the major areas of environment and energy research in the FAA. This resulted in an independent review panel consisting of: [1]

    a. Prof. Juan J. Alonso, Associate Professor, Department of Aeronautics & Astronautics, Stanford University
    b. Mr. Steve Alterman, President, Cargo Airline Association
    c. Dr. John Cavolowsky, Director, Airspace Systems Program, NASA
    d. Dr. Mahendra Joshi, Chief Engineer, Noise, Vibrations & Emissions, Boeing Commercial Airplanes
    e. Mr. Zia Haq, Lead, Defense Production Act Biofuels Initiative, Department of Energy

[1] See Appendix B for short biographical information on panel members.

3. A series of communications between Prof. Alonso and Dr. James Hileman, Chief Scientific and Technical Advisor in FAA's Office of Environment and Energy, took place in December 2012 to set up an agenda for the panel to review and discuss environment and energy research programs with FAA staff and to request that certain information be provided to the review panel prior to the review itself. In addition, specific requests for the content of the presentations (during the review) were made.
4. A one-day session was held at FAA Headquarters on January 25, 2013 from 8 am to 4:30 pm, with the participation of the full review panel and FAA personnel. The agenda is included in Appendix A.
5. The report was written by the members of the review panel based on their evaluation of this review session and independent analysis.

During the review session (Step 4 above), FAA's energy-related and environment-related research programs were described to the independent panel by Dr. Hileman and a number of program leaders for each of the individual research activities reviewed. Detailed discussions during these presentations allowed the panel to obtain clarifications and develop a better understanding of the programs and how they are coordinated with other relevant programs within FAA and with other government agencies. At the request of the panel, Dr. Hileman also provided additional clarifying documentation after the meeting that was reviewed prior to the writing of this report.

The review focused on obtaining the necessary information to provide answers to the four questions derived from the legislative language:

1. Do the programs have well-defined, prioritized, and appropriate research objectives?
2. Are the programs are properly coordinated with the energy-related and environment-related research programs at NASA, NOAA, and other relevant agencies?
3. Have the programs allocated appropriate resources to each of the research objectives?
4. Are there suitable mechanisms for transitioning the research results into the FAA's operational technologies, procedures, and certification activities?

Because of the familiarity of the review panel with the vast majority of FAA's environment and energy research programs and because of the data and presentations provided by FAA personnel, the review panel felt that it could provide answers to these questions. The remainder of this report addresses each of the questions individually and provides the required assessments, together with the rationale for these assessments and, when appropriate, a number of observations and recommendations to strengthen the contributions of FAA's energy-related and environment-related research programs.

Question 1. Do the programs have well-defined, prioritized, and appropriate research objectives?

The research objectives for the environment and energy programs are defined based on full consideration of the challenges related to energy (availability and sustainability) and environmental protection (noise, air quality and climate) to enable continued aviation growth. These challenges include:

- Improving energy efficiency in the National Airspace System via operational procedures;
- Developing alternative jet fuels;
- Reducing aviation noise that limits airport expansion, airspace capacity, and efficient operations;
- Reducing criteria pollutants that degrade surface air quality in the neighborhood of airports; and
- Limiting net aviation carbon dioxide (CO_2) emissions to control potential climate impact.

Based on these considerations the FAA has set specific goals for each of these areas and defined corresponding performance metrics. These goals are aspirational with the understanding that the complexity and breadth of these challenges require aiming higher to achieve continuous significant progress. The program goals also take into account the aviation system needs (supporting the ongoing transition to NextGen, the new approach to managing the National Airspace System) as well as domestic / international policy development needs.

Consistent with these needs and challenges, FAA' Office of Environment and Energy has adopted a five-pillar approach for organizing the research portfolio. These pillars focus on scientific knowledge and integrated modeling (for environmental impact assessments and establishing mitigation needs), aircraft technologies, alternative jet fuels, ATM modernization and operational improvements, and policies, standards and market based measures (all for environmental impact mitigation).

The programs support multiple priorities such as policy development, supporting NextGen, and the development of alternative jet fuels. The Office of Environment and Energy has actively adjusted the research portfolio to align to changing needs and priorities. Initially the portfolio was highly focused on integrated modeling for policy development and on operational improvements. More recently, the focus has been (appropriately so, in the opinion of the review panel) on mitigation via aircraft technologies and alternative jet fuel development.

Within this framework of five pillars, specific research projects are defined and implemented to support the policy and mitigation needs using a bottom-up approach, but aligned to evolving roadmaps. High-quality technical expertise is

assigned to work these tasks via the FAA PARTNER Center of Excellence (COE), programs like the Continuous Lower Energy, Emissions & Noise (CLEEN) and the Aviation Climate Change Research Initiative (ACCRI), and consortia like the Commercial Aviation Alternative Fuels Initiative (CAAFI).

Observations and recommendations

The panel's general impression of the FAA energy- and environment-related research programs is a very positive one. FAA's Office of Environment and Energy has a clearly articulated and thought-out strategy based on the five pillars described above. This five-pillar strategy is used to ensure the appropriateness of their research objectives. The unanimous opinion of the review panel is that, indeed, these five pillars are widely accepted by the aviation community as the logical guiding principles in developing environment- and energy-related research programs. As such, as long as FAA continues to evolve its research portfolio according to the principles expressed in these pillars, the research programs will continue to be relevant, appropriate, and well prioritized.

At the same time, the review panel notes that due to the significant magnitude of the energy and environment challenges that we face today, the FAA's environment and energy research programs are somewhat hampered by diminishing resources, requiring the Agency to make difficult decisions on which projects and objectives to prioritize.

Question 2. Are the programs properly coordinated with the energy-related and environment-related research programs at NASA, NOAA, and other relevant agencies?

FAA has clearly recognized that the energy- and environment-related challenges outlined in the panel's assessment of Question 1 are significant, multi-disciplinary and cannot be met without the pooling of technical expertise and resources. To this end multiple mechanisms have been implemented to coordinate, plan or execute research tasks with other government agencies, industry, and academia.

For example, CAAFI (Commercial Aviation Alternative Fuels Initiative) continues to develop a coalition of stakeholders to remove barriers to the adoption of alternative jet fuels. Besides the FAA, this coalition includes DoD, DoE, EPA, USDA, NASA, fuel suppliers, airline and airport associations, as well as airplane OEMs. The FAA pillar related to alternative jet fuels focuses on environmental impact and sustainability assessments, fuel certification and qualification, airplane systems compatibility, and economic analyses. Other stakeholders focus on feedstock production and logistics, fuel conversion, conversion process scale-up, enabling production etc. This coordination is fundamental to facilitate appropriate research investments (in the areas where FAA or their partners have both expertise and can make a difference) and rapid deployment.

Similarly, the CLEEN program is a cost-shared collaboration between the FAA and the airframe / engine manufacturers to accelerate the maturation of environmental and energy technologies via full-scale engine / airplane or large-scale component testing. The program started with a strong collaboration between FAA and NASA Aeronautics and now involves a wide cross section of the aerospace industry. It is widely acknowledged, and the consensus opinion of the review panel, that in the short span of 5 years CLEEN has acted as a catalyst for the acceleration of new technologies that can be introduced into the aircraft fleet with both fuel burn and environmental benefits, and that it is important that this program continue.

Additionally, FAA, DoD, EPA, NASA and Transport Canada along with multiple academic institutions and industry are collaborating via the PARTNER Center of Excellence in many research projects. The energy and environment programs have also made significant progress in achieving aircraft operational efficiencies by working together with FAA's Air Traffic Organization (ATO) and NASA Airspace Systems Program. This collaboration has the potential for near-term progress in fuel efficiency for the current fleet, and the panel supports continuing this collaboration.

It is important to point out that the FAA's research programs also interact extensively with other segments of the FAA to provide input on the environmental and energy issues involved in the development of NextGen. Moreover, FAA's Office of Environment and Energy also provides the majority of the input for policy decisions at the international level within the context of the International Civil Aviation Organization (ICAO) and the Committee on Aviation Environmental Protection (CAEP). These kinds of FAA coordination processes are very important and must continue to be fostered so that the FAA's environment and energy research can realize its maximum impact.

One of the members of the review panel points out that FAA has a separate coordination mechanism with a wide cross-section of the aviation community through the Environment and Energy Subcommittee of the FAA Research, Engineering and Development Advisory Committee (REDAC), which provides recommendations on the environmental research portfolio and ensures the relevance and prioritization of all research goals. This Subcommittee consists of industry, government and academic representatives who meet regularly with FAA.

Finally, FAA continues to work well with NASA: a long-standing partnership that has strengthened multiple programs in both agencies including CLEEN, NASA's Subsonic Fixed Wing Program, and NASA's Environmentally Responsible Aviation initiative.

<u>Observations and recommendations</u>

The review panel's general observation regarding Question 2 is that FAA is properly coordinating with the agencies mentioned in Section 912 and, just as importantly,

with a large number of stakeholders in the aviation community including multiple other government agencies, academic institutions, and industry. Given the scarceness of resources and the magnitude of the task at hand, such collaborations and proper coordination are seen as the only viable approach to accomplishing anything close to the aspirational energy and environmental goals of FAA. For these reasons, the independent panel urges continued collaboration and aggressive development of the relationships that have already been established.

In particular, the panel would like to emphasize the importance of proper coordination with other portions of the FAA. Since the ultimate customer of a significant portion of the research being carried out is the FAA itself, transition of the research (see also the panel's observations for Question 4) would be greatly enhanced by further improving the coordination with other offices within the FAA.

Question 3. Have the programs allocated appropriate resources to each of the research objectives?

Given the difficulty and breadth of the challenges related to energy (availability and sustainability) and environmental protection (noise, air quality and climate) for continued aviation growth, the independent panel is pleased to see that the R&D resources grew in 2009, and that in the past four years (up to and including FY12, prior to recent sequester effects) they have been sustained at that level. The panel wants to ensure that its comments are understood within the context of the significant budget constraints facing the federal government in the recent past and for the foreseeable future.

The level of resources allocated to FAA's environment and energy research has enabled some significant progress, but continued funding at the FY12 level is necessary for the foreseeable future to achieve the program goals. The FY12 budget allocation (by pillar) shows a reasonable distribution of the resources with 33% for scientific knowledge and integrated modeling, 45% for aircraft technology, 10% for alternative fuels, 2% for operations, and 10% for policy. Earlier (starting in 2003-04), the priority was on integrated modeling of the environmental impact of commercial aviation and, therefore, a large percent of the investment was committed to this area. As a result, a good suite of tools exists today to perform environmental assessment and support policy decisions. Although some level of investment will be required to maintain and enhance these tools, it seems logical that the total amount of investment will decrease in comparison to the level during peak years. It is important to note that the early investment in the development of a comprehensive suite of tools has paid off: the Aviation Environmental Design Tool (AEDT) is now the mandated tool for environmental impact assessment for air traffic airspace and procedure actions (for compliance with the National Environmental Policy Act, NEPA, and for expedited NEPA procedures). When terminal capabilities are complete in AEDT, the tool will be used for airports as well.

The aircraft technology maturation investment (mainly within the CLEEN program) is the highest leveraged resource (with at least 100% industry match). The large current magnitude of this investment is justified given the historical costs of maturing research ideas to technologies that can be incorporated into a commercial airliner. This investment has already matured several engine / airplane technologies for environmental impact mitigation. Additional technologies with significant environmental benefits have been proposed for maturation.

A considerable amount of resources is being channeled through the PARTNER COE. Over the years, PARTNER has become the directed research arm of the FAA and continues to be an institution of fundamental importance to achieving the environment and energy research goals of FAA, and for informing the national and international priorities of the FAA.

Observations and recommendations

It might come as no surprise that the panel's consensus is that funding is, and will continue to be, a major constraint on the ability of the FAA to achieve its energy and environmental goals. In light of possible changes in funding profiles during the coming years, we find that it is important that the Agency continue to assess its priorities to determine how to spend available resources. There is concern by the review panel that the levels of funding for several activities in the FAA's environment and energy research portfolio are barely sufficient to achieve a significant portion of the aspirational goals. Added funding can have the effect of accelerating or achieving a larger portion of the goals. Reduced funding has a different effect: rather than simply trimming a portion of the achievable goals, the possibility exists that some areas of research will be decimated as critical mass is lost.

Given the recent successes (via flight demonstrations) of the CLEEN program, the independent panel strongly recommends the continuation of these efforts beyond the end of the current CLEEN program. The recommendation is that a finite-length extension (possibly an additional 5 years) be granted so that technologies that will impact the next generation of commercial aircraft can be matured appropriately and in a timely fashion.

The panel recognizes the fundamental importance of the PARTNER COE in the research strategy of FAA. For this reason, we find that the FY12 of investment must be maintained, particularly as the COE expands to include major research responsibilities in aviation alternative fuels. This is an example of a program at risk of losing critical mass should funding levels be reduced.

Finally, we note that early investments in operations (including optimal profile descents and airport surface movement optimization) were very successful, but some en-route optimization studies had to be scaled back due to technical challenges. This is the nature of research projects, and we point out that

appropriate action was taken by FAA leadership. Given that operations-related research represented a very small portion of the overall investment in FY12, the independent panel recommends strong collaboration with FAA's Air Traffic Organization (ATO) and NASA to leverage investments for rapid maturation and implementation of environmental operational concepts.

Question 4. Do suitable mechanisms exist for transitioning the research results into the FAA's operational technologies and procedures and certification activities?

FAA has a long track record of successful transitions of research products into various different constituencies, both internal and external to the FAA. This question, however, focuses on two aspects of internal transitions (within FAA): those to the FAA Air Traffic Organization (ATO), and those relating to certification activities. The panel's response is limited to transition mechanisms related to these organizations.

The strongest track record of internal transitions can be found in the deployment of advanced environmental impact analysis tools (such as AEDT, mentioned earlier in this report) in various parts of the FAA. In particular, AEDT is now used for the assessment of compliance with the National Environmental Policy Act for new operations or alterations to existing operations.[2] The Office of Environment and Energy works directly with FAA implementing organizations to ensure the proper utilization of the tools and the timeliness of the applications of these tools. In addition, many of the analyses performed with this and other tools have been used to inform policy decisions (by other parts of the FAA) in both national and international settings.

Similarly, operational improvements derived from environment and energy research, such as optimal profile descents and airport surface movement optimizations, have been transitioned to operators and airports through interactions with FAA's Air Traffic Organization.

Finally, the aircraft/engine technology maturation program (CLEEN) has been set up in direct collaboration with the industry and, thus, has a built-in mechanism for transitioning the research results.

<u>Observations and recommendations</u>

Overall, the review panel feels that FAA has done a proper job of transitioning research results to other parts of the FAA, in particular those portions of the FAA

[2] Effective March 21, 2012, AEDT 2a is the required tool for noise, fuel burn, and emissions modeling of air traffic airspace and procedure actions where the study area is larger than the immediate vicinity of an airport, incorporates more than one airport, or includes actions above 3,000 feet AGL.

that are responsible for both operations and certification programs. However, the consensus of the panel is that, in this area, there room for improvement.

For example, while programs such as CLEEN provide vehicles for transitioning research into operational technologies, there is still concern over the ability to receive timely Agency certification for new products. In this vein, the REDAC Environment and Energy Subcommittee has recommended (and the full REDAC has endorsed) that personnel from the FAA certification office become involved in promising research activities at the earliest possible stage so that concerns can be addressed as early as possible.

In research transitions to the Air Traffic Organization, there have been successful hand-offs such as the Continuous Descent Approaches (aka Optimized Profile Descent), but members of the review panel find that the timeliness of further research transitions will require much tighter coordination between AEE and ATO. In fact, a similar setup to the NASA-FAA Research Transition Teams (RTTs) is suggested for use between FAA's Office of Environment and Energy and the Air Traffic Organization. Such RTTs involve members from the participating organizations early on in order to improve the chances of a seamless transition. By embedding members of the recipient organization in the early stages of the research process, the likelihood of completing research that can be transitioned is improved. Conversely, by allowing members of the producing organization to participate in the implementation of the foundational research, the possibility of misunderstanding or misusing the research products is minimized.

Overall, the consensus of the review team is that, in future research interactions, FAA should think carefully about how the research transition is accomplished. In helping ensure timely certification of the technology research products, FAA should propose and develop new mechanisms for transition. Such transition mechanisms can and should be implemented during the conduct of the research work in the CLEEN program.

Appendix A. Agenda for Review

The following agenda was provided to the FAA by the review committee specifying the requested presentations, their suggested content, and a target duration.

Review Date: January 25, 2013
Review Location: FAA Headquarters, Washington, DC

Draft Agenda

8 am **Welcome and Introductions, Purpose of the Review**

8:15 am **FAA AEE Research Objectives, Priorities, and Overall Approach** (*an umbrella presentation including details on: (1) overall philosophy/mission statement of AEE, (2) how this mission is translated into specific research objectives with details of the process you follow, (3) what approach is used to prioritize the research itself with considerations of available budget, (4) how is/are your mission / research objectives changing with time and how are you positioning your research for what may come in the mid term, and (5) what are your strategic partnerships and how are you nurturing them*.) Presentation to address these questions for all strategic energy and environmental impact issues considered relevant, including alternative fuels. If appropriate (although it could be included in the second presentation) include your view of the relative importance of national and international priorities. 45 min.

9:00 am **Initial Q&A.** 15 min.

9:15 am **Research Transition Mechanisms to All Stakeholders** (*a detailed presentation on the way in which you are ensuring that the products of your research have impact. The presentation should focus on the charge of the review: how is your research impacting the operations side of the FAA? Can you give specific examples? What has worked and what has not? Success stories to illustrate the impact you are having? Even though the focus is on impact on the FAA we would also like to hear about other transitions of your research that have had an impact, including how energy/environmental policy at FAA is being helped, impact on ICAO/CAEP processes and transitions, impact on the other stakeholders of your research (tool transitions, airports, CAAFI, others?*) 45 min.

10 am **Initial Q&A**. 15 min

10:15-10:30 Break

10:30 am **Resource Allocation for FAA AEE's research program** (*This presentation should describe, in some level of detail, how AEE determines both the high-level breakdown of its research investments and, within each major area of research, how the lower-level tasks are prioritized and funded. For the high-level budget allocation, we are interested in ensuring that (a) your process is aligned with the objectives from the first presentation, and (b) that you provide your view on the relative importance, today and tomorrow – within the time frame of development / applicability of your research – of the various investments you are making. For the lower-level research efforts within each area, what drives your allocation strategy?)* 45 min.

11:15 am **Initial Q&A**. 15 min

11:30 am **Research Coordination with Other Energy- and Environment-Related Effort/Programs** (Presentation to include how you are coordinating your efforts to maximize leverage and minimize duplication with other government agencies including, at least, NASA, NOAA, DoE, Air Force, and Dept of Agriculture. Just like in the case of transitions within the FAA, can you indicate what regular processes/interactions you follow to ensure this level of coordination? How could this coordination improve? Can you highlight success stories? Lessons learned?) 45 min.

12:15 pm **Initial Q&A**. 15 min

12:30-1:30 **Working lunch**. Review team and FAA AEE leadership.

1:30-2:30 **Review Team Caucus**. Review team only.

2:30-3:30 **Q&A with All Presenters**.

3:30-4:00 **Initial/Preliminary Outbrief from Review Team**.

4:00-4:15 **Final Discussions with AEE Leadership in Preparation for Final Report**.

4:15 **Adjourn.**

Appendix B. Short Biographical Sketches of Review Panel Members

Juan J. Alonso is an associate professor in the Department of Aeronautics & Astronautics at Stanford University. He joined the faculty in 1997 shortly after receiving a PhD degree in Mechanical and Aerospace Engineering from Princeton University. He is the founder and director of the Aerospace Design Laboratory (ADL) where he specializes in the development of high-fidelity computational design methodologies to enable the creation of realizable and efficient aerospace systems. Prof. Alonso's research involves a large number of different applications including transonic, supersonic, and hypersonic aircraft, helicopters, turbomachinery, and launch and re-entry vehicles. In addition, some of Prof. Alonso's research attempts to understand, in collaboration with academic institutions in the PARTNER CoE, complex interactions of technology improvements at the full system level. During the period spanning August 2006-October 2008, Prof. Alonso was the Director of the NASA Fundamental Aeronautics Program in Washington, DC. In that position he was responsible for the entire portfolio of aerospace vehicle and vehicle technology research for the agency in the subsonic rotary wing, subsonic fixed wing, supersonic, and hypersonic regimes, with particular emphasis on the energy and fuel efficiency and sufficiency of the aviation enterprise and its environmental impact. Prof. Alonso serves in the AIAA Multidisciplinary Optimization Technical Committee, the CGNS Steering Committee and the Center for Turbulence Research Steering Committee and he is a reviewer for a number of archival journals. He has also served in the NASA Advisory Council (Aeronautics Committee), the VAATE Steering Committee, the Fixed Wing Vehicle Executive Council, and the FAA Office of Environment & Energy REDAC. More recently (2010), Prof. Alonso was a member of the Secretary of Transportation's Future of Aviation Advisory Council and in December 2010 he was appointed to the FAA Administrator's Management Advisory Council for a term of 3 years.

Stephen A. Alterman is the President of the Cargo Airline Association, a nationwide (U.S.) trade organization that promotes the use of air freight and represents the United States all-cargo industry before Congress, State and Local Governments and the Courts. Prior to this, he was a Senior Partner at Meyers & Alterman, a Washington, D.C. law firm specializing in air transportation law, and the Chief of the Legal Division, Bureau of Enforcement, U.S. Civil Aeronautics Board. Before that, Mr. Alterman served as a Trial Attorney for the Bureau of Enforcement (1968-1975). He holds a law degree from Boston University School of Law (1968) and an undergraduate degree in Political Science from Brown University, Providence, Rhode Island (1965).

Other past and present positions relevant to this effort include:

- Chairman, Environment and Energy Subcommittee, FAA Research, Engineering and Development Advisory Committee, 2003-Present.
- Member, Steering Committee, Environmental Discussion Group (JPDO), 2005-Present.
- Member, Aviation Security Advisory Committee, 1996-2008; Chair, Air Cargo Sub-Committee, 2012- Present.

- Member, Air Cargo Sub-Committee, CBP Commercial Operations Advisory Committee (COAC), 2011-Present
- Member, Federal Advisory Panel on Land Use Planning, 1993-1995.
- Member, FAA Aviation Rulemaking Advisory Committee, 1991-2012
- Member, Federal Airport Noise Working Group, 1987-1991.
- Member, Federal Advisory Committee on Fuel Savings, 1991.
- Member, Federal Advisory Committee on Passenger Facility Charges, 1990.

John Cavolowsky is the director of the Airspace Systems Program Office at NASA Headquarters, which develops concepts, capabilities and technologies for high-capacity, efficient and safe airspace and airportal systems. Previously he was deputy program director, providing strategic management of technical product across multiple projects within the program, and supporting the Joint Planning and Development Office in the ongoing development of the Next Generation Air Transportation System (NextGen). Dr. Cavolowsky has also been associate program manager for the Airspace Systems Program, and the project manager for the Human Measures and Performance Project. He began his career at NASA Ames in 1989 as a research and development project manager in hypersonic propulsion and thermal protection systems for spacecraft reentry. John also served as a technical manager for aerospace programs in the Office of the Center Director at Ames. He received the Gene Zara Award for outstanding contributions as a national team member to the National Aerospace Plane program, as well as a number of agency achievement awards. He has published more than 25 technical papers. Dr. Cavolowsky has a bachelor's of science degree in mechanical engineering from the Massachusetts Institute of Technology, and master's and doctoral degrees in mechanical engineering from the University of California at Berkeley.

Mahendra C. Joshi is the Chief Engineer for Noise, Vibration and Emissions at Boeing Commercial Airplanes in Seattle, WA. He leads a team that is responsible for providing full design center support in noise, vibration and emissions for all commercial airplane programs. This includes defining requirements, developing relevant tools and technologies, supporting configuration development, implementing efficient designs to achieve program requirements, certifying new designs, providing operational support to customers and coordinating regulatory activities. Mahendra has held several engineering and management positions – all related to environmental performance during his 28 years career at the Boeing Company.

Zia Haq is currently the Department of Energy lead for a Defense Production Act biofuels initiative. He also manages the analysis and sustainability activities of the Biomass program. He has been at DOE for 12 years and has over 20 years of experience in the energy sector. Prior to joining DOE, Zia worked at Southern Company Services, in the area of coal gasification. Zia has a BS in Chemical Engineering from Northwestern University and an MS in Chemical Engineering from Johns Hopkins University.