NASA Advisory Council Aeronautics Committee Meeting
April 27, 2022
Virtual Meeting Originated at NASA's Mary W. Jackson Headquarters Building
Washington, DC

Welcome and Announcements

Dr. John-Paul Clarke, committee chair, called the meeting to order. Introductions were made and information regarding the purpose and scope of the Committee's discussions, findings, and recommendations were described. Due to travel restrictions and complications resulting from the COVID-19 pandemic, this meeting was conducted in a hybrid style, with some attendees present at NASA Headquarters and others attending virtually.

NASA Aeronautics Research Mission Directorate FY 2023 Budget Overview

Mr. Robert Pearce, NASA's associate administrator for Aeronautics, provided an overview of the activities and key drivers included in the Fiscal Year 2023 (FY23) budget. He gave a summary of NASA's aeronautical programs, projects, missions, and partnerships.

He noted that the proposed FY23 budget on Capitol Hill at the time of the meeting reflected the numbers of the President's Budget Request for FY23, and that the increases proposed for NASA Aeronautics in this request, should it be passed by Congress, reasonably cover NASA's priorities with the rise in inflation. He emphasized how the bulk of the increases in the budget request go towards the Sustainable Flight National Partnership (SFNP) and the Sustainable Flight Demonstrator (SFD).

Mr. Pearce elaborated on specifics with regards to the SFNP, and summarized NASA's involvement with Sustainable Aviation Fuels (SAFs). He explained how NASA has a primary role in the development of vehicle technology to support the future use of SAFs, but not in the actual development of SAFs themselves; the FAA and Department of Energy (DOE) are tackling that challenge.

He stated the goal of NASA's sustainable aviation activities are to reach a 25-30 percent improvement in energy efficiency for the next generation of single-aisle aircraft, followed by the ability to use SAFs. Altogether, this set of activities come together as part of the SFNP. Mr. Pearce noted the SFNP is moving fast with these technologies, and although he wished it were possible for NASA to move fast on other topics including hydrogen fuel, NASA must be strategic in its choices because it doesn't have the resources to work on them all.

Discussion

Mr. Peter Bunce commented that the aviation industry, with regards to sustainable aviation fuels, is looking at hydrogen as an energy option. He noted that the DOE, especially, has considered its use and wondered whether NASA could understand what DOE's requirements, timelines, and investments are with regards to the subject.

Dr. Clarke commented hydrogen is an important part of a suite of options for different energy solutions for reaching more sustainable aviation systems. He noted all of them must be studied in a systemic way, and it would be good for NASA and the industry to understand all the trade-offs involved via system assessments.

Mr. Jay Dryer added he would encourage NASA to take the systems-level approach and not presuppose any solutions, expressing that NASA may run into issues if it focuses on one particular technology over another, as well as the importance of trades between the technologies.

Dr. Nicole Key stated the schedule for the SFD seems tight, and from a pragmatic perspective, expressed concern for the risk the programs might face given inflation and ongoing supply chain issues. She asked whether NASA is considering the current state of the economy, especially pertaining to schedules, budgeting, and big testing programs.

Dr. Clarke noted the discussion on the budget brought the X-57 Maxwell to mind. He posited that enough time has passed to ask the question "how do we put the 'expedite' into the X-plane?" He expressed there seems to be a relative non-urgency with X-planes. He explained how while it's beneficial NASA is learning much from the process, getting planes in the air faster is crucially important.

Mr. Dryer added there may be a point of diminishing returns on what NASA has been able to learn and use to inform other efforts. He suggested that since the timeline is a function of the budget, the Committee itself could be of use to NASA – that NASA could share with the Committee what comes up in deliberations with the Office of Management and Budget or Capitol Hill for its advice and input. He suggested that NASA could then, in turn, use said advice and input in further budget deliberations, communicating with budget-makers that NASA conferred with its advisory council and received certain advice.

Dr. Clarke added that the broader philosophical point is how the learning curve is a function of time, and asked at what point the cost-per-incremental-learning reaches a point for NASA to finally take that learning and do something else. He suggested a decision framework, so the people involved with the projects understand what each unit of incremental learning is in order to ensure value relative to cost.

Findings

- Though much is being learned in the development of X-planes, some projects such as the X-57 Maxwell are taking longer than they should. The Committee encourages NASA to consider the question of value relative to cost, and whether there is a point of diminishing returns.

- Issues stemming from rising inflation and supply-chain constraints could pose risks to program schedules and costs, especially for demonstrators.

Sustainable Flight National Partnership

Dr. James Hileman, the FAA's chief scientific and technical advisor for environment and energy, and Dr. Rich Wahls, NASA's strategic technical advisor for the Advanced Air Vehicles Program, presented an overview of the U.S. Aviation Climate Action Plan and the Sustainable Flight National Partnership.

Dr. Hileman also explained the FAA's work on SAFs. He noted the challenges of cost and blending fuels, but explained FAA is working closely with industry to eliminate the blending requirement such that airlines could use 100% SAFs. He explained there have been successes in reaching more than a 50 percent blend already and emphasized the goal of reaching 100 percent SAFs by 2050.

Dr. Hileman noted how due to U.S. policy, SAFs that contribute at least 50 percent noise reduction relative to conventional jet fuel are desirable. He pointed out SAFs can potentially improve air quality and contrail emissions, are scalable, and that there is broad support within the U.S. and overseas. He also stressed that much work is needed to decarbonize aviation, that there is no "silver bullet," and that many regulatory agencies domestically and internationally are working together on the challenge of identifying solutions.

Dr. Hileman stressed it is more difficult to use battery power on larger aircraft such as Airbus A380, whose power needs are so immense it can be compared to a modular nuclear reactor. So, therefore, large energy-per-mass-volume fuel like jet fuel and other similar energy sources fit the bill.

Dr. Wahls noted the importance of the timeline in research achieving technology readiness level 6 (TRL-6) in the late 2020s to meet the 2030-2035 window of introducing sustainable technology to the single-aisle market. He noted how NASA projects on some of these topics are already out of pre-formulation and are approved and working, and how it's a significant accomplishment how quickly it happened.

Dr. Wahls explained how NASA's SFNP projects exist in swim lanes – meaning that the projects research and develop in parallel, independent of other projects. He noted how NASA intends to integrate the learnings later in a way similar to model-based engineering through systems analysis at a central hub.

Discussion

Mr. Michael Dumais explained that based on work occurring in the energy industry and the aviation industry in Europe, it may be a foregone conclusion that SAFs are the solution. Mr. Dumais reckoned that hydrogen and ammonia and other solutions are being significantly examined for use and reinforced the earlier point that given NASA's limited budget, conducting early technology assessments and trade studies on the subject would be of high value to ensure NASA has the best roadmap.

Mr. Natesh Manikoth pointed out that work on SAFs is mostly conducted by the FAA, and that FAA may not be able to complete its work without NASA support and vice versa.

Mr. David Silver added that the idea of reaching a 100% SAF blend is a critical near-term component in showing the goal of reaching net zero emissions by 2050 is being taken seriously. He agreed that NASA does, and should, have a support role to the FAA's primary role in developing SAFs.

Mr. Dumais conveyed the value of working on SAFs but emphasized the risk of being leapfrogged by the industry in Europe should NASA and the FAA be blind to potential alternate solutions.

Mr. Dryer expressed it will be important for NASA to make sure that it adjusts, to some degree, the criteria or lens that it looks through when trying to deliver something at a higher TRL in a given time. He communicated the importance of delivering within that timeframe and not just focusing on the highest performance parameters, as well as looking at the "-ilities" (i.e., quality, reliability, safety, flexibility, etc.) that can make a difference in the next generation of aircraft. He noted this isn't necessarily the same lens NASA has looked through for lower-TRL research.

Mr. Dryer continued to express the desirability of having this balance of lower and higher-TRL thinking and emphasized its importance for goals such as single aisle replacement in the 2030 timeframe, while also not forgetting the "bread and butter" of NASA's fundamental research, tools, and long-term technology. He stated it isn't a one-or-the-other decision, rather, it is having both viewpoints simultaneously to have the criteria needed to look forward. He reckoned that subjects like data release is something NASA will have to look at carefully as it starts working TRL-4 or TRL-5 technologies into its demonstrator aircraft.

Mr. Dryer added how having a strong bipartisan message helps reinforce the important

effort of not only enabling sustainable aviation by way of the SFD, but also contributing to the economic, competitive aspects of helping industry develop technologies. He expressed that this holistic message could help with the effort surviving pivots between administrations.

Dr. Clarke posited there should be a greater emphasis or need for a digital thread with regards to model-based systems analysis and engineering. He expressed the benefits of having a complete chain that helps improve the quality of tools, as well as helps in predictions of costs and manufacturing difficulties, as NASA performs the operations of manufacturing tools and prototypes. He stated if such a system were to be utilized, now is the time to implement it, not five years down the road, and that such a system would advance the whole design process and model-based systems engineering.

Mr. Dryer asked what NASA's role should be and whether NASA or industry should do this digital thread. He asked whether a company would design, build, and then continue to manufacture it where there is a community, compared to something like model-based systems engineering where NASA develops tools, say, to analyze various ports that could be incorporated as part of a larger digital thread.

Dr. Clarke replied that since companies are using NASA tools as part of their design and engineering process in addition to their own tools, NASA should be connected in the tool chain digital thread so it can benefit from the information gathered downstream. He noted how proprietary information doesn't have to be communicated as part of this thread for NASA to learn, for instance, that the manufacturing costs on its tools were five percent off versus ten percent off.

Mr. Dryer pointed out this is already done in NASA's supersonic flight activities, but on the subsonic piece, it may be similar to how the Department of Defense does higher TRL work and experimentation that feeds into the tools.

Findings

- Given the uncertainty of the energy mix of the future, NASA should be cognizant of other energy sources besides sustainable aviation fuels (SAFs) by way of system-level trade studies that would be of high value in cases where the use of SAFs is not a foregone conclusion.

- NASA needs to have a more expansive lens with respect to delivering higher TRL products in a constrained timeframe. Delivering in that timeframe, versus just focusing on improved performance, is important and better articulates that these efforts help address "ilities" and other concerns such as economic growth and safety – which helps maintain bipartisan support also.

- There is an opportunity for NASA to create digital threads for its higher TRL experiments to help improve lower TRL design tools, or to be included in other organizations' digital threads for projects where NASA has contributed tools. The Committee believes since the benefit of a digital thread is having a complete chain that improves the design of tools, as well as helps in predictions of cost and manufacturing difficulties, the time to implement digital threads is now rather than later.

- While there is a focus on a long-term goal of 2050 for net zero aviation emissions, it will also be important to establish key steps and measures of progress in the short term (within five years) that can be better linked to resource needs. The Committee believes that having a balance of both short and long timeframes is important to good decision-making and maintaining support for programs.

Future Airspace Vision

Mr. Akbar Sultan, director of NASA's Airspace Operations and Safety Program, and Mr. Steve Bradford, chief scientist for infrastructure and NextGen development for the FAA, presented on the future vision for airspace operations that both NASA Aeronautics and the FAA support. Mr. Sultan's presentation included an overview of the Sky for All vision, and Mr. Bradford's an overview of the NextGen vision.

Mr. Sultan highlighted how in a diverse airspace including multiple vehicle classes at lower altitudes, safety factors and needs will need to increase several orders of magnitude compared to current practices. He presented automation as a method to offload and assist in a human workload, increase precision for ground-based systems, and perform help monitoring risk assessments.

Mr. Bradford explained NextGen and its specifics, including, but not limited to, upper Class E traffic management, system-wide information management, trajectory-based option sets, and new capabilities needed to support vehicles while they are on their various trajectories. He spoke on the confluence of traditional infrastructure and newer shared infrastructure to operationalize new air traffic management systems for Advanced Air Mobility (AAM), including cloud computing, service-based architectures, and local edge devices. He elaborated on the volume of communication required to achieve the NextGen vision and new data sharing devices and protocols that can enable it.

Mr. Sultan described how Sky for All is building on work related to the Info-Centric National Airspace System (NAS) via integrated system level research that is extensible and buildable. He emphasized that NASA is developing capabilities leveraging what has been done for the Info-Centric NAS with the key principles of scalability, diversity of operations, density, safety, resilience to disruption, and environmental sustainability. Mr.

Sultan explained that a vision roadmap development with the community is in the works that largely works on what was learned in NextGen's own operational improvements. He noted the Sky for All team is already at work with the community and stakeholders through a set of workshops and engagements.

Mr. Sultan pointed out that architecture needs to be developed for Sky for All, but traditionally, the FAA has developed architecture because it owns the enterprise architecture and is the implementing agency. He explained how NASA and the FAA are closely working together to be able to establish a process and pathway where Sky for All's architecture can be developed.

Mr. Sultan noted the importance of avoiding point solutions, or "being the hammer looking for a nail." He explained how each iteration of the technology is learning what works and what doesn't, and that the method NASA is following is to learn, iterate, improve, and adapt as dynamically as possible in order to align fast-moving capabilities.

Discussion

Mr. Silver brought up the idea of having NASA help develop the standards for certification in aviation. He noted although the FAA is ultimately responsible for approving these standards, there exists an opportunity for NASA to have a role in the cooperative areas of certification, with Advanced Air Mobility (AAM) as an example. He suggested the current situation seems to be "bring a rock and we'll tell you whether it's the right one." Mr. Silver communicated how such a lack of guidance slows things down across the board, and NASA can help resolve that.

Mr. Manikoth stated NASA does a great job demonstrating different possibilities without dictating how exactly they should be done, and that industry still does much of the innovation. He expressed that there are counter-voices objecting to the FAA's approach to standardization, and that the Committee in its deliberations should consider the fact that innovation could be stifled by premature standardization.

Mr. Silver elaborated how the suggestion is less about approved standards than it is about the beginning of a standards structure – a framework for consensus-based standards bodies to build their conversations while NASA is still working on a project itself. It is an opportunity, Mr. Silver explained, for time to be spent valuably.

Dr. Helen Reed added that evidence of why standards and recommendations are reached should be part of the certifications and trade studies that would be conducted.

Mr. Dryer recognized the strong collaboration between NASA and the FAA, especially with regards to air traffic management, and expressed that the collaboration is worthy of note. He viewed the synergy in the roles shared between the organizations, and how their work comes together, as a strong advantage to having the focus to solve the aeronautical challenges the agencies are working on solving together.

Dr. Clarke and Dr. Reed both expressed that the collaboration is refreshing and to be encouraged.

Recommendation

- Although the primary role of certification and development of standards is the FAA's purview, the Committee recommends, where relevant throughout its research portfolio, that NASA should conduct trade studies that support the certification process and back-up analyses of why certification criteria are recommended the way they are.

Finding

- The strong collaboration between NASA and the FAA is encouraging. The Committee applauds the synergy between the agencies and encourages NASA to continue enhancing the collaboration.

Public Comments

A public comments period was offered as required. No public comments were received.

Conclusion

The meeting of the Committee was concluded with discussions on the timeline and plans for future meetings.

MEETING ADJOURNED

List of Attendees

Committee Members:

1. Dr. John-Paul Clarke, Chair
2. Mr. Peter Bunce
3. Mr. Jay Dryer
4. Mr. Michael Dumais
5. Dr. Nicole Key
6. Mr. Natesh Manikoth
7. Ms. Susan Pfingstler
8. Dr. Helen Reed
9. Dr. Hassan Shahidi
10. Mr. David Silver

NASA:

11. Steven Clarke
12. Mary Dijoseph
13. Shannon Eichorn
14. Shawn Engelland
15. Barbara Esker
16. Dale Hopkins
17. Sharon Monica Jones
18. James Kenyon
19. Paul Krasa
20. Nateri Madavan
21. Kate McMurtry
22. Jon Montgomery
23. Lee Olson
24. Robert Pearce
25. Cheryl Quinn
26. Irma Rodriguez
27. Mike Rogers
28. Naseem Saiyed
29. Akbar Sultan
30. Huy Tran
31. Edgar Waggoner
32. Rich Wahls
33. Alicia Wesley

External:

Collins Aerospace:

34. Ron Corsetti
35. Dan Kaplan

FAA:

36. Steve Bradford
37. Jim Hileman
38. Tiffany Mitchell

FedWriters (NAC Meeting Support):

39. John Gould

No affiliation identified:

40. Taylor Armentrout
41. Mary Boiraud
42. John Borghese
43. Andrew Farquharson
44. Charles Fremaux
45. B. Harvey
46. James Lochner
47. Mary T. Lombardo
48. Stanley Merritt
49. Andrew Provenza
50. John Tylko
51. Yohann