

SUSTAINABILITY IN FLIGHT: OUR JOURNEY TO DECARBONIZATION

Aviation connects the world – people with people, producers with consumers, supply with demand, ideas with resources, and much more, ultimately increasing global productivity, standards of living, economic opportunity, and quality of life. The preservation of these benefits requires that our aeronautical industries, government, and academia collaborate in setting forth, investing in, and achieving sustainability goals that propel us into a cleaner and greener future for the United States and the globe.

THE CHALLENGES

Oil has literally and figuratively fueled the 20th-century revolutions in mobility, economics, geopolitics, and our way of life. It is fair to say that we live in an oil ecosystem, with 85% of global energy derived from fossil fuels. Even as we have made strides toward ever-more efficient uses of petroleum energy in all applications (e.g., the airline industry has improved fuel efficiency by 1.5% annually from 2009 to 2020), we now know that those advancements will not be sufficient to protect our civilization in coming decades as air travel will continue to grow following the recovery from the pandemic – we must do more.

Incremental advancements in aerodynamics, lightweight structures and materials, manufacturing processes, and air traffic efficiencies will provide only part of needed solutions. To achieve significant carbon reductions, more efficient aircraft engines are needed. The solutions we pursue will reduce the overall need for energy and will enable shifting to more sustainable sources of energy. The efficiencies from advances in aircraft electric propulsion will complement revolutionary airplane concepts.

The transition from oil to new energy sources represents challenges for every facet of our aviation systems. Whether they be sustainable aviation fuels (SAF), hydrogen fuel cells (HFC), hydrogen turbine propulsion (HTP), battery-electric vehicles (BEV), or innovations yet to be discovered, the changes are energizing the entirety of the aviation community, including researchers, manufacturers, operators, regulators, policymakers, and most importantly, the flying public.

The good news is the United States has world-leading R&D infrastructure in the aeronautics community that can be used to meet these challenges. Resulting from past R&D investments, battery-electric vehicles continue to improve a few percent annually; HFC systems are predicted to be cost competitive with internal combustion engines in as little as five years; and “green” hydrogen production costs are declining to cost-competitive levels with oil over the coming decade. Sustainable aviation fuel meanwhile is a solution that is available today, but needs support to remove market barriers for greater production and wider adoption. What will it take? If the United States focuses and invests in these products and systems, we can bring about the transformation from fossil fuels to sustainability through decarbonization, and aeronautics will play a leading role.

THE PATH TO DECARBONIZATION

The aeronautics community is committed to being carbon neutral by 2050. How will this happen?

- › To start, the community needs the shared commitment and alignment of the U.S. government, along with global leaders, universities, federal research systems, and the energy industry on these objectives. With the support of Congress, the federal government can play a most influential role.
- › Next, the community will take nearer-term action on deployment of SAF for current airline fleets and will promote unleaded and, where possible sustainable, Avgas for general and business aviation.
- › The emerging advanced air mobility industry (for both urban and regional electric air vehicle solutions) is poised to serve as the earliest adopters of hydrogen fuel cells, hydrogen turbine propulsion, and battery-electric vehicles using clean, renewable energy sources. Correspondingly, NASA programs are underway (HyTEC, EPFD) focused on revolutionary efficiency improvements for commercial aviation market segments.
- › The community stands ready to work with departments and agencies and their research laboratories and university partners to contribute the advancements required to realize SAF, HFC, HTP, and BEV solutions.
- › The community will also encourage workforce development for STEM-educated scientists and engineers in the vital technical disciplines, as well as in the essential capacities for systems of systems creative innovators.



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