Enabling Development of Alternative Fuels and Energy Efficient Aviation Systems

An AIAA Information Paper

Overview

To enable future growth in the aerospace industry, the U.S. must develop sustainable alternative fuels and technologies that improve energy efficiency so that the environmental impact of aviation systems is mitigated. Worldwide the aviation industry consumes 1.5–1.7 billion barrels of traditional jet fuel annually and contributes to 2–5% of anthropogenic greenhouse gases\(^1\). Alternative fuels are also needed to increase our sources of reliable energy and to protect our national energy security and economic viability. In 2008, the U.S. Air Force spent over $9 billion for energy, over 80% of which was for aviation fuel. Aviation fuel is presently petroleum-based, and the majority of suppliers are located outside of the United States. Many of these supplier nations would not otherwise be considered allied to U.S. interests. Developing “drop-in” alternative fuels and increasing the efficiency of our aviation system addresses both the supply and demand for fuels, which improves the economics of the industry, reduces emissions, and enhances our energy security through new domestic fuel sources.

Background

Over the past several years, multiple sources of alternative feedstocks have been considered. There is general agreement that this nation’s fuel situation will not be resolved by only one feedstock. Companies large and small are researching and developing feedstocks from sources as diverse as algae, wood pulp, and garbage. A number of government agencies already have programs in place to examine feedstock production, perform life cycle assessments, and test and evaluate alternative fuel. DOD, FAA, and the Commercial Aviation Alternative Fuels Initiative (CAAFI) are moving forward in certifying alternative fuels in anticipation of sustainable quantities in the near future. Although accounting for a small (2–3%) percentage of overall fuel usage\(^2\), aviation is positioned to be a first mover for alternative fuels. One of the greatest obstacles is the available supply of sustainable feedstock and the capability to produce the quantities of fuel needed at affordable prices.

Whether fossil-based feedstock such as natural gas, or biofeedstock such as camelina, jatropha, soybeans, algae, or a number of others, similar environmental and economic issues must be considered and resolved. Understanding the issue of scale is critical as we move toward alternative fuels. While there will likely be multiple types of feedstock required, all will have to be scaled up to be sustainable. This, in turn, raises increased environmental concerns relative to local water supply usage, direct and indirect land use change, soil and biodiversity impacts, air quality, and energy balance. Regulations could delay or derail efforts to develop certain feedstocks and/or deploy alternative fuels. It is critical that regulators at all levels be involved early in the process.

Another key facet of improving the compatibility of aviation systems and the environment is to develop technologies that substantially increase energy efficiency. Lower fuel burn directly reduces emissions and cost, which improves the environmental footprint as well as the business case. The U.S. should take an integrated, holistic approach to advance not only component efficiencies, but also the efficiency of the entire aviation system. This approach should assess and develop new architectures, technologies, materials, and operational procedures to improve overall system efficiency.
While a number of government agencies are engaged in research and development in these critical areas, enhanced coordination to tie together existing technology development roadmaps would be very beneficial to the aviation enterprise. Furthermore, developing alternative fuels and energy efficient technologies is capital-intensive and incentives are required to encourage investment at all stages of research, development and production.

**Recommendations**

AIAA recommends that Congress take the following actions:

- Encourage research and development of alternative fuels and energy efficient propulsion and airframe technologies through direct funding and tax policy incentives.
- Provide tax policy incentives, similar to those employed for ethanol and other renewable sources, for jet fuel feedstock production, conversion, and use, to ensure that aviation has an equal opportunity in the marketplace, and institute other measures which will encourage the necessary capital investments in certified aviation alternative fuels production and delivery infrastructure.
- Direct relevant federal agencies to report on their existing alternative fuel roadmaps to: (a) identify gaps that may inhibit qualification, environmental performance definition, or deployment; and (b) present a comprehensive strategic national roadmap toward establishing specific fuel technology goals and guidelines.
- Ask the relevant federal agencies and the private sector to identify where regulatory uncertainty may be inhibiting development and deployment of alternative fuels, and how that uncertainty can best be addressed.
- Direct relevant federal agencies to articulate a coordinated approach to execute environmental life cycle assessments to ensure that environmental regulatory uncertainty does not slow development and deployment.