Ensuring Surety of Supply through Sustainable Aviation Fuels

Maj Marcus R. McWilliams, USAF

Background

In the last 15 years, there has been massive instability in the global petroleum market. In the last three years alone, US prices for commercial-grade Jet A fuel have risen to a high of $3.29 per gallon in 2013 and plummeted to a low of 80 cents per gallon in 2016.[1] In the wake of rapidly spiking crude oil prices in the early 2000s, Congress passed the Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007. The legislation included tax incentives and funding for the research, development, and production of biomass-sourced fuels. While the legislation was largely aimed at diesel fuel production, the technologies and methods developed have had a direct impact on the production of alternative jet fuels.

As a result, the production of biodiesel has doubled in just five years, going from 678 million gallons in 2008 to 1,359 million gallons in 2013.[2] During this period, the US Air Force's Alternative Fuels Certification Office, working in conjunction with the Commercial Aviation Alternative Fuels Initiative—a consortium of airlines, manufacturers, and fuel producers—led the way in testing and certifying alternative jet fuels for use in military and commercial aircraft.[3]

While the Air Force certification program ended in 2012, the US Navy has continued participating with the commercial sector in the testing and development of aviation biofuels. Five different production methods have now been standardized and certified for commercial production of sustainable aviation fuels. Multiple airlines, both US and international, are pursuing the adoption of aviation biofuels into daily operations as a means of expanding their corporate environmental sustainability portfolios, meeting government-mandated emissions requirements, and taking advantage of tax incentives.

Meanwhile, as US foreign policy has shifted from a post–Cold War Eurocentric focus toward the Asian-Pacific region of the world, the Department of Defense has had to adjust, making plans for conducting military operations in an area of the world with comparably few established military bases. Utilizing existing facilities owned by allied and partner nations has become a planning reality, meaning the ability to use locally available fuel sources will have a direct impact on the flexibility of military air operations.[4]

Current State

In the last decade, biofuels have made significant strides in moving mainstream in the commercial aviation world. The American Society for Testing and Materials (ASTM) International, owner of the US jet fuel production standard, has approved blends of five biofuels as part of the Jet A standard.[5] These are (1) coal, biomass, or natural-gas-based jet fuel (Fischer-Tropsch Synthetic Paraffinic Kerosene, FT-SPK)—up to 50 percent; (2) Fischer-Tropsch fuels with added aromatic content (FT-SKA)—up to 50 percent; (3) plant, oil, and fat-based fuel or hydroprocessed esters and fatty acids (HEFA)—up to 50 percent; (4) sugar-based jet fuel or synthesized isoparaffins (SIP)—up to 10 percent; and (5) alcohol-based jet fuel or alcohol to jet (ATJ)—up to 30 percent.[6]

Because of their inclusion in the Jet A standard specification, these biofuels can be used in the approved blend ratios at any time with no warning or additional marking noting the biofuel content. This practice is similar to that for B5 biodiesel, which does not require markings on gas station dispensers. In contrast, biofuels that have warranty implications from manufacturers, such as E10/E15 gasoline and B20 biodiesel, are required to have warning labels.

However, despite the adoption of biofuels into the jet fuel standard, very few production operations have come online to make aviation biofuels. Economics is a major factor here. Producing aviation biofuels remains significantly more costly than refining crude oil. Depending on the production method, the extra costs stem either from the required feedstock or from the capital cost of building and running the facility. Current estimates suggest that the best possible production price comes from biomass feedstocks making HEFA fuels. The same reports indicate that prices are unlikely to go below $3 per gallon in the near term.[7]

Thanks to sustained efforts by Air Force Materiel Command (AFMC), the Air Force has certified all aircraft using JP-8 to fly on available biofuel blends except for the F-22 and F-35. The F119 and F135 engines in those aircraft have not been approved for ATJ blends by manufacturer Pratt and Whitney and would require an extensive testing effort lasting 12–24 months to be certified. At present, no funding is available to pursue ATJ certification for those engines from Air Force research and development channels. Not only would funds be required to obtain the fuel for testing but also the engine and flight tests must be built into AFMC's already busy testing and development curriculum. The Navy is currently testing ATJ in its aircraft and, as of May 2016, had not noted any serious setbacks.

Future State

Aviation biofuels face an uncertain future. In the United States, the tax incentives for using biofuels under the Environmental Protection Agency's Renewable Fuel Standard program are subject to change each federal budget cycle. Also at stake are the federal subsidies and loans given to renewable energy producers. Additionally, the availability of cheap oil—currently around $50 per barrel—reduces the incentive for commercial airlines to use biofuels beyond the level incentivized by tax relief. Internationally, agreements to reduce greenhouse gas emissions—such as the United Nations' 2015 Paris Agreement—have governments both incentivizing and directly sponsoring aviation biofuel programs.[8]

Aviation biofuel projects under way in the European and Pacific theaters represent an opportunity for the US Air Force to ensure unencumbered access to potential operating locations. In Norway, Oslo Airport has integrated a HEFA biofuel blend, produced by Air BP, into the airport's main fuel hydrant system.[9] In Japan, 46 companies and universities have teamed to create the Initiatives for Next Generation Aviation Fuels, an organization with the goal of mass-producing aviation biofuels in time to showcase them during the 2020 Tokyo Olympics.[10] In the South Pacific, Virgin Australian Airlines and Air New Zealand have teamed in an attempt to acquire 5 percent of their aviation fuel from local renewable sources by 2020.[11]

Implications

The *National Military Strategy of the United States of America 2015* lists "improving our global agility" as a means of effectively and efficiently executing integrated operations around the world. Doing so requires the US Air Force to rapidly position forces in areas of need to "seize opportunities, deter adversaries, and assure allies and partners" around the world.[12] Thus, our aircraft must be able to fly on whatever fuel is available.

In general, the Air Force is well positioned to do just that; most US Air Force aircraft have been authorized to use aviation biofuel blends as drop-in replacement fuels. As previously mentioned, the main holdouts are the F-22 and F-35, which have not been approved to use ATJ blends. However, with the F-35 expected to be the workhorse of combat airpower in the coming decades, the ability to operate at any suitable airfield around the world will become increasingly important. Likewise, the F-22 is now being regularly forward deployed to Europe, at times flying from allied-nation airfields rather than Air Force bases. The ability to operate from any suitable foreign commercial airports is a tactical advantage that should be maintained.

Finally, of a more immediate concern is the fact that the Air Force has converted from JP-8 to commercial Jet A at most continental US bases, having completed the changeover in 2014. As the commercial aviation fuel standards have continued to progress, adding more biofuel production pathways, the US Air Force has been unable to keep pace due to lack of funding for engine, fuel system, and flight testing. Currently, only a handshake agreement between the military services and commercial fuel producers and consumers is keeping aviation biofuel blends that are not approved for military engines from making their way to military bases. Without testing to ensure full operability with commercial fuel standards, the Air Force could soon face the uncomfortable reality of having to perform risk assessments—likely reducing flight performance envelopes on some aircraft—to accommodate unapproved aviation biofuel blends in commercial circulation.

Conclusion

The US Air Force must devote the appropriate resources to achieve and maintain certification for its aircraft to fly on all commercially available blends of sustainable aviation fuel. As sustainable aviation fuels proliferate across the globe, the US Air Force's ability to use these as drop-in replacements for military fuels will foster surety of supply and freedom of operation at airports worldwide. ✪

Notes

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Maj Marcus R. McWilliams, USAF

Major McWilliams (BS, University of Cincinnati; MS, Air Force Institute of Technology [AFIT]) is the operations officer for the 20th Logistics Readiness Squadron at Shaw AFB, South Carolina. He is responsible for providing materiel management, vehicle support, transportation services, and petroleum management in support of the 20th Fighter Wing's 79 combat-coded F-16s. His master's degree is in logistics and supply chain management. Major McWilliams spent the 2015–16 academic year embedded at FedEx in Memphis, Tennessee, as part of AFIT's Education with Industry program. During his time with FedEx, his work centered on the transportation industry with a focus on petroleum management.