Pathways to a Sustainable Aviation Ecosystem

Photo by Dennis Schroeder, NREL 51852

Accelerated Sustainable Aviation Fuel Properties Modeling

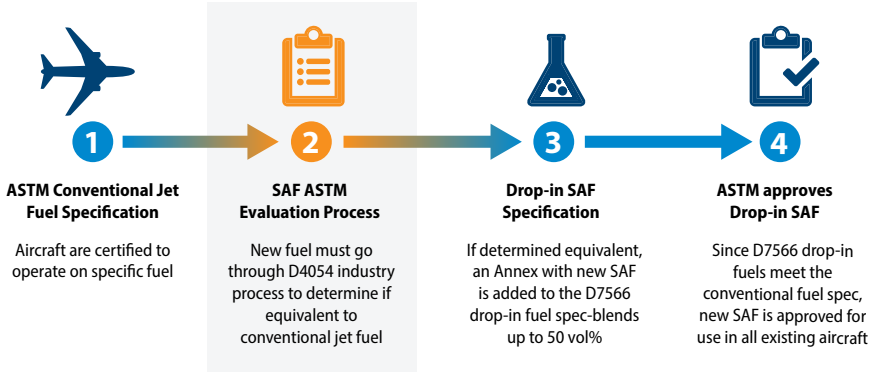
Airlines, fuel refiners, and federal agencies are investing heavily to accelerate the production of climate-friendly sustainable aviation fuel (SAF). As part of a coordinated effort to decarbonize aviation by midcentury, this push requires an accelerated approach to scaling and demonstrating SAF production pathways, as well as rapidly securing approval for their use in airplanes. With bold pledges, big investments, and rigorous timelines at play, aviation stakeholders need reliable fuel property data to lower risks and meet SAF goals on or ahead of schedule.

Understand the Complexities of SAF Properties

Numerous economic, environmental, technological, and social vectors shape the success of SAF production and use in the real world. Before receiving approval for use in commercial aircraft, SAF must exhibit specific chemical and physical properties that ensure safe, reliable operation and performance.

What You Need To Know

1. **Commercialization Involves Substantial Risks**—Like any new technology, advancing SAF pathways from the lab to the market involves risks, including economic, logistical, and regulatory risks. Airlines and fuel producers must be confident that SAF development and production pathways are robust and stable to support the reliable service consumers expect.
2. **ASTM Approval Requires Significant Investment**—New SAF formulations must meet a strict list of operational, performance, and safety standards set by ASTM International before they can be used in an aircraft (and only at up to 50% blends with conventional jet fuel). Thousands of gallons of SAF are needed for this approval process, only possible by piloting production processes at a large scale and at a cost of up to $10,000 per gallon of liquid fuel.



New SAFs must go through a rigorous evaluation process by ASTM International before they can be used in aircraft, even if these fuels are fully compatible with existing engines (i.e., a "drop-in" fuel). Illustration by Joelynn Schroeder, NREL

Tap High-Performance Computing

NREL's high-performance computing system is the largest in the world dedicated to advancing renewable energy and energy efficiency technologies. With this capability at hand, researchers can perform highly detailed simulations on SAF combustion, operation, performance, and emissions, as well as integrated models that predict the production and deployment of a new SAF pathway in the market.

Photo by Dennis Schroeder, NREL 53840

NREL Models Rapidly Demystify Risks To Guide Investments

With world-class models and supercomputing capabilities combined with accurate property measurement, the National Renewable Energy Laboratory (NREL) can turn even the most complex SAF property characterization challenges into achievable successes. NREL provides holistic analysis and modeling to guide investments and accelerate the broad adoption of SAF.

- **Measuring Accurate Properties at Actual Conditions**—NREL measures fuel properties critical to turbine engine performance at extreme operating conditions, such as at very low or high temperatures and pressures, which enables high-fidelity simulations of fuel effects on turbine performance.
- **Reducing ASTM Approval Risks**—Using accurately measured fuel properties, NREL models and simulates critical fuel properties and performance in early stages of technology development, helping companies prioritize technologies most likely to receive ASTM approval.
- **Mapping Fuel Properties to Performance**— Using simulations and property measurements, NREL accurately relates fuel properties to performance, helping de-risk the transition from 50% SAF blends—the current ASTM limit—to the use of pure SAF. This also clears the way for future SAF formulations specially tuned for novel new turbine designs to achieve even greater performance and emissions advantages.
- **Securing Critical Pathways**—Using physical and virtual modeling, NREL can empower feedstock producers and hydrotreating technology providers with a holistic look at economics, risks, and feedstock supply chains.

Unlock the Benefits of NREL's SAF Modeling

1. **Fuel property measurements and high-fidelity simulations** to understand how SAF impacts engine performance well before investing in large volumes of fuel for ASTM approval.
2. **Novel SAF formulas and production pathways** for fuel with lower carbon intensity and higher energy content.
3. **Trade-off modeling and analysis** to address pre-production risks, including cost, feedstock availability, production volumes, carbon intensity, and fuel properties.
4. **Partnerships with engine manufacturers** to understand relationships between key fuel properties and possible maintenance or engine problems in the future.

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