

EAGLE AirVenture 2025

Transition to the Unleaded Aviation Fuels

Monday, July 21, 2025

11:30 a.m. – 12:45 p.m. CDT

EAGLE's Goal and Partners

“Eliminate the use of leaded aviation fuels for piston-engine aircraft in the United States by the end of 2030 (2032 for Alaska) without adversely impacting the safe and efficient operation of the existing fleet.”



American
Petroleum
Institute



Agenda

11:30 – 11:34 Welcome and Introductions (4 mins)

11:34 – 11:40 Co-Chair Remarks (6 mins)

11:40 – 12:00 Progress Made (20 mins)

- Fuel Status and Updates
- Reauthorization Language

- Nationwide Transition Plan – Phased Approach – Phase 1

- ✓ Fuel Authorization
- ✓ Comparative Testing
- ✓ Early Adoption / SAIB

12:00 – 12:10 Understanding Tactical Impact (10 mins)

- Potential Limitations / Material & Detonation Impacts
- Work in Progress to Understand and develop mitigations as needed
 - R&D Pillar and FAA Research and Development

12:10 – 12:25 Industry Impacts – CEOs (15 mins)

- Pilots, Aircraft Owners & Mechanics – AOPA
- Fixed Base Operators (FBOs) and Distributors – NATA
- Manufacturers – GAMA
- Business Operations - NBAA

12:25 – 12:45 Q&A (20 mins)

12:45 Summary and Closeout

What Is a Viable Unleaded Replacement for 100LL Avgas?

Safety

- Engines and aircraft must continue to meet FAA airworthiness requirements
- Components of a new fuel must be acceptable for use

Production & Distribution

- Understanding of fuel to make business decisions for supply to end user aircraft
- Can be produced and distributed in quantities and locations to meet U.S. need

Consumer Use and Continued Operational Support

- Economically reasonable for consumers
- Manufacturer understanding of fuel for continued technical and warranty support

EAGLE Leadership Perspectives

Setting the Stage – EAGLE Co-Chairs

- **Transition to Unleaded Fuel / Reauthorization Language – Caitlin Locke, FAA**
- **Industry Engagement – Curt Castagna, NATA**

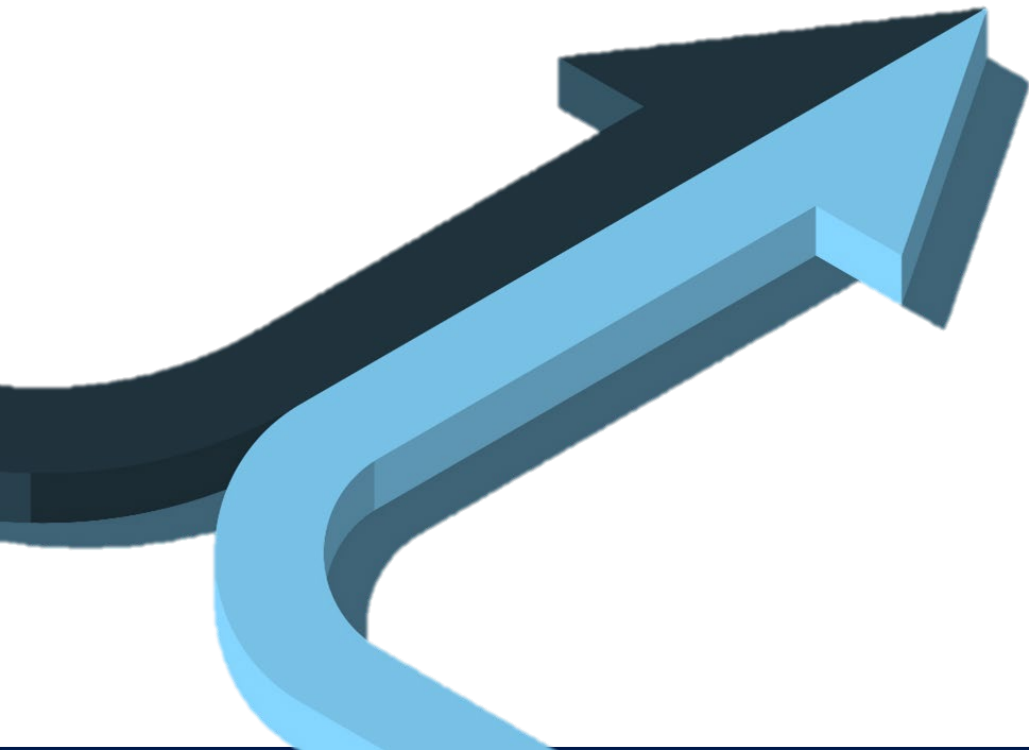
Progress: Unleaded Fuels Update

- **Two Pathways for Unleaded Fuel Authorization/Approval**
- **Fuel Status Updates**
 - **STC Pathway**
 - G100UL (GAMI)
 - 100R (Swift Fuels)
 - **Fleet Authorization Pathway**
 - UL100E Testing Update (LyondellBasell/VP Racing – PAFI)

Two Paths to Approve Use of Fuel

Supplemental Type Certificate Process

- Traditional FAA aircraft type certification process
- GAMI & Swift Fuels are pursuing FAA STC approval for high-octane unleaded fuel use



Fleet Authorization Process

- FAA aviation fuel fleet authorization process established by Congress through a collaborative industry/government testing program
- LyondellBasell/VP Racing are pursuing FAA authorization of a high-octane unleaded fuel through the PAFI

Unleaded Fuel Update – GAMI's G100UL



- FAA Approved Model List STC (AML STC) – All Certified Piston Engine Airplanes
 - SE01966WI Part 33 Engine AML STC includes all FAA type-certificated spark-ignition piston engines
 - SA01967WI Part 23 Airplane AML STC includes all type-certificated fixed-wing airplanes
- Project for Rotorcraft Airframe STC ongoing (Engines approved)
- Vitol Aviation has produced 1.3 million gallons
- G100UL currently available at Reid-Hillview-CA, Watsonville-CA, Tupelo-MS, Refugio County-TX, Ada-OK



Thursday, July 24, 11:30 AM – 12:45 PM, Forum: Stage 8

Unleaded Fuel: New Developments (GAMI)

As the nation transitions to unleaded fuel, learn about new developments and what information may be important for the aircraft owner.

Unleaded Fuel Update – Swift Fuels 100R



- FAA issued initial **100R** STCs for airframe and engines:
 - SE4651CH Part 33 Engine STC for Lycoming IO-360-L2A engines
 - SA04652CH Part 23 Airplane STC for Cessna 172 R/S
 - AML Expansion for both engines & airplanes is underway
- Working with ASTM International for industry consensus Production Spec
- California's San Carlos Flight Center (SCFC) announced in its January 2025 press release that it had transitioned its fleet of Cessna 172 aircraft to using Swift Fuels' 100R fuel
- As of June 2025, researchers at the Southern Illinois University (SIU) are also assessing the Swift Fuels' 100R in two of its Cessna 172S training planes and comparing operational data to other planes in the fleet that use 100 low-lead fuel



Monday, July 21

1:00 PM – 2:15 PM

Swift Fuels Unleaded Avgas

Forum: Stage 11

Join us for the latest news on FAA certification, ASTM International standards, and the latest transitioning on UL94 & 100R sales. We'll include nationwide pilot and expert testimonials.

Wednesday, July 23

12 Noon – 1:30 PM

Swift Fuels–Transition to Unleaded Avgas FAA Safety Center

Join us for a discussion on the statutory 5-year transition plan to 2030 with technical highlights impacting pilot safety, aircraft reliability, OEM alignment, and regulatory discipline.

Unleaded Fuel Update – UL100E



LyondellBasell/VP Racing's UL100E

- Fuel evaluation testing being conducted under joint FAA/Industry Piston Aviation Fuels Initiative (PAFI) Test Program
 - Status of materials, engine & aircraft testing on the following slides
- Working with ASTM International to obtain an industry consensus test specification



Wednesday, July 23, 8:30 AM – 9:45 AM, Forum: Stage 11

UL100E PAFI Testing Update (Lyondell)

The presentation will focus on the properties and performance of UL100E, a new 100-octane unleaded fuel for piston aircraft. UL100E is the only remaining candidate fuel in the FAA PAFI program. Lyondell and VP Racing Fuels jointly developed the fuel and have balloted an ASTM specification for UL100E. The fuel will be flown in the AirVenture Cup by Andy Findlay in his Lancair Super Legacy.

UL100E Full Scale PAFI Testing Status as of July



flyEAGLE.org

Piston Aviation Fuels Initiative (PAFI)
Full Scale Testing Status
LyondellBasell / VP Racing UL100E

Last Updated: 6/25/2025

Detonation & Performance

| Engine | Completed |
|--|------------|
| <input type="checkbox"/> Lycoming IO-540-K1A5 | 100% |
| <input type="checkbox"/> Continental TSIO-520-VB | 93% |
| <input type="checkbox"/> Continental IO-550-D | 0% |
| <input type="checkbox"/> Continental O-470-U | 0% |
| <input type="checkbox"/> Lycoming TIO-540-J2B | 0% |
| <input type="checkbox"/> P&W R-1830 S1C3-G | 0% |
| Total | 32% |

Durability & Performance

| Engine | Completed |
|---|------------|
| <input type="checkbox"/> Continental TSIO-550-K | 100% |
| <input type="checkbox"/> Lycoming IO-540-D4A5 | 10% |
| <input type="checkbox"/> Air Repair W670-6N | 0% |
| <input type="checkbox"/> Continental TSIO-550-K (Oil) | 0% |
| <input type="checkbox"/> Lycoming TIO-540-AE2A | 0% |
| Total | 22% |

Additional Engine Testing

| Type | Completed |
|---|------------|
| <input type="checkbox"/> Fuel Quantity Gauging | 75% |
| <input type="checkbox"/> Propeller Vibration | 25% |
| <input type="checkbox"/> Cold Starting | 0% |
| <input type="checkbox"/> Combustion Heat Transfer Testing | 0% |
| Total | 25% |

Scheduled completion: Sept 2026

Research & Development

| Engine | Completed |
|--|------------|
| <input type="checkbox"/> Lycoming IO-540-K1A5 | 100% |
| <input type="checkbox"/> Continental TSIO-520-VB | 82% |
| <input type="checkbox"/> Lycoming TIO-540-AJ1A | 0% |
| <input type="checkbox"/> Lycoming TIO-540-J2B | 0% |
| <input type="checkbox"/> Continental IO-550-D | 0% |
| <input type="checkbox"/> Continental O-470-U | 0% |
| Total | 30% |

Aircraft Flight Testing

| Aircraft | Completed |
|---|------------|
| <input type="checkbox"/> Lancair Super Legacy | 100% |
| <input type="checkbox"/> CCF Harvard IV | 6% |
| <input type="checkbox"/> Beechcraft G36 | 2% |
| <input type="checkbox"/> Cessna 182Q | 2% |
| <input type="checkbox"/> Cessna 402C | 2% |
| <input type="checkbox"/> Cessna T206H | 2% |
| <input type="checkbox"/> Cirrus SR22T | 2% |
| <input type="checkbox"/> Piper PA-46-350 | 2% |
| <input type="checkbox"/> Robinson R44 II | 2% |
| Total | 13% |

Scheduled completion:
Sept 2026

Materials Compatibility

[Testing Details](#)

14 Categories / 193 Materials

| Category | Completed |
|---|------------|
| <input type="checkbox"/> O-Rings (5) | 100% |
| <input type="checkbox"/> OEM Wing Test (4) | 93% |
| <input type="checkbox"/> Paint Systems (10) | 92% |
| <input type="checkbox"/> Fuel Bladders (12) | 92% |
| <input type="checkbox"/> OEM Materials/Parts (28) | 77% |
| <input type="checkbox"/> Polysulfides (9) | 72% |
| <input type="checkbox"/> Aircraft Hoses (5) | 20% |
| <input type="checkbox"/> Non-Metallics (27) | 19% |
| <input type="checkbox"/> Metallics (32) | 9% |
| <input type="checkbox"/> Composite Resins (17) | 0% |
| <input type="checkbox"/> Composites (21) | 0% |
| <input type="checkbox"/> Distribution System (15) | 0% |
| <input type="checkbox"/> Fabric Systems (5) | 0% |
| <input type="checkbox"/> Finished Parts (5) | 0% |
| Total | 41% |

Scheduled completion: Sept 2026

UL100E Fleet Authorization
Scheduled completion: Spring 2027

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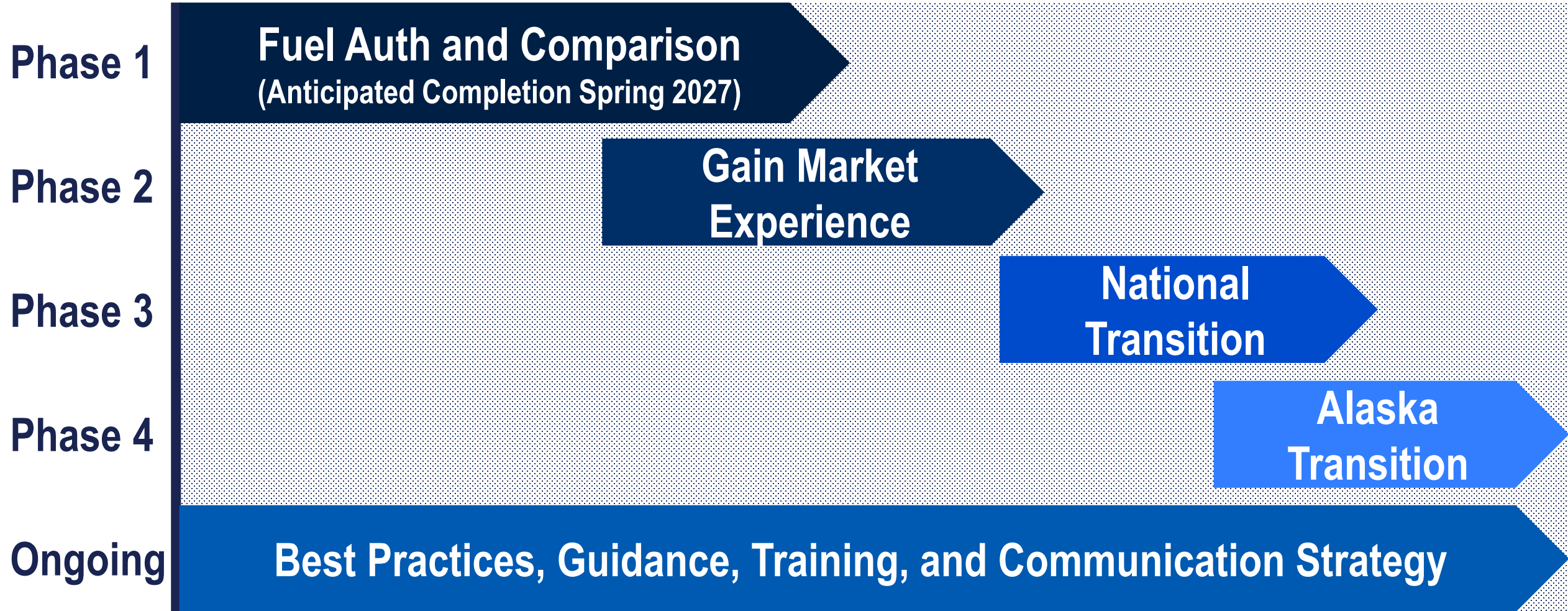
Source: FAA Piston Aviation Fuels Initiative (PAFI)

Progress:

Building Toward the Transition to Unleaded Fuels

- Reauthorization Language
- FAA Developing Transition Plan
 - Phased Approach through December 2030
 - First Phase:
 - ✓ Fuel Authorization
 - ✓ Comparative Testing
 - ✓ Early Adoption / SAIB

Phased Approach for Transition



Special Airworthiness Information Bulletin



- SAIB-2025-04
 - Support to the transition to unleaded fuels
 - Collaborate with aviation stakeholders to collect data and understand any impacts to piston-powered GA aircraft
- Continue to submit information and reports
 - **OperationalSafety@faa.gov**;
Subject Line: “Unleaded Fuel”



FAA
Aviation Safety

SPECIAL AIRWORTHINESS INFORMATION BULLETIN

SUBJ: UNLEADED FUEL

SAIB: 2025-04

Date: March 28, 2025

This is information only. Recommendations aren't mandatory.

Introduction

This Special Airworthiness Information Bulletin (SAIB) advises aircraft operators, fixed base operators, Federal Aviation Administration (FAA) repair stations, Flight Standards District Offices (FSDO), and Foreign Civil Aviation Authorities to report to the FAA any issues (service difficulties, maintenance) related to the use of unleaded fuel when used as an alternative to any other fuels. The FAA has not identified an unsafe condition that would warrant airworthiness directive action under Title 14 of the Code of Federal Regulations (14 CFR) part 39.

In 2022, the FAA announced a government-industry initiative known as Eliminate Aviation Gasoline Lead Emissions (EAGLE), with the goal of transitioning to lead-free aviation fuels for piston-engine aircraft in the United States without adversely impacting the safe and efficient operation of the existing general aviation (GA) fleet. The FAA aims to collaborate with aviation stakeholders to collect data and understand any impacts to piston-powered GA aircraft as unleaded fuels are introduced, and usage of unleaded fuel increases.



Comparative Testing – Replacement Unleaded Fuels

Specification and Fit for Purpose

Compare and contrast leaded and unleaded fuel properties and verify conformity to their respective specifications prior to initiating engine and materials testing.

Engine Testing

- Performance Testing – Sea level testing
- Limited Detonation Testing
- Engines utilized:
Lycoming TIO-540-J2B and IO-540-K1A5
Continental IO-550-D, TSIO-520-VB,
O-470-U, and TIO 540-AJ1A

Testing Materials

- O-ring Material (Fuel system)
- Bladder Coupons (Fuel system)
- Tubing (Fuel system)
- Polysulfide Sealants (Aircraft)
- Paint and Fabric (Aircraft)
- Accelerated Storage (Storage/Aging)
- Cold Storage (Storage/Aging)

Toxicology Testing (Unleaded Fuels and 100LL)

Compare relative risks from exposure to fuels in the workplace and environment.

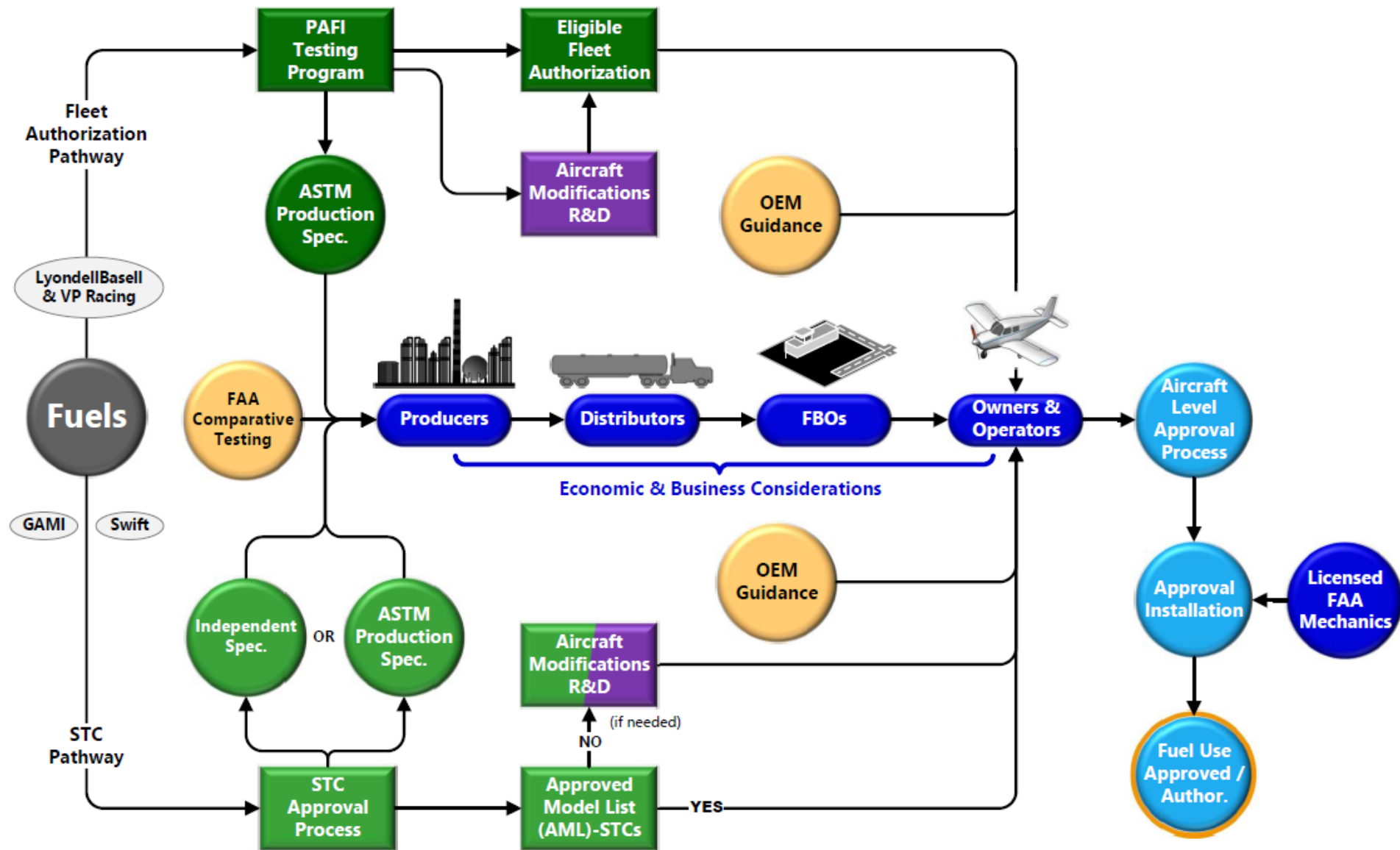
Anticipated Completion – Summer 2026

Progress:

Understanding the Tactical Impact

- EAGLE R&D Pillar Collaborations
- FAA Research and Development

Transition to Unleaded Aviation Gasoline – “Big Picture”





- Facilitate stakeholder support for the development and deployment of viable replacements for 100LL.
- **Research and develop technical solutions to mitigate the potential impacts on the existing GA fleet.**
- Inform the regulatory and policy processes to safely and smartly transition to a viable replacement to eliminate lead emissions.
- Protect the availability of 100LL during the transition.



Octane – Detonation Protection Performance

- FAA & industry fuel development best practices (flyeagle.org) identifies critical engine models for detonation testing
 - Critical worst-case engines for detonation testing
 - Lycoming IO-540-K1A5 & TIO-540-J2BD
 - FAA AC 33.47.1 and ASTM D6424 and D6812 Methods

Materials Compatibility – New Fuel Components/Chemistry

- PAFI TAC Materials Compatibility Test Plan (flyeagle.org)
- Testing & field experience identifies some potential impacts
 - Paint, fuel tank sealants, o-rings, aged bladders/patches

FAA SAIB to Collect Additional Field Experience for Potential Impacts

Octane – Detonation Protection Performance

- Detonation Testing Method of Compliance – Understanding of unleaded MON benefits & current measurement and monitoring capabilities may support update of current margins
- Changes to Operational Procedures (i.e., ignition timing, max manifold and cylinder temps)
- Engine Modifications (i.e., electronic ignition, compression ratio)

Materials Compatibility – New Fuel Components/Chemistry

- Comparative Testing/Assessment to understand potential materials issues
- Identification of Mitigations (i.e., practices, coatings, replacement materials)

Transition Planning to Consider FAA Certification/Approval and Deployment of any Mitigations

PAFI Technical Advisory Committee (TAC)



Steering Group (PSG)



Engine & Propeller OEMs



Aircraft OEMs



Fleet Operators



Accessory OEMs



Government Agencies



Fuel Distribution



Technical Support



EAGLE Leadership – CEO Perspectives – Industry Impact

- Pilots, Aircraft Owners & Mechanics – Darren Pleasance, AOPA
- Fixed Base Operators (FBOs) and Distributors – Curt Castagna, NATA
- Manufacturers – James Viola, GAMA
- Business Operations – Ed Bolen, NBAA

Questions?



Related AirVenture Fuel Forums



Mon, July 21, 1:00 PM – 2:15 PM

Forum Stage 11

Swift Unleaded Avgas (Swift Fuels)

Join us for a discussion on FAA certification news, an ASTM production standard update, and a transitioning UL94 to 100R sales update. We'll include nationwide pilot and A&P testimonials.

Tues, July 22, 10:00 AM – 11:15 AM

Workshop Classroom B

Wed, July 23, 10:00 AM – 11:15 AM

Forum Stage B

Piston Engine Fuels: What Pilots Need to Know (Lycoming)

Wed, July 23, 8:30 AM – 9:45 AM

Forum Stage 11

UL100E PAFI Testing Update (LyondellBasell)

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Wed, July 23, 12:00 Noon – 1:30 PM

FAA Safety Center

US Transition to Unleaded Avgas (Swift Fuels)

WINGS: BK3

Thurs, July 24, 11:30 AM – 12:45 PM

Forum Stage 8

Unleaded Fuel: New Developments (GAMI)

As the nation transitions to unleaded fuel, learn about new developments and what information may be important for the aircraft owner.

Thank you!

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Social (X)
Email

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info@flyEAGLE.org