Session 4 – Unleaded Fuel Transition

Presented to: Association of California Airports Annual Meeting, September 17, 2025

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Federal Aviation Administration

Focus Areas

- General Aviation Ecosystem
- CA Aviation 100LL Ecosystem
- EAGLE Initiative
- Unleaded Fuel Status
- FAA Reauthorization
- Discussion | Q&A

General Aviation 100LL Avgas Ecosystem

FAA regulates aircraft and engines, including use of fuel

Unregulated: Industry consensus standards and liability

Existing General Aviation Aircraft Fleet (~ 220,000 aircraft in US)

Aircraft and engine designers/builders demonstrate safe flight with a given fuel

Propeller driven, piston engined, aircraft and rotorcraft manufacturers Light Sport Aircraft manufacturers, Experimental aircraft (builders, kits, modifications, etc.)

Each aircraft is marked for what fuel(s) it can safely use

Aircraft Approved to Use Fuel

Existing 100LL Fuel Supply and Storage (~3600 airports in US)

100LL is a commodity fuel

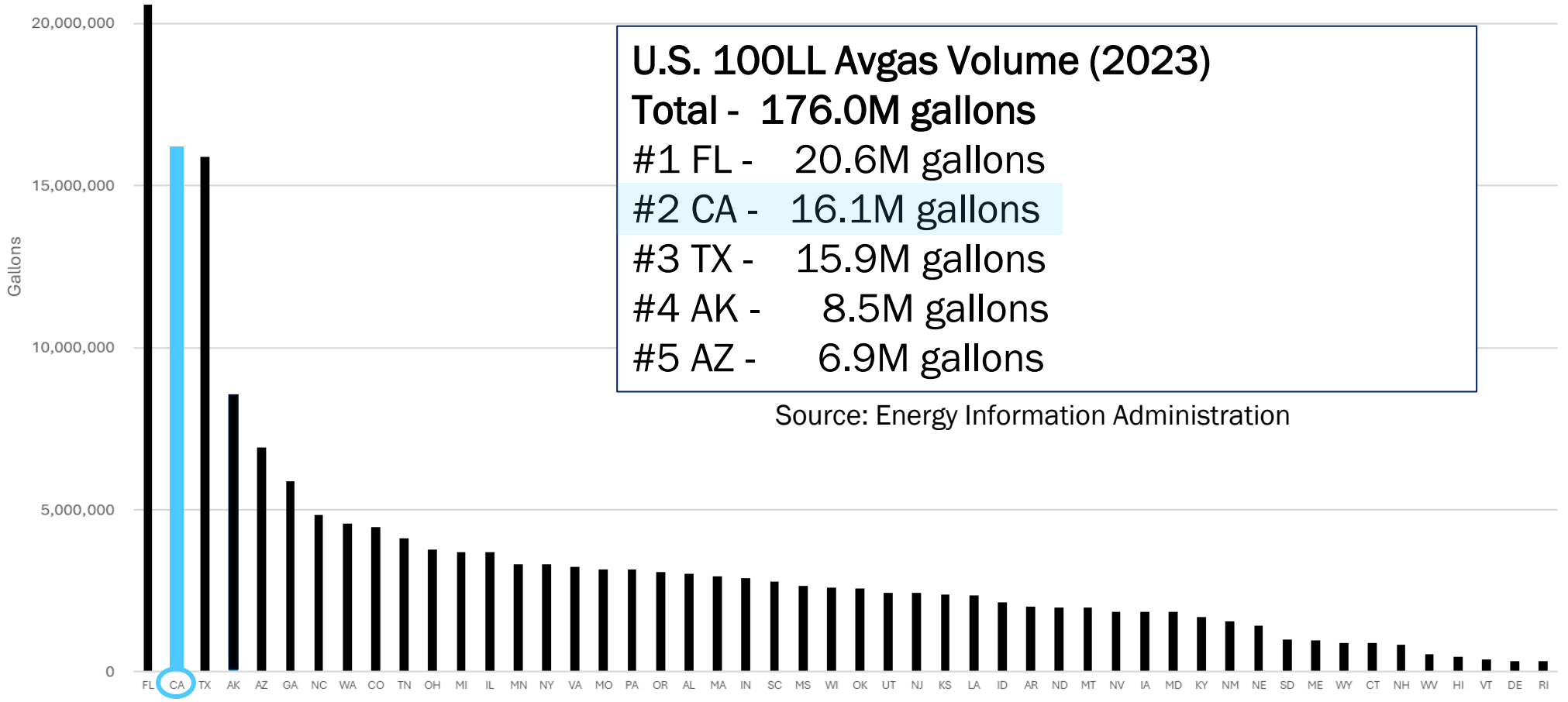
Avgas production and distribution

~180M gallons of 100LL fuel annually

Storage & distribution on existing network

Federal Aviation Administration

CA 100LL Avgas EcoSystem



U.S. 100LL Avgas Volume (2023)
Total - 176.0M gallons
#1 FL - 20.6M gallons
#2 CA - 16.1M gallons
#3 TX - 15.9M gallons
#4 AK - 8.5M gallons
#5 AZ - 6.9M gallons

Source: Energy Information Administration

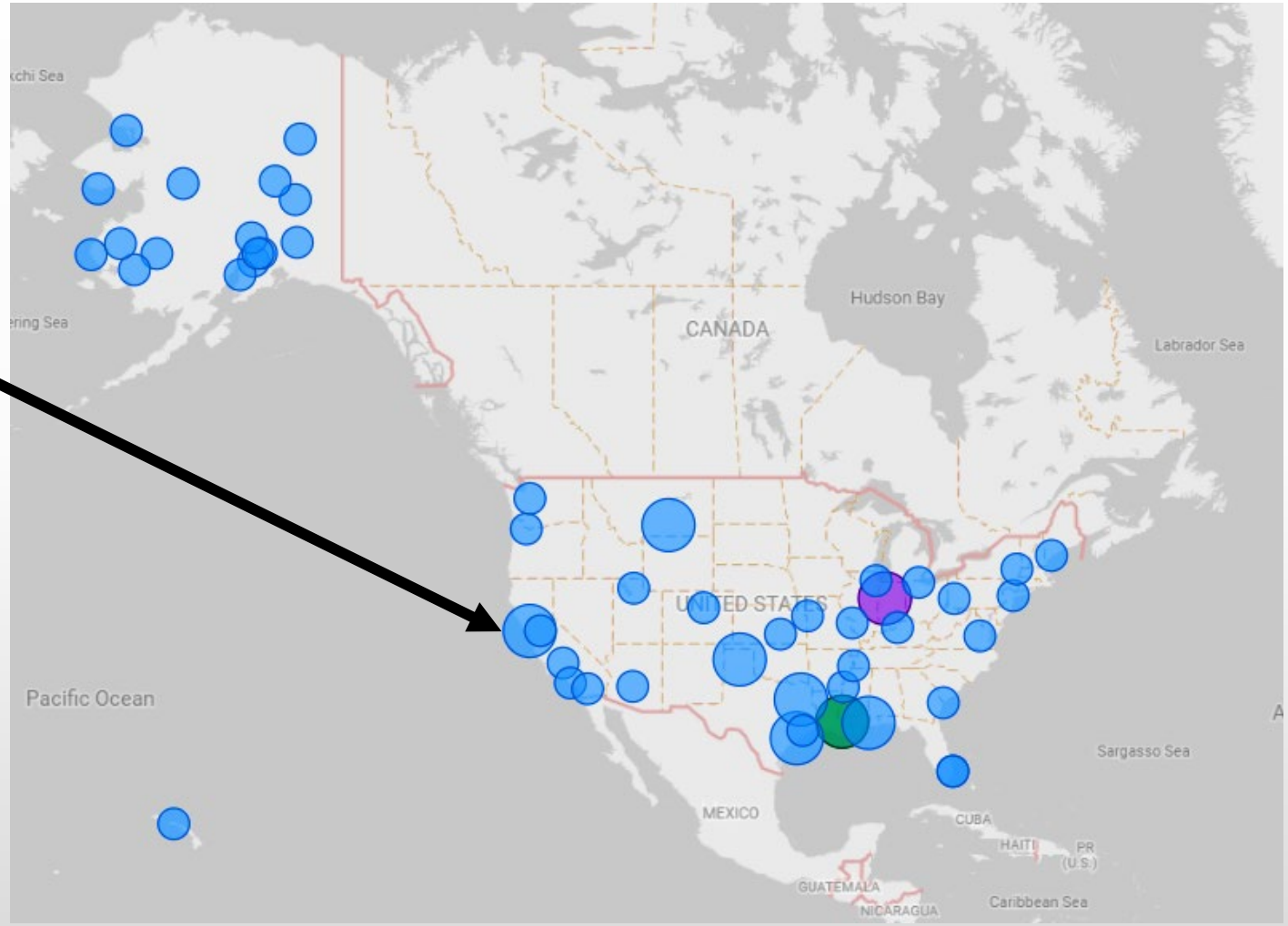
Federal Aviation Administration

National Supply Chain Infrastructure and Deployment/FBOs

U.S. Avgas Sources (2025)

- 9 Refinery facilities in the U.S.
- CA: Chevron-Richmond Refinery

- Refinery 100LL (7)
- Refinery G100UL (1)
- Refinery UL94 (1)
- Terminals



Source: Public information

National Supply Chain Infrastructure and Deployment/FBOs – 100LL

	Producers	Distributors	FBOs	Pilots	Fleet	Mechanics
U.S.	4	+15	+3,500	+460,000	+230,000	+300,000
California	1	5	174	42,000	20,000	27,000

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

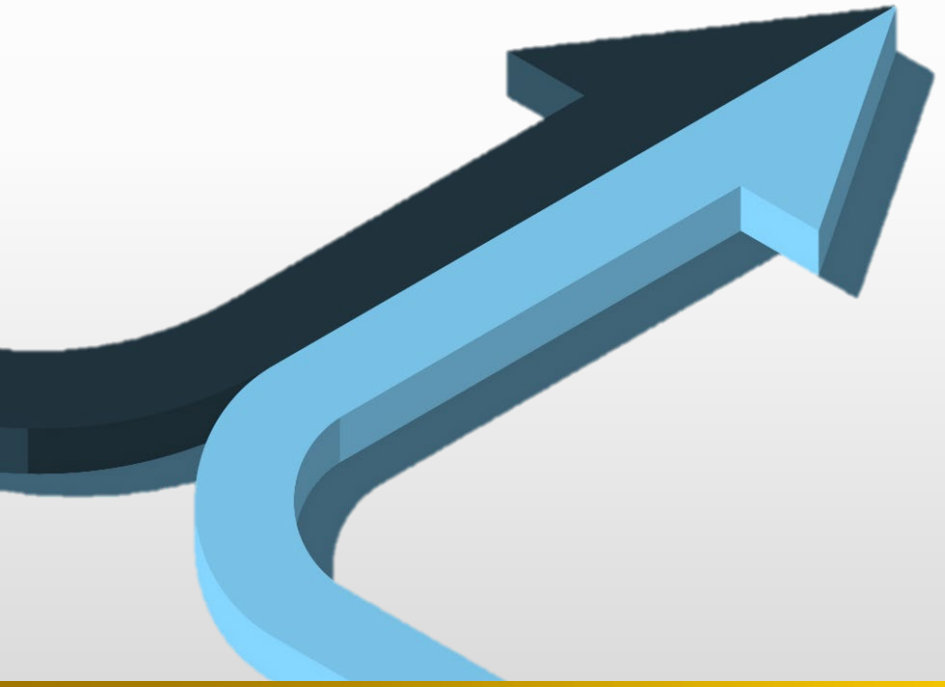
EAGLE's Goals and Partners

"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."

Two Pathways to Approve Use of Fuel

Supplemental Type Certificate Process

- Traditional FAA aircraft type certification process
- GAMI and 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 Status

Unleaded Fuel	FAA Authorization Pathway	Current Status (Sept 2025)
UL91/UL94	• Fleet Authorization (Planned) • Approved Model List (AML) Supplemental Type Certificate (STC) • OEM approvals	• Fleet Authorization – Pending • SWIFT STC – Approved • Select OEMs – Approved
GAMI G100UL	• AML STC • Independent Specification	• Engine AML STC – Approved • Airplane AML STC – Approved • Rotorcraft AML STC – In progress
Swift Fuels 100R*	• STC / AML STC • ASTM Specification	• ASTM Production Specification – Approved • Initial Engine STC – Approved • Initial Airplane STC – Approved • Expanded Engine AML STC – In progress • Expanded Airplane AML STC – In progress
LyondellBasell/VP Racing UL100E	• Fleet authorization • ASTM Specification in development	• FAA Initial PAFI testing – Complete • FAA Full Scale PAFI testing – In progress

Swift Fuels has indicated it may merge its certification efforts with the PAFI Fleet Authorization process in the months ahead, if this can accelerate approvals or help expand its deployment efforts to experimental and LSA.

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 is currently available at**
  - Reid-Hillview, CA
  - Watsonville, CA
  - Tupelo, MS

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

- On September 4, 2025, ASTM International published the final voting results **approving Swift Fuels' 100R unleaded avgas for an ASTM International Production Specification.**

- **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**

Unleaded Fuel Update – LyondellBasell/VP Racing's UL100E

- **Fuel evaluation testing being conducted** under joint FAA/Industry Piston Aviation Fuels Initiative (PAFI) Test Program
- Working with ASTM International to **obtain an industry consensus test specification**

UL100E Full Scale PAFI Testing Status as of August

flyEAGLE.org

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

Last Updated: 8/12/2025

Detonation & Performance

Engine	Completed
Lycoming IO-540-K1A5	100%
Continental TSIO-520-VB	93%
Continental IO-550-D	0%
Continental O-470-U	0%
Lycoming TIO-540-J2B	0%
P&W R-1830 S1C3-G	0%
Total	**32%**

Research & Development

Engine	Completed
Lycoming IO-540-K1A5	100%
Continental TSIO-520-VB	82%
Lycoming TIO-540-AJ1A	0%
Lycoming TIO-540-J2B	0%
Continental IO-550-D	0%
Continental O-470-U	0%
Total	**30%**

Materials Compatibility

Testing Details

14 Categories / 214 Materials

Category	Completed
O-Rings (5)	100%
OEM Wing Test (5)	98%
Paint Systems (10)	94%
Fuel Bladders (12)	92%
OEM Materials/Parts (50)	87%
Polysulfides (9)	72%
Aircraft Hoses (5)	20%
Non-Metallics (27)	19%
Metallics (32)	9%
Composite Resins (17)	0%
Composites (21)	0%
Distribution System (15)	0%
Fabric Systems (5)	0%
Finished Parts (5)	0%
Total	**42%**

Durability & Performance

Engine	Completed
Continental TSIO-550-K	100%
Lycoming IO-540-D4A5	44%
Air Repair W670-6N	0%
Continental TSIO-550-K (Oil)	0%
Lycoming TIO-540-AE2A	0%
Total	**29%**

Aircraft Flight Testing

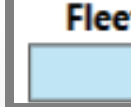
Aircraft	Completed
Lancair Super Legacy	100%
CCF Harvard IV	58%
Beechcraft G36	2%
Cessna 182Q	2%
Cessna 402C	2%
Cessna T206H	2%
Cirrus SR22T	2%
Piper PA-46-350	2%
Robinson R44 II	2%
Total	**19%**

Additional Engine Testing

Type	Completed
Fuel Quantity Gauging	80%
Propeller Vibration	25%
Cold Starting	0%
Combustion Heater Testing	0%
Total	**26%**

Scheduled completion: Sept 2026

UL100E Fleet Authorization



36%

Scheduled completion: Spring 2027

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

2024 FAA Reauthorization Act

•**SEC. 827. EAGLE INITIATIVE** – This section requires the FAA to continue to partner with industry and other Federal government stakeholders to carry out the Eliminate Aviation Gasoline Lead Emissions Initiative (EAGLE Initiative) through the end of 2030. This section specifies that the FAA shall take such actions as may be necessary to facilitate:

1) the **safe elimination of the use of leaded aviation gasoline by piston-engine aircraft by the end of 2030** without adversely affecting the safe and efficient operation of the piston-engine aircraft fleet.

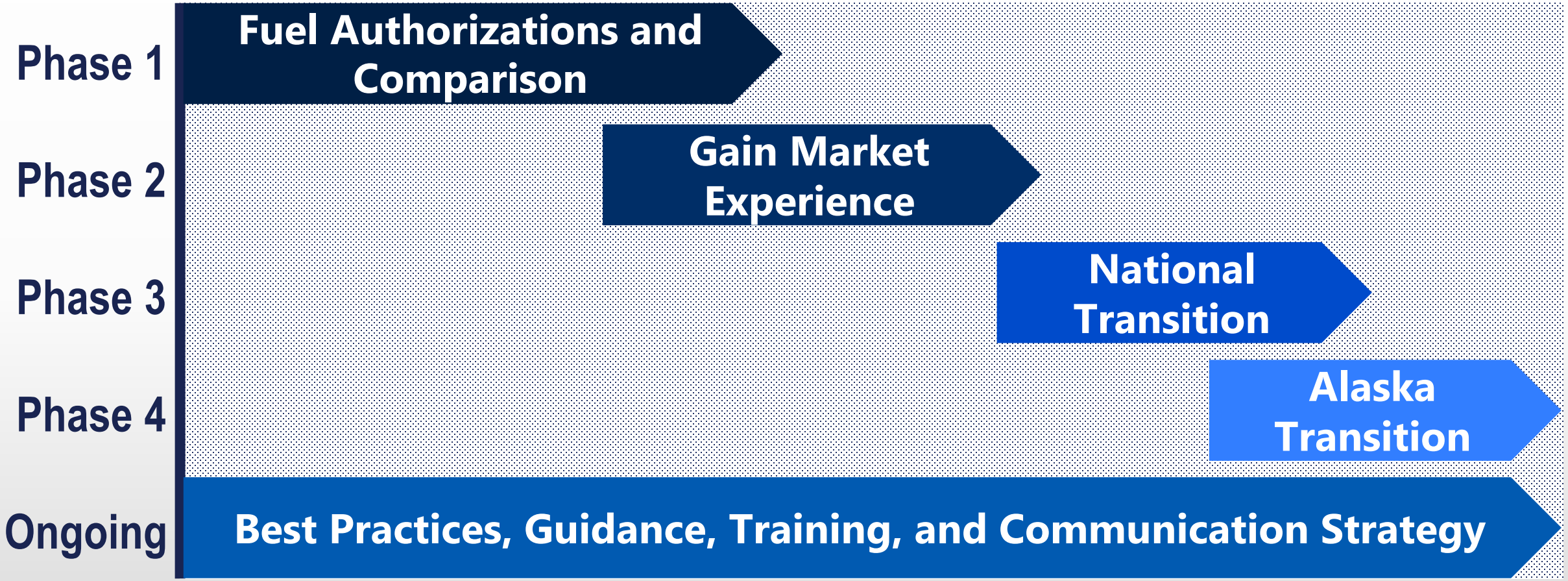
2) the **approval of the use of unleaded alternatives to leaded aviation gasoline for use** in all piston-engine aircraft types and piston-engine types.

3) the **implementation of the requirements relating to the continued availability** of aviation gasoline.

4) efforts to make unleaded aviation gasoline **widely available** for purchase and use at airports, and

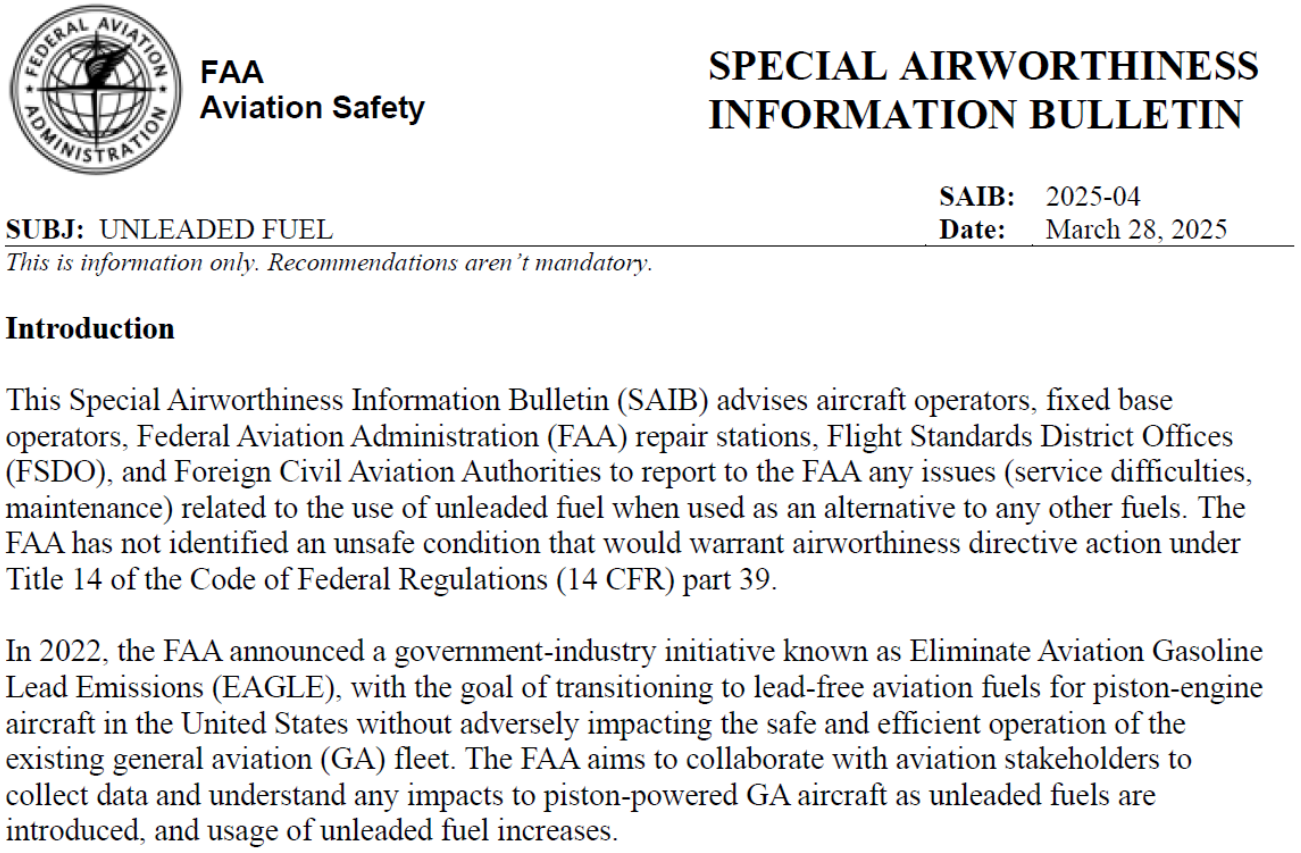
5) the **development of a transition plan** in consultation with industry and the EAGLE initiative.

Phased Approach to 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

SAIB: 2025-04
Date: March 28, 2025

SUBJ: UNLEADED FUEL

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.

FAA Office of Airports Update

1 – What do Airports Need to Know?

- Gradual transition
- Airport owners/operators, service providers, users have a role in the transition
- Key actions:
  - Work to offer unleaded fuel types (while maintaining 100LL).
    - Include transition to unleaded fuels in airport planning initiatives.
  - Increase distance between run-up locations and people on/off airport by relocating run-up locations or distributing run-ups.
  - Minimize engine idle time and run-up time.
  - Promote airport and pilot awareness.

2 – New Grant Assurance 40

- Implements Section 770 of the FAA Reauthorization Act of 2024
- Grant Assurance 40 specifies that if 100-octane low lead aviation gasoline (100LL) was available at an airport at any time during 2022, the airport owner or operator cannot restrict or prohibit the sale or self-fueling of 100LL for use by general aviation aircraft operators until certain criteria are fulfilled
- As of now, the Administrator has not authorized a replacement fuel for 100LL for aircraft, including rotorcraft, that meet the criteria set forth in Section 770 of the FAA Reauthorization Act of 2024 (47107(22)(B)(i) and (ii)).
- The FAA will provide additional information when the criteria are met.

2 – New Grant Assurance 40

For additional information, see:

1. FAA message to Airports on Grant Assurance 40
   - https://content.govdelivery.com/accounts/USAFAA/bulletins/3e58058
2. FAA Grant Assurances Page (see updated Grant Assurances)
   - https://www.faa.gov/airports/aip/grant_assurances/assurances-airport-sponsors-2025
3. Questions/Answers on Grant Assurance 40, Access to Leaded Aviation Gasoline
   - https://www.faa.gov/airports/airport_compliance/compliance_guidance/Grant-Assurance-40-Leaded-Aviation-Gas-QA.pdf

3 – Support for Transition-Enabling Infrastructure

- **FAA Support for Transition-Enabling Infrastructure**
  - Infrastructure Investment and Jobs Act (IIJA) Airport Infrastructure Grant (AIG) allocated funds can be used on sponsor-owned revenue producing aeronautical support facilities such as fuel farms.
    - For additional information, see IIJA FAQs (https://www.faa.gov/iija/faq/IIJA_FAQs.pdf)
  - The FAA is authorized to provide funding for aircraft fueling systems, e.g., to add an additional tank or to purchase a fuel truck.
    - Please coordinate with your respective FAA Airports District Office.
    - FAA published Reauthorization Program Guidance Letter (PGL) 25-02.
    - See Section 702(2)(G), Fueling Systems: (https://www.faa.gov/airports/aip/guidance_letters/R-PGL-25-02-AIP-Discretionary-Set-Aside)
- **Include transition to unleaded fuels in airport planning initiatives and identify in Airport Capital Improvement Plans.**

4 – Resources

- EAGLE website – https://flyeagle.org/
- FAA.gov
  - FAA.gov – Aviation Gasoline Overview
  - FAA.gov – What can airports do in the short-term?
  - FAA.gov – Building an Unleaded Future by 2030
- National Academies, Consensus Report - Options for Reducing Lead Emissions
- NATA Factors Affecting the Commercial Sale of Emerging Unleaded Aviation Fuels
- NATA White Paper, Unleaded Avgas Considerations For Aviation Fuel Providers
- EAGLE/FAA - Guidance on Transitioning a Flight School to Unleaded Avgas
- ACRP 03-73, Airport Guide for Transitioning to Unleaded Aviation Gasoline
- Grant Assurance 40, Questions/Answers on Grant Assurance 40, Access to Leaded Aviation Gasoline (https://www.faa.gov/airports/airport_compliance/compliance_guidance/Grant-Assurance-40-Leaded-Aviation-Gas-QA.pdf)

5 – Key Airport Takeaways

- The transition to an unleaded future is underway.
- The goal is to: 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.
- Unleaded fuels are available today; UL94 and 100R from Swift Fuels and G100UL from GAMI.
- Airport owners/operators, service providers, users can take constructive actions today:
    - Work to offer unleaded fuel types (while maintaining 100LL). Plan for transition in airport planning initiatives. FAA is authorized to provide funding for aircraft fueling systems (through AIP, IIJA).
    - Increasing distance between run-up locations and people by relocating run-up locations or distributing run-ups.
    - Minimizing engine idle time and run-up time.
    - Promoting airport and pilot awareness.
- New Grant Assurance 40 prohibits airports from restricting 100LL availability.
- Resources are available at: https://flyeagle.org/, faa.gov, etc.

Please visit EAGLE's website at www.flyEAGLE.org
Contact EAGLE at info@flyEAGLE.org

Engage on social media / X with @flyEAGLEorg

Discussion

BACK-UP

3 – Section 770

SEC. 770. GRANT ASSURANCES – This section requires that airports that offered 100-octane low lead aviation gasoline for sale in 2022 to continue offering such gasoline for sale until the earlier of 2030 or the date on which a FAA-certified unleaded aviation gasoline alternative can be made available for purchase or use by general aviation aircraft operators at airports subject to certain conditions. Any airport violating this grant assurances will be assessed a civil penalty of not more than $5,000 per day if the airport fails to comply with the grant assurance.

- **SEC. 771. AVIATION FUEL IN ALASKA** – This section extends the 2030 deadline provided in § 770 in the state of Alaska until the earlier of
  - December 31, 2032; or
  - 6 months after the date on which the Administrator of the Federal Aviation Administration finds that an unleaded aviation fuel is widely commercially available at airports throughout the State of Alaska

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.

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)

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

Toxicology Testing (Unleaded Fuels and 100LL)

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