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Sticking the Landing with Safe Skies: an Investigation into the Transition to Unleaded Aviation Gas

Abstract

The prevalence of lead in industry products has been a burden on the public health of American communities for decades. Leaded aviation gas remains as a stubborn source of lead pollution in the skies above American communities. Boston University students Ariana Seniuk, Lauren Magee, and Christopher Donatelli worked with national non-profit Quiet Communities staff Dr. Jamie Banks and Becky Petrou O'Rourke to understand the current state of the transition to unleaded aviation gas, identify bottlenecks, and find incentives and policy changes that can help accelerate the transition. What was discovered was a jumbled, interconnected landscape of private, state, and non-state actors with competing ideas. A transition to unleaded aviation gas makes those in the sky and on the ground safer. Through our research on the current state of the problem, we identified points of leverage to help accelerate the transition.

Introduction

Despite leaded gas for automobiles being phased out in 1995, leaded aviation gas, also known as "100LL" (low lead), emitted by piston engine planes continues to be an issue plaguing residents and environments near airports that use leaded aviation gas across the nation.

Leaded aviation gas is the largest source of atmospheric lead in the United States (US EPA, 2023), and the EPA states that "there is no evidence of a threshold below which there are no harmful effects on cognition from lead exposure," (US EPA, 2023). Lead exposure has irreversible health effects on children, including a decreased IQ, cognitive function, and academic performance. It is also detrimental to environmental health, including its adverse effects on soil quality and biodiversity. Atmospheric lead emitted from aircrafts can be inhaled directly, or it can be consumed after it settles into soil or dust (Miranda *et al.*, 2011).

Additionally, atmospheric lead pollution disproportionately affects individuals residing near airports. A 2011 study by Miranda *et al*. revealed that children living within 1000 meters of an airport that uses leaded aviation gas have higher levels of lead in their blood than children who do not. The authors employed a spatial analysis to find that there was the largest impact on lead blood levels on children living within 500 meters of an airport that uses leaded aviation gas, a smaller, but still significant impact on children living within 1000m. This study and others like it speak directly to the ongoing debate about the public health impacts due to leaded aviation gas

and the transition to unleaded aviation gas.

As a result of these severe public and environmental health implications, there is a need to investigate the landscape surrounding atmospheric lead emitted from piston engine aircrafts, to determine why this transition is such a slow process, and to explore future recommendations for research, government agencies, and private organizations.

Research question

This project aims to investigate the current state of the transition to unleaded aviation gas, in order to identify the next steps to help accelerate a phase out. We sought to understand what variables and stakeholders are barriers to the transition and discover what airports have successfully made the switch. Major changes in the aviation industry require firm safety and regulatory standards due to the risk involved with flying, therefore a large emphasis on understanding the hesitation some stakeholders and pilots have is important in gaining the trust of those using the new unleaded fuel. Because of this, we also investigated who holds liability and indemnity in the case of an accident. Sensitivity and thorough understanding of the mechanics of the new fuel is required since one accident with a new unleaded fuel source can tarnish people's trust in the initiative to switch fuels. Overall, our investigation into the current state of the transition involved discussions with a wide variety of stakeholders in the industry in order to discover what steps could help accelerate a widespread use of unleaded fuel.

Methods

Identifying the major stakeholders in the aviation industry, public health, and environmental health was integral to targeting potential interviewees and understanding the landscape of the transition to unleaded aviation gas. These include:

- Federal Aviation Administration (FAA)
- Eliminate Aviation Gasoline Lead Emissions (EAGLE)
- United States Environmental Protection Agency (US EPA)
- National Aviation Transportation Association (NATA)
- Aircraft Owners and Pilots Association (AOPA)
- Swift Fuels, sells UL94
- General Aviation Modifications, Inc. (GAMI), produces G100UL
- Pilots and mechanics
- American Society for Testing Materials (ASTM)

Based on the accessibility of the different stakeholders, we conducted a series of interviews to research and find out more about the landscape of the industry. These included:

- Curt Castagna, President and CEO of NATA, co-chair of EAGLE,

- Thomas Seniuk, Pilot and Flight School Administrator,
- Dr. Robert Kraus, Dean of UND Aerospace College,
- Cindy Chavez, Santa Clara County Supervisor, and
- George Braly, Co-Founder of General Aviation Modifications, Inc. (GAMI).

These interviews provided invaluable insight into the landscape of the aviation industry as a whole and more specifically into the transition to unleaded aviation gas. Our first interview was with Thomas Seniuk, in which we began to understand the intricacies of airport infrastructure and overall awareness of pilots of this issue. We also learned about the way that flight schools work and their potential role in transitioning to unleaded fuel.

We conducted two interviews with Curt Castagna, one which focused on an overall understanding of the state and barriers of the transition to unleaded aviation gas, and one which filled in some of the information we were missing in specific categories, such as industry and innovation, government affairs, and safety and education. He also touches on his thoughts regarding GAMI's fuel and bans of unleaded avgas.

Our last interview was with George Braly. Braly informed us about his hesitations for pursuing ASTM certification. Braly spoke about how he tested his fuel himself, his relationship with Vitol, a fuel distributor, and his plans to announce that G100UL is "commercially available."

Results

The Landscape of the Transition to Unleaded Aviation Gas

There have been several recent developments within the landscape of the transition to unleaded aviation gas. The county commissioned a report in 2021 that found that children living within half a mile of the airport had lead concentrations in their blood similar to that of the children of Flint, Michigan during the height of the Flint water crisis. The Santa Clara County Supervisors then immediately framed the issue as a public health issue for the community which resulted in rapidly forming political will to do something concrete. In January of 2022, Santa Clara County banned the use and sale of leaded aviation gas, more specifically, at the Reid-Hillview airport. This followed a peer-reviewed study showing elevated levels of lead in the blood of children living near the airport. Shortly after, the Federal Aviation Administration (FAA) created the Eliminate Aviation Gasoline Lead Emissions (EAGLE) in February 2022, with a goal of eliminating the use of leaded aviation gas in piston engine aircrafts by 2030. The EAGLE initiative aims to identify at least one unleaded fuel that is safe for general aviation fleet use, minimize safety and technical issues from unleaded avgas, facilitate production and distribution, and establish policies to support the transition, among other statements. However, this transition has not been without controversy. AOPA filed a complaint towards the airport that resulted in a formal part 16 investigation by the FAA. While the investigation resulted in the

airport having to perform maintenance on certain safety fixtures in the airport as well as a partnership with AOPA. It demonstrates that the transition is not without resistance.

In October of 2023, the United States Environmental Protection Agency (EPA) issued an "Endangerment Finding," stating that lead emissions from aircrafts cause and contribute to air pollution. This determination obligates the EPA to "propose and promulgate regulatory standards for lead emissions from certain aircraft engines," (US EPA, 2023) under the Clean Air Act.

In November of 2023, the Federal Aviation Administration (FAA) officially approved the use of Swift's UL94, which is an unleaded, 94-octane fuel, and the first of its kind to reach this FAA milestone (Phelps, 2023).

In February of 2024, the University of North Dakota John D. Odegard School of Aerospace Sciences discovered issues with valve recession after solely using Swift's UL94 in their piston engine aircrafts. They experienced "more than 128 episodes of recessed valve seats or other valve problems," (Phelps, 2023). This ignited an emphasis on the importance of an unleaded 100 octane fuel that can withstand the amount of flying done by major flight schools such as UND.

In April of 2024, GAMI's G100UL became "commercially available," which is significant for the aviation industry due to the terminology. Due to a lawsuit in California, the state is obligated to transition to using only unleaded fuel once a 100 octane unleaded equivalent becomes "commercially available." However, NATA stated that they will not indemnify any aspect of the supply chain process for GAMI, resulting in further difficulties for GAMI. NATA claims that their lack of indemnity means that G100UL is actually not "commercially available" for distribution in the United States (Davoren, 2024).

The Barriers to the Transition

We discovered a multitude of barriers to the transition to unleaded aviation gas. One of the major issues we ran into was the problem of fungibility. The two major unleaded fuels on the market are Swift's UL94 and GAMI's G100UL. These fuels have been found to not be able to mix together due to GAMI's use of aromatic amines in G100UL. This has severe implications for pilots, especially those who may encounter a ban on the use and sale of leaded aviation gas. For example, during a ban on 100LL, a plane fueled with G100UL that landed in an airport that only distributed UL94 would be stranded at that airport because the two could not cross contaminate in the fuel tank. In addition to fuel fungibility regarding engines, fungibility must be considered for the fueling infrastructure of airports. This would include and not be limited to fuel pumps, tanks, and trucks. To achieve this it would be a separate certification process.

Another significant barrier is the competition that arises between different producers and distributors when they compete to be the first to breach such a small market. Until very recently, GAMI and Swift were competing to create a 100-octane fuel with the necessary safety certifications that is commercially available. Swift and its CEO, Chris D'Acosta, is backed with the support of EAGLE and the FAA, while GAMI has funded the development of their G100UL independently. This competition and unevenly distributed support results in distrust and a lack of

cooperation between producers, distributors, and government agencies. Due to Chris D'Acosta's presence in the ASTM certification process and the fear of an unfair and biased process, George Braly decided not to pursue an ASTM certification. Even though an ASTM certification is not required to have a fuel be commercially available, his decision could lead to hesitancy from distributors, pilots, and government agencies when considering using G100UL.

Braly's reluctance to pursue the ASTM certification reflects an issue that arises from the next barrier, which are safety certification processes altogether. Secondly, the FAA, Department of Transportation, and Congress have not come out and openly supported one process or produced a certification process of their own. The lack of clarity and running off of industry precedent has muddied the waters for fuel producers and distributors, FBOs, and insurance agencies. While these processes are undoubtedly necessary for ensuring safety and compatibility with different engine types, these processes have proven to be a roadblock to the transition to unleaded fuels. Firstly, these processes take an extremely long time, halting the process of bringing a fuel to market altogether. Overall, these certification processes need to be streamlined, expanded, and supported by government agencies in order to operate more effectively and efficiently.

The lack of clarity with certification processes and the overall unclear messaging surrounding the issue has led to a general sense of distrust amongst those in the pilot community. As a rule, the pilot community is very distrustful of change within their community. Based on the interviews conducted this semester it was made clear that many pilots would not be willing to fuel their planes with unleaded avgas because of the perceived untested nature of the fuel itself. While AOPA has teamed up with airports that have made the transition to prove the viability of the fuel as a case study. Further efforts to win the trust of pilots themselves will be needed.

Due to unleaded avgas being inherently an interstate commerce issue, the only way that the issue will be meaningfully addressed will be with clear and effective regulations and incentives from the federal government. Currently the FAA and Congres is preoccupied with more pressing issues in light of the recent controversies surrounding Boeing. However, even with less pressing matters occupying the FAA's day to day, there would be little legislative progress made with the current congress. Despite the coalition mentioned previously, it has been proven and will most likely continue to prove to create and pass effective legislation to address the issue.

Incentives that Support the Transition

The information gathered through interviews and independent research has led to the understanding that one of the best ways to support the transition is from subsidies and grants for airports to price adjust and accommodate the infrastructure needed for the use of unleaded aviation gas. There are several ways in which this can be accomplished, and some airports are already using these strategies. The City of Long Beach has provided subsidies for Long Beach

Airport in Los Angeles County, California to adjust the price difference between 100LL and unleaded aviation gas in order to make it more affordable and competitive compared to 100LL. Another strategy involves airports working with the private sector to provide subsidies. Centennial Airport in Englewood, Colorado was the first airport in the state to provide Swift's 94UL (Richards, 2023). The airport worked with FBO jetCenters of Colorado to reimburse customers "up to $110 per aircraft based at Centennial Airport to secure a supplemental type certificate [STC] that allows use of the unleaded avgas in the airplane," (Centennial Airport, 2023). In contrast, Reid-Hillview airport, alongside Santa Clara County, outright banned the use and sale of 100LL at the airport, effectively forcing aircraft owners to secure STCs in order to use 94UL, however, this strategy has proven to be controversial among government agencies and the private sector. Lastly, a major incentive to switch to unleaded fuel is that it's much better for the plane's engine, resulting in less maintenance costs over time.

Conclusion and Next Steps

Based on our findings, we have identified actionable steps that would support the transition to unleaded fuel. The first would be to investigate how to streamline and clarify the regulatory and safety certification processes for aircraft and the distribution of the unleaded fuel. Currently, the certification process for pilots and airports to start administering the new fuel is not clearly communicated and the lack of fungibility with the two fuels is causing ambiguity amongst those seeking to make a switch.

Another gap in knowledge is tracking how many airports have made the switch to unleaded fuel. Mapping out which airports across the nations have switched to unleaded fuel and interviewing the airports to identify trends in their transition and what fuel they chose could provide a measure of the success rate of transitioning. Similarly, conducting a spatial analysis of the widespread use of leaded gas could measure the amount of exposed communities.

Finally, pilot outreach must be taken seriously to ensure the safe transition to unleaded gasoline. Unleaded Gasoline will be useless if pilots do not trust it. However, if there was broad trust amongst pilots due to an awareness campaign to educate pilots on unleaded alternatives, it could enhance support. Reaching out to pilots on their knowledge and increasing communication and conversation in the aviation community (Ex: Survey, Best Practices pamphlet) can be an additional help in increasing awareness. An example could be the Massachusetts Office of Technical Assistance C.R.A.S.H. course that provided mechanics with best practices for dealing with toxics in the workplace.

More actionable steps can be taken in order to streamline the transition such as clarifying the regulatory and safety certifications processes for aircraft and distribution supply chain. This can fall under overall awareness of the issue amongst pilots, but it could also highlight any lapse

in certification processes. Another way to highlight gaps in knowledge is by collecting data to track the use of UL fuel as it is adopted into airports across the US. In order to follow what is working and what is not, tracking the progress of its implementation and the issues that have risen for airports during the process. Reach out to pilots on their knowledge and increase communication and conversation in the aviation community (Ex: Survey, Best Practices pamphlet)

A transition to unleaded gasoline is currently a multi faceted issue with solutions needed in multiple areas. However momentum seems to be on the side of progress. From GAMI announcing that their G100UL is commercially available in April 2024 to the EPA issuing their Endangerment finding in October 2024. There is a clear momentum shift on the issue, like the old adage goes, “ There are decades where nothing happens; there are weeks where decades happen” and the last few months have been that for the unleaded avgas transition. It is only by seeking progress where available can the dream of a lead free future become a reality.

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