



Propane Fueling Infrastructure Trends: A Decade in Review

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1 National Renewable Energy Laboratory

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List of Acronyms

GGE	Gasoline gallon equivalent
NFPA	National Fire Protection Association
PERC	Propane Education & Research Council

Table of Contents

Background	1
Propane Basics	1
Trends	1
Stations and Fuel Use	1
Vehicles	4
Nozzle Type	4
The Future of Propane Use	5
Legislative and Regulatory Support	5
Technological Developments	5
Renewable Propane	5
New Engine Technology	5
References	7

List of Figures

Figure 1. Propane station count and fuel use (GGE), 2011–2021.	2
Figure 2. Propane fuel use (GGE) per station, 2011–2021.	2
Figure 3. Total public and private propane station openings and closures in the Station Locator, 2011– 2021.....	3
Figure 4. Propane vehicle count by vehicle type.	4

Background

This report provides information on propane fueling infrastructure and industry trends over the last 10 years. It is informed primarily by propane fueling station location data collected through the Alternative Fuels Data Center's Alternative Fueling Station Locator from 2011 through 2021. Industry stakeholders, including the Propane Education & Research Council (PERC) and other members of the Alternative Fuels Data Center Station Locator Propane Working Group, also provided data and additional context around trends seen in the data.

Propane Basics

Propane, also known as liquified petroleum gas, is a byproduct of natural gas processing and crude oil refining. As of 2020, more than 93% of the United States' propane supply was produced in North America (Alternative Fuels Data Center 2021a). The same propane (HD-5 grade propane) used in residential heating, cooking, and grilling can be used to fuel vehicles. As of 2021, almost 60,000 on-road vehicles in the United States run on propane (Propane Education & Research Council, email message, October 15, 2021).

Propane is a low-emission, cost-effective fuel, as proven by many years of use in light-, medium-, and heavy-duty on-road and off-road vehicle applications, including school buses and delivery fleets. The fuel is generally less expensive than gasoline or diesel. Based on October 2021 fuel prices, the average price of propane at a public station was \$3.17 per gallon, compared to \$3.25 per gallon of gasoline and \$3.48 per gallon of diesel (Alternative Fuels Data Center 2021b). Negotiated fleet prices are reportedly even lower, making propane an attractive alternative for fleets. For example, Alliance Autogas' prices averaged \$2.16 per gallon across the United States in February 2021 (Alliance Autogas 2022).

For additional background on propane and propane vehicles, see the U.S. Department of Energy's "Propane Basics" fact sheet (Alternative Fuels Data Center 2021a).

Trends

Stations and Fuel Use

Between 2011 and 2021, the number of propane fueling stations in the Station Locator increased by almost 12%, while propane fuel use in the transportation sector decreased by 10% (Figure 1). However, looking at a more recent timeframe tells a slightly different story. Although the number of propane stations increased by about 47% between 2011 and 2015, the count has decreased each year since 2015, for a total decrease of 24% between 2015 and 2021. Further, total propane fuel use in gasoline gallon equivalent (GGE) remained relatively steady between 2011 and 2017, fluctuating between 58.3 million GGE and 61.8 million GGE. Between 2018 and 2021, propane use fluctuated between 53.5 million GGE and 56.4 million GGE. Despite the decrease in usage in 2020 and 2021, likely a result of the COVID-19 pandemic, the average fuel use per station has been on the rise since 2015 (Figure 2).

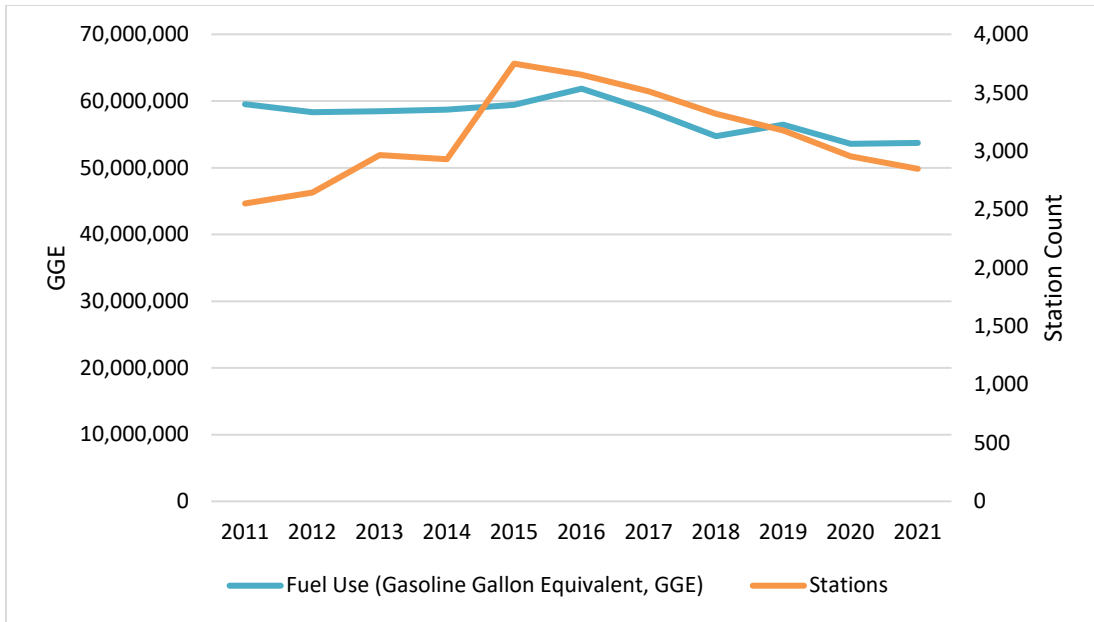


Figure 1. Propane station count and fuel use (GGE), 2011–2021.

Source: Alternative Fuels Data Center 2022a; U.S. Energy Information Administration 2022

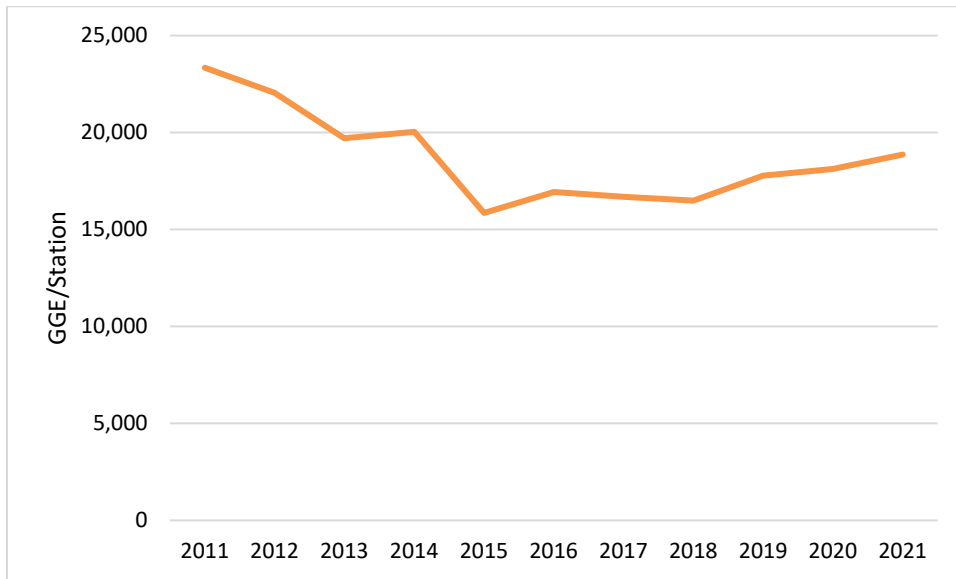


Figure 2. Propane fuel use (GGE) per station, 2011–2021.

Note: Data derived by dividing total GGE dispensed per year by station count per year in Figure 1.

Breaking down propane station counts by public and private access provides additional insight into the decrease in propane stations. As shown in Figure 3, most closures over the last 10 years have been public stations, although there was a significant number of private closures in 2018. Additionally, although the total number of closures has exceeded the total number of openings for the last 5 years, there have generally been more openings of public stations than private stations (Figure 3).

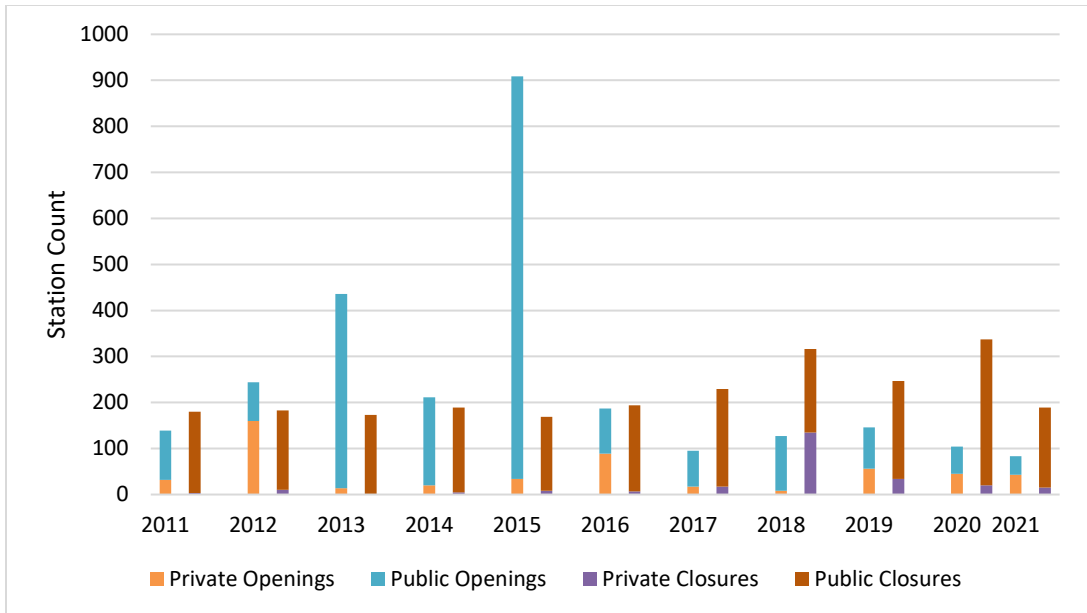


Figure 3. Total public and private propane station openings and closures in the Station Locator, 2011–2021.

Source: Alternative Fuels Data Center 2022a

There are several potential factors which contribute to the decrease in the total number of propane stations. First, the Alternative Fuels Data Center Station Locator only includes propane stations that can fuel on-road vehicles. As the need for public refueling has decreased, stations that have discontinued vehicle fueling and shifted to only offering bottle fueling have been removed from the database.

Second, there are regulatory constraints to public propane fueling. For example, some state regulations prevent drivers that have not completed appropriate training from fueling vehicles themselves, requiring that a propane station have an employee on-site that is trained and available to fuel vehicles during operating hours. This may serve as a barrier to opening new public stations.

Lastly, there may be growth in private infrastructure not being captured due to the difficulty of obtaining private station data for the Station Locator. Reporting is voluntary, and as such, these stations may be underrepresented in the Station Locator.

Although propane station counts have decreased and propane fuel consumption has decreased in recent years, as previously noted, the average fuel throughput per station has been increasing. Industry cites two main reasons for this trend. The first is the expansion of propane fleets, which are more likely to fuel at one central station. For example, in 2021, the National Star Route Mail Contractors Association, an industry group made up of transportation companies that contract with the U.S. Postal Service, saw a rising commitment to propane use throughout the United States (Lewis 2021). Five of these contracted fleets have invested in propane vehicles, with commitments to purchase 79 vehicles over just 6 months (Propane Education & Research Council 2021; Lewis 2021). Municipal fleets are also deploying these vehicles. For example, the

city of Petersburg, Virginia, is converting 49 police and shuttle vehicles to run on propane, specifically renewable propane (Richesson 2021b).

Furthermore, increasingly efficient propane engines are becoming available (Superior Propane 2021). Coupled with lower per-gallon prices compared to gasoline and diesel, this reduces operating costs, which may contribute to a greater uptake of these vehicles and thus an increase in fuel use (Rich 2015).

Vehicles

As of 2021, propane powers nearly 60,000 on-road vehicles throughout the United States. As shown in Figure 4, propane continues to be primarily used in private, medium-duty fleets (Class 3–7) such as school bus and delivery fleets. Only a small share (8.1%) of the propane vehicle population is light-duty (Class 1–2), or passenger, vehicles. Discussions with PERC indicate that increases in propane vehicles over the last several years have been driven by school transportation, paratransit, package and parcel delivery, and food and beverage delivery. Propane-powered school buses, in particular, have experienced significant growth in recent years. At the start of the 2020 school year, the number of propane-powered school buses in the United States had grown by 10% since 2019 and by 960% since 2012 (Gray 2020).

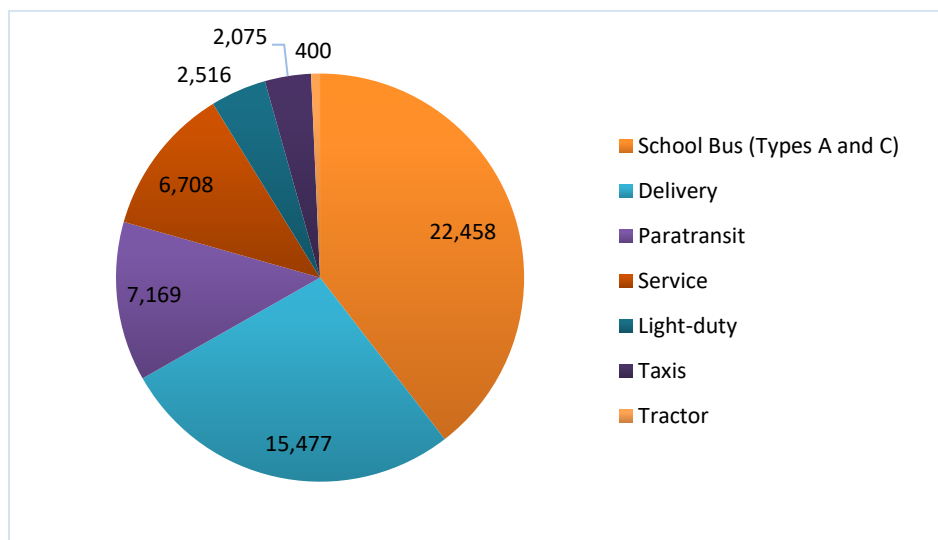


Figure 4. Propane vehicle count by vehicle type.

Source: Propane Education & Research Council, email message, October 15, 2021. These data are collected annually by PERC, who collects and aggregates sales numbers from all original equipment manufacturer partners.

Nozzle Type

A typical propane fueling station will have a dispenser equipped with a hose and nozzle. Fueling a propane vehicle requires attaching the nozzle to a connector on the vehicle. There are two primary types of propane fueling nozzles. ACME nozzles require the user to screw it on to the vehicle to fuel, while the quick-release “Type K15” nozzles—more commonly known as “quick-connect” nozzles—snap on to the vehicle to fuel (Alternative Fuels Data Center 2022b).

The Station Locator began tracking propane nozzle types in 2019, differentiating between stations that have the ACME nozzle and the Type K15 nozzle. As of December 2021, about 46%

of public stations have ACME nozzles only and about 3% have Type K15 nozzles only, while about 43% have both.

ACME nozzles have been in use since 1994, but as of January 1, 2020, all new vehicles must be equipped to use the Type K15 nozzle under National Fire Protection Association (NFPA) 58 Liquefied Petroleum Gas Code (Alternative Fuels Data Center 2022b). Given this relatively new requirement, there are still older vehicles on the road with ACME connectors, and adapters are available for vehicles that are only compatible with the ACME nozzle. Therefore, while stations with the ACME nozzle are not expected to disappear, growth of stations with the ACME nozzle may be slower in the future.

The Future of Propane Use

Legislative and Regulatory Support

Although there has been a decrease in public propane stations in the Station Locator, new funding opportunities and updated codes may provide an opportunity to reverse this trend. The federal Bipartisan Infrastructure Law (HR 3684), signed into law in November 2021, provides several new opportunities for propane (U.S. Congress 2021). For example, HR 3684 allocates \$2.5 billion in grants for publicly available alternative fueling infrastructure, including propane fueling infrastructure for medium- and heavy-duty vehicles. Additionally, \$2.5 billion is allocated to replace existing school buses with those that operate on alternative fuel, further supporting the use of propane.

Further, NFPA 58 is being refined in a way that may be more conducive to public fueling. The proposed change to the code will likely remove a requirement regarding the sizing of excess-flow devices in container openings (Fredenburg 2021).

Technological Developments

Ongoing research, development, and deployment efforts by the propane industry have resulted in recent improvements to propane fuel and technology to improve its environmental impact.

Renewable Propane

Renewable propane is now available and private fleets have recently started to use this fuel in certain parts of the country. While chemically identical to conventional propane, renewable propane is produced by biomass-based feedstocks and yields roughly half the greenhouse gas emissions produced by conventional propane (Alternative Fuels Data Center 2021b). Renewable propane, available in different blends, can be used in any propane vehicle and is thus an attractive option for fleets seeking to reduce emissions. PERC expects that 300 million gallons will be available by 2030, and a report by the World LPG Association suggests that renewable propane could meet half of the global non-chemical demand for propane by 2050 (Propane Education & Research Council 2020; World LPG Association 2022).

New Engine Technology

The development of ultra-low-NO_x (nitrogen oxide) engines is helping to advance the propane industry's efforts to reduce emissions, with fleets across the country embracing these engines (Propane Education & Research Council 2020; Perkins 2018). Additionally, the propane industry

seeks to make a more efficient, 6.7-liter medium-duty engine available in 2024 (Richesson 2021a). Finally, Cummins announced plans to develop fuel-agnostic engine platforms with several engine versions derived from a common base engine (Cummins 2022). These new engines are similar to today's diesel engines in terms of installation, operating practices, and performance, but can operate on low-carbon fuels, including propane. Cummins seeks to expand low-carbon vehicle offerings with the development of these engines and powertrain platforms.

As these new fuels and technologies become more mainstream, the Station Locator team will continue to track infrastructure development. To report new propane stations for inclusion in the Station Locator, visit the [Submit New Station](#) page or email the [Technical Response Service](#).

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