Financing Models:
Propane Autogas Vehicles and Infrastructure

Introduction

Propane autogas is the nation's third-most common vehicle fuel, after gasoline and diesel. According to the U.S. Department of Energy (DOE), propane fuels more than 270,000 on-road vehicles today in the United States.[1] These vehicles are fleet vehicles, such as work trucks, delivery trucks, shuttles, vans, and buses. Worldwide, more than 24 million vehicles were powered by propane autogas in 2014.[2] Propane autogas is a viable option for fleets, especially as cost-effective technology continues to be developed and improved. In response to technological advances and cost reductions, the availability of new light- and medium-duty propane vehicles has increased from both vehicle manufacturers and companies offering conversion packages. In addition, fleets with heavy-duty vehicles like school buses are finding cost savings in propane autogas.

This document is intended for:

- Fleet managers and asset purchasers
- City planners
- Sustainability managers

Iredell County Sheriff refuels his vehicle with Propane

There are two options for propane vehicles: bi-fuel or dedicated. Bi-fuel propane vehicles have two separate fueling systems that enable the vehicle to run on either propane or gasoline, while dedicated vehicles are designed to run on propane only. Propane autogas vehicles are available directly from vehicle manufacturers such as Honda, or with a gaseous prep engine package option from the manufacturer such as Ford. In addition, new and used vehicles can be converted to either bi-fuel or dedicated option by a qualified system retrofitter (QSR).

Converting vehicles to be able to run on propane as a dedicated or bi-fuel vehicle increases the total cost of the vehicle. However, because propane fuel typically costs less per gallon than gasoline or diesel, the additional cost can be recovered over the

[1] World LP Gas Association 2013 (http://worldlpgas.com/gain/key-autogas-data)
[2] World LP Gas Association meeting announcement, October 2014 (Miami FL).

lifetime of the vehicle through fuel savings. In order to realize high cost savings from the fuel, the vehicle must be high mileage or require significant volumes of fuel. A propane vehicle experiences up to 20% lower fuel economy than a gasoline or diesel vehicle, but propane on average typically costs 50% less per gallon.

The infrastructure needed to refuel propane vehicles is similar to gasoline and diesel refueling equipment.[3] The basic elements of a propane station are a storage tank, pump, and dispenser. Propane is delivered to the vehicle under pressure so that it remains a liquid. Propane stations can be private or public and will vary in size relative to the demand of the fleet(s) that uses the station. A propane station can range from a 1,000 gallon skid-mounted storage tank up to a 30,000 gallon station. Stations can be owned by a fleet or leased, typically from a fuel provider.

Due to the variety of fueling and vehicle combinations, financing propane fleet vehicles and infrastructure and determining the return on investment can be challenging. This document is intended to assist you in the decision process and provide information about other resources.

Financing Propane Autogas Vehicles

Propane vehicles can be financed in the same fashion as other gasoline or diesel vehicles. A fleet can choose to purchase the vehicles outright, take out a loan, or lease the vehicles. Vehicles can also be up-fitted through turn-key contracts with conversion companies. There are advantages and disadvantages for each of these options.

Outright Vehicle Purchase
The benefit of purchasing vehicles is the acquisition of an asset that has a useful life of five to seven years, is depreciable, and can be resold or salvaged at the end of its useful life. The drawback of purchasing vehicles is the high upfront cost of acquisition.

Vehicle Loan
The benefit of a vehicle loan is the acquisition of an asset that has a useful life of five to seven years, is depreciable, and can be resold or salvaged at the end of its useful life. The drawback is the added cost of interest on a loan.

Vehicle Lease
The benefits of leasing are the lower upfront cost and the potential to purchase the vehicle at the end of the lease period. The drawback of a lease is not acquiring an asset that can be depreciated and resold or salvaged at the end of its useful life.

Turn-key Vehicle Conversion Contracts

[3] Alternative Fuels Date Center: Propane Fueling Infrastructure Development. http://www.afdc.energy.gov/fuels/propane_infrastructure.html Accessed 12.4.12

Fleets opting for “turn-key” contracts will pay for their vehicle conversions, the electrical and safety portions of the infrastructure installation costs, and the fuel (via a longer term contract), but the remainder of the costs associated with fueling infrastructure will be covered by the propane conversion company. Benefits of the turn-key option include lower up-front costs and no responsibility for fueling infrastructure costs or maintenance. Some fleets may prefer to own the fueling equipment, however, this is a good opportunity to try out propane for little upfront costs.

Financing Propane Autogas Fueling Infrastructure

The costs of installing and operating a propane fueling station vary substantially from one project to another. The total cost depends on a number of factors, including but not limited to:

- the permitting and construction process
- equipment chosen
- logistics related to the tank location at the site
- fuel storage capacity
- fleet size
- the market it serves (retail versus fleet setups)

Skid Mounted Propane Station. Picture courtesy of NREL

Fleets may choose to either purchase the station equipment or to lease the station equipment from propane gas suppliers. Suppliers may offer a no cost or inexpensive lease of the station equipment in return for a multi-year fuel supply contract. In these cases, the fleet is responsible for the installation of infrastructure that cannot be removed from the site, such as electrical connections and concrete pads.

Propane fueling station costs consist of: station equipment, station design, and installation. Propane station equipment typically includes storage tank, dispenser, pump and motor, and a fuel management system. At a minimum, station design and installation costs include site design, connections for electrical and concrete foundations and pads, and permitting fees.

Purchasing

The smallest and least expensive propane stations are skid-mounted and require minimum labor and construction. Typical skid-mounted stations have a 1,000 or 2,000 gallon storage tank and can range in price from $45,000 up to $70,000. Medium size stations with 12,000 to 18,000 gallon storage tanks can range in price from $120,000 up to $220,000. The most expensive stations are large capacity stations with 30,000 gallon

storage tanks and can range in price from $225,000 to $300,000 to purchase the equipment.[4]

Leasing

Many propane gas suppliers offer station and equipment leases. The fleet (lessee) would be responsible for the cost of installing permanent equipment, such as the concrete pad, electrical, and safety controls (bollards). The station equipment cost is recovered by the gas provider (lessor) in the fuel pricing, and typically, a short-term agreement stipulating fuel quantity and fuel surcharge amount is required. For example, a small skid-mounted fast fill station can typically cost the fleet $12,000 for the equipment installation (electrical, concrete pad, and safety controls installation), with a surcharge on the price per gallon of fuel for five years to cover the fuel suppliers cost for the equipment.

Example: Paratransit E-450 Fleet

Propane E-450 Transit Van. Photo courtesy of NREL

For this analysis, a fleet purchase of ten Ford E-450 Super Duty Cutaway paratransit vans was selected to compare fleet vehicle costs - both upfront and life-cycle costs to gasoline and diesel vehicles. The vans are expected to operate for five years and be driven approximately 40,000 miles per year. The vans will be converted to operate on a dedicated propane system by a Ford and EPA Qualified System Retrofitter. The gaseous prep package from Ford for the E-450 is an additional $315.00 per vehicle over the base vehicle cost. Roush CleanTech's dedicated propane conversion was selected for these paratransit vehicles. Roush CleanTech's conversion for E-450's has completed the Federal Transit Administration's (FTA) New Model Bus Testing Program (Altoona Testing) which rates transit bus models on safety, structural integrity and durability, reliability, performance, maintainability, noise and fuel economy.[5]

Vehicle Comparison

The table below compares the vehicle lifecycle costs of a gasoline, diesel, and propane fueled E-450 paratransit van using the market price of fuel as of January 2015, and does not take into account the option of negotiating lower fuel prices in exchange for

[4] Smith, Margaret; Gonzales, John. "Costs Associated With Propane Vehicle Fueling Infrastructure." August 2014. U.S. DOE. http://www.afdc.energy.gov/uploads/publication/propane_costs.pdf

[5] U.S. Department of Transportation. Federal Transit Administration. January 15, 2015. http://www.fta.dot.gov/12351_4584.html

longer term fuel contracts. This analysis also does not include body configuration, license, registration, or insurance costs.

Vehicle Costs	Ford E-450 6.8L V10 Gasoline	Ford E-450 6.8L V10 Diesel	Ford E-450 6.8L V10 Propane
Base Vehicle Price	$32,035	$40,035	$32,350
Dedicated Conversion (Ford up-fitter)			$15,995
Total Vehicle Cost	$32,035	$40,035	$48,345
Operating Costs			
Total Vehicle Life Cycle - 5 yrs (40,000 miles/yr)	200,000	200,000	200,000
Average MPG	6.9	8	5.5
Gallons of Fuel over Life Cycle	28,986	25,000	36,364
NC Fuel Price (per gallon)*	$2.67	$3.13	$2.00
Fuel Costs	$77,391	$78,250	$72,727
Maintenance Rate (per mile)**	$0.14	$0.16	$0.08
Maintenance Costs (life cycle)	$28,000	$32,000	$16,000
Total Vehicle Life-cycle Cost **10 Vehicle Fleet Life-cycle Cost**	**$137,998** **$1,379,977**	**$150,285** **$1,502,850**	**$136,310** **$1,363,104**

Assumptions:
*NC Fuel Price is Average NC Prices for December 2014 (http://fuelgaugereport.aaa.com/states/north-carolina/).
**Ford vehicle 5-year warranty or 60,000 miles with required 7,000 mile maintenance service and after warranty period assume reduced maintenance services for propane vehicles. Maintenance service charge: $1,000 for gasoline and propane and $1,200 for diesel vehicles each service.

Propane Station Comparison

This fictional fleet has decided to install a private propane station at their office location to fuel the fleet of paratransit E-450 vehicles to take advantage of lower bulk propane fuel price. The table below compares the cost to purchase or lease a propane station to serve the fleet for five years.

Propane Station Costs	Purchase	Lease (requires 5 year fuel contract)
Skid-mounted 1,000 gallon storage tank and 1 single-hose dispenser	$60,000	$12,000
Fuel price per gallon (assume ~206 gallons/day or ~72,700 gallons/year)	$0.99	$1.52
Total station cost over 5 years	**$419,865**	**$564,520**

E-450 Propane Fleet Conclusion

Assuming the purchase price of a propane E-450 6.8L V10 at $48,345.00 with an additional $16,000 in total life-cycle maintenance costs and the station costs as listed above, the table below lists the costs for purchase methods for both the vehicles and station.

Fleet of 10 E-450 Propane Fueled Van Options	Station Purchase	Station Lease	Assumptions
Vehicle Purchase	$1,003,315	$1,147,970	Assume $6,000 per vehicle salvage value at end of 5 years
Vehicle Loan	$1,037,306	$1,181,961	Assume 5 year loan at 3% APR with 10% down payment and $6,000 per vehicle salvage value at end of 5 years
Vehicle Lease	$1,204,038	$1,348,693	Assume 5 year lease, 5% down payment and $1,000 per vehicle monthly payment

The lowest cost option for the fleet of 10 E-450 paratransit vehicles, if capital is available, is to purchase both the vehicles and propane station outright. The most expensive option is to lease the vehicles and station but this option does not require a large initial capital investment which might be more feasible for some fleets.

In comparison to the life-cycle cost of a gasoline E-450 fleet, the purchase of propane E-450 vehicles and the propane station is more economical. This is due in part to the lower fuel cost of propane over the market price of gasoline and propane (propane $0.99 versus gasoline $2.67 price per gallon).

Example: Turn-key vehicle conversion contracts

After-market vehicle conversions can range from around $6000-12000 per vehicle, which includes the in-vehicle system, the tank, and the cost of installing the fueling station (not including electrical and crash protection). The conversion company retains ownership of the fueling station, and responsibility for station maintenance. Fleets typically go through authorized vehicle conversion centers to have the vehicles up-fitted, and enter into a long-term fuel agreement with the vendor. The fleet retains ownership of the vehicle conversion equipment, which can be moved from vehicle to vehicle as long as they are the same make/model and/or weight class. This flexibility means that the majority of the 'per vehicle' conversion cost can potentially be stretched out across

multiple vehicles. Below is a cost scenario of a 10-vehicle fleet choosing the turn-key option.

Vehicle Costs	Gasoline	Propane Up-fit
Vehicle conversion	--	$8,000
Operating Costs		
Total Vehicle Life Cycle - 5 yrs (40,000 miles/yr)	200,000	200,000
Average MPG	16	13.6
Gallons of Fuel over Life Cycle	12,500	14,706
NC Fuel Price (per gallon)*	$2.67	$1.32
Fuel Costs	$33,375	$19,412
Propane fuel infrastructure cost, *averaged over 10 year fleet life cycle*	n/a	$500
Propane vehicle technician training, *averaged over 10 year fleet life cycle*	n/a	$300
Total Vehicle Life-cycle Cost **10 Vehicle Fleet Life-cycle Cost**	**$33,375** **$333,750**	**$28,212** **$282,120**

For more information:

There are a number of resources available that can provide additional information and assistance.

- The complete Alternative Fuels Implementation Toolkit provides more information on propane vehicles and stations, and guidance on transitioning to propane use.
- The Alternative Fuels Data Center provides more information on propane vehicles and stations.
- The North Carolina Propane Gas Association provides more information on propane vehicles.
- NC Clean Cities Coalitions:
    - Centralina Clean Fuels Coalition – Charlotte, NC
    - Land-of-Sky Clean Vehicles Coalition – Asheville, NC
    - Triangle Clean Cities Coalition – Durham, NC