

CASE STUDY

Nation's Largest Alternative-Fuel Fleet Delivers the Goods for the U.S. Postal Service



The U.S. Postal Service (USPS) handles more than 43% of the world's mail. In 1996, it processed about 603 million pieces of mail each day. Its 208,000 vehicles drive more than 1.1 billion miles each year, using 114.3 million gallons of fuel at a cost of more than \$102 million. A reliable fuel source is essential – the mail must go through – and an operation as large as this one is always looking for new ways to reduce costs and increase efficiency. The USPS is studying vehicles that run on fuels other than gasoline, providing a unique testing ground for alternative fuels and new technologies.

Choosing from a Variety of Fuels

As a government agency, the USPS must comply with the Energy Policy Act of 1992 and the Clean Air Act of 1990, which require federal fleets to acquire alternative-fuel vehicles (AFVs). The USPS has been experimenting with alternative fuels since the turn of the century, when the automobile began replacing the horse as the main means of transportation in the United States. Anticipating developments in AFV technology, the USPS has committed to using compressed natural gas (CNG) for the near term while it tests electric vehicles (EVs) in a pilot program. Han Dinh, USPS Engineering Program Manager, explains: "We are looking at different technologies to keep up with the technology and because we believe that even if CNG is a viable solution today, it might not be a solution for the future. CNG is still a natural resource that could run out, and although CNG is cleaner than gasoline, it still results in a certain level of pollution. The electric or fuel cell vehicle, or the hydrogen vehicle, is probably the ultimate vehicle."

Converting Unique Vehicles to CNG Fuel

With a cargo capacity of 1,000 pounds and life expectancy of 24 years, the 143,000 specially designed Grumman Long-Life Vehicles (LLVs) in the USPS fleet are the workhorses of the U.S. mail delivery system. Mail carriers have used LLVs to deliver mail in urban areas since 1987. Based on a Chevrolet S-10 truck chassis, LLVs come equipped with Pontiac gasoline engines and three-speed transmissions. The last LLVs were

delivered in 1994, and the USPS has no plans to add more or replace any in the near future, because of financial considerations.

In 1990, to meet stricter air-quality requirements and reduce costs, the USPS began converting its LLVs into bi-fuel vehicles that can switch between CNG and gasoline. About 7,000 LLV conversions (5% of the fleet) have been done to date, and the USPS plans to convert another 3,600 by 1998.

By the Numbers

Fuel Cost: CNG – \$0.70 per gasoline gallon equivalent;
gasoline – \$1.10 per gallon (nationwide averages)

Fuel Economy: 19 mpg for both fuels

Operating Cost: CNG – \$0.099/mile;
gasoline – \$0.149/mile

Installing CNG Conversion Kits

About half of the CNG conversions are based on Beacon Power kits, one-fourth use IMPCO kits, and one-fourth have Mesa kits. The Beacon Power and Mesa kits contain fuel-injection systems; the IMPCO kits provide a carburetion system. Local contractors hired by the kit manufacturers installed the kits. It takes about 4 hours to install a kit, and Dinh says the instructions are easy to follow. Each conversion costs about \$2,000, including kit, tank, and labor.

The first LLV conversions included a 4-gallon CNG tank. Although the nominal CNG pressure at a fueling station is 3,000 psi, actual pressure is only about 2,600 psi. Therefore, the tank is usually not completely filled with CNG. Later

conversions use 5.4-gallon tanks. Since 1995, the USPS has required that conversion kits and tanks be capable of operating at 3,600 psi. The USPS is now considering the possibility of adding three 4-gallon CNG tanks to each vehicle, for a total capacity of 12 gallons. However, the 13-gallon gasoline tank would have to be removed to accommodate the extra tanks so that the vehicle would become a dedicated CNG vehicle, not a bi-fuel vehicle.

The kit manufacturers offer a 3-year/36,000-mile warranty. Obtaining replacement parts has been a major concern, however. NGV Technology, one of the USPS's early kit suppliers, folded in 1994; about 500 LLV conversions had to be retrofitted with new kits because of the lack of spare parts. Although parts are easily obtained from IMPCO, Mesa has ceased manufacturing conversion kits, and Beacon Power is a small operation; USPS is its main customer. Dinh warns: "Some companies don't have enough power and money to do the testing, so we become guinea pigs for their kits. If you have a unique vehicle, you have to work with a manufacturer to develop a kit tailored specifically to your vehicle. If you have a commercial vehicle, make sure you are using a kit that has been well proven, tested, and used by other fleets; otherwise, you could be heading for disaster."

Driver Training and Acceptance

The USPS provides training for new drivers, and a local utility representative demonstrates the fueling process. Driver reactions to the CNG vehicles have been mostly positive. Many like the vehicles because of their environmental advantages: in EPA FTP-75 tests, the CNG vehicles emitted fewer pollutants than the original gasoline LLVs. However, some drivers were reluctant to use the converted vehicles at first because of a perception that CNG is not as safe as gasoline, but training addressed that concern.

In-Use Performance of CNG Vehicles

An average LLV travels less than 5,000 miles per year; most are driven less than 25 miles per day. A mail delivery route consists of many stops spaced at short distances. This constant stop-and-start pattern results in a fuel economy of about 19 mpg for both CNG and gasoline. Drivers are encouraged to run the vehicles on CNG whenever possible; Dinh estimates that usage ranges from 50% to 90% on CNG.

Some sites have reported fewer breakdowns in CNG vehicles compared with gasoline vehicles. Although the IMPCO kits are less sophisticated, they appear to be more reliable than the other types according to Dinh. Difficulties with the conversions have included reduced power, slow cold weather starts, problems in switching between fuels, pressure regulator failure, and check valve replacement. The USPS has worked with the manufacturers to resolve these issues by modifying the kit designs, for example by switching to more durable materials for components.

Mechanics attend a training session at the USPS's Oklahoma Technical Center to learn about the principles of a CNG engine and maintenance techniques. Dinh states: "At certain sites, maintenance costs for the CNG vehicles are lower than those for gasoline vehicles because the oil change interval can be decreased to one year compared with six months for a gasoline vehicle. The USPS saves in oil and filter, labor, and disposal costs."

Fueling CNG Vehicles

The USPS prefers not to build fueling stations — about half of its vehicles fuel at commercial gasoline stations. Local natural gas utility companies operate most of the CNG stations the USPS uses. The capital expenditure and increased liability make on-site CNG fueling a large commitment that the USPS is reluctant to take on.

Fleet Facts

Fleet Type: Federal government

Fleet Size: 208,000, of which about 7,000 are AFVs

Alternative Fuels: CNG, electricity, ethanol

Vehicles: Long-life vehicles, medium- and heavy-duty trucks, vans, sedans

Location: Nationwide

Miles per Year: 1.1 billion



Putting Electric Vehicles to the Test

Back in 1899, one of the first vehicles the USPS tested for mail delivery ran on electricity. Today, trial runs of EVs continue at postal facilities in California and Virginia.

In 1993, six electric Ford Ecostar vehicles arrived in Huntington Beach, California, as part of a test program. These vehicles run on sodium sulfur batteries. They have been used for mail delivery; Dinh says they have performed well.

operational data (trip statistics, energy consumption, costs) are collected as part of the evaluation. Dinh expects that although the operating cost of the EVs proved to be slightly higher than that of gasoline vehicles, the EVs will cost less in the long run because of the lower maintenance requirements: EVs do not need tune-ups or oil changes.

Drivers have noticed slightly reduced acceleration power in the electric LLVs, due primarily to the added weight, but no other problems. Dinh states: "Drivers have been very enthusiastic about the EVs; in fact, they volunteer to use them because they are

quieter, and the drivers feel they are contributing to a cleaner environment."

The USPS is pleased with the overall performance of this test fleet and plans to continue to evaluate EVs. According to Dinh, 20 more LLVs were to have been converted to electricity by 1996, but none has been delivered yet because the conversion contractors are undercapitalized.

Evaluating Ethanol Vehicles

The USPS has a small test fleet of ethanol vehicles. Five ethanol-fueled Ford Taurus sedans are being used in Merrifield, Virginia, and Chicago. Six ethanol-fueled Ford Windstar minivans are being used for Express Mail delivery in Washington, D.C.; Des Moines, Iowa; and DeKalb, Illinois. The USPS is evaluating this fuel as it works with Ford to develop a way to convert

Operating Cost Comparison: Electric vs. Gasoline Vehicles

Location	Gasoline LLV^a	Electric LLV^b	Difference
California	\$0.339/mile	\$0.389/mile	\$0.050/mile
Virginia	\$0.356/mile	\$0.376/mile	\$0.020/mile

^a Includes gasoline, maintenance, and repair.

^b Includes electricity, battery amortization, maintenance, and repair.

In 1995, six gasoline LLVs were converted to electricity. General Motors engineered and supplied the electric system, which was then installed by U.S. Electricar. The internal combustion components were removed and replaced with an electric propulsion system consisting of a high-voltage advanced lead acid battery pack, electric drive system, and supporting hardware. Structural reinforcements were added to support the additional weight of these components. The USPS paid about \$7,500 for each conversion; General Motors provided its engineering and research services to the USPS at no cost.

Assigned to post offices in Torrance, California, and Merrifield, Virginia, these converted vehicles were integrated into the regular delivery fleet. The batteries are recharged right at the post office. Daily

Simple Payback Analysis for CNG Conversions

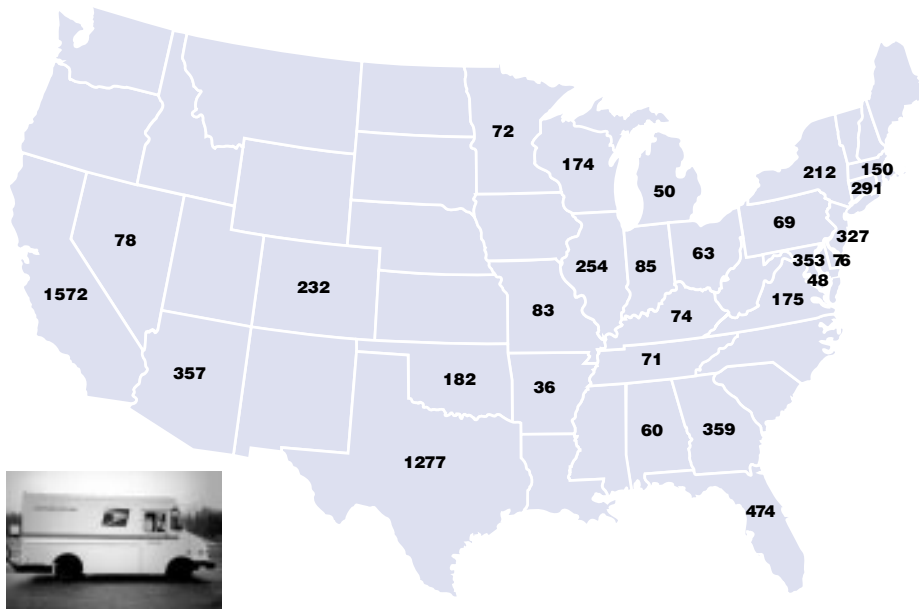
Operating Cost Savings

(25 miles/day) (312 delivery days/year) (\$0.149 – \$0.099/mile) = \$195/year

Payback Time

(\$2,000/conversion) ÷ (\$195/year) = 10.25 years

USPS's Natural-Gas Vehicle Placements



some of its 10,000 Ford minivans into ethanol vehicles. Items to be analyzed include user convenience, costs, tailpipe emissions, and vehicle performance.

Deciding Where to Use AFVs

Because of the variety of vehicles available and the national scope of its services, the USPS developed an equitable way to allocate its AFVs. Each year, the USPS budgets a certain amount for AFVs. Local post offices submit proposals to request vehicles for their areas. A committee reviews the proposals and rates them according to the following criteria:

- Is the area located in a DOE Clean City?¹
- Is a fueling facility available?
- Are fuel discounts available?
- Have local residents expressed an interest in AFVs?
- Are state or local government grants or other incentives available for purchase of AFVs?

Before placing AFVs, the USPS requires the local fleet manager and postmaster to sign a letter requesting the AFVs, supporting the project, and ensuring that the vehicles operate on alternative fuel, not gasoline.

When a new AFV site opens, USPS employees and the local press are invited to a ceremony to mark the occasion. The AFVs also bear labels stating the alternative fuel they use. Dinh says, "Our experience with alternative fuel in general has been very positive. When you go out, you see people are very receptive to the idea."

Planning for the Future

The USPS is authorized to increase the number of CNG conversions to 7% of the LLV fleet — about 1,800 conversions per year in 1997 and 1998. A major review of all vehicle technologies is planned for 1998. As Han Dinh says: "With the changing technologies, in CNG or in electric, we have to continue to keep up with the changes."

¹ The Clean Cities Program is a voluntary, locally based government/industry partnership to expand the use of alternative fuels.

USPS Has a Long History with AFVs



1899	First experimental use of an EV: collecting mail from 40 mailboxes took 1 1/2 hours by EV compared with more than 3 hours by horse
1903	Electric mail vehicles used in St. Louis, Missouri
1914	Electric delivery van used in Long Island City, New York
1959	Three-wheeled electric "mailster" used in Miami, Florida
1960-1963	77 EVs tested in 6 locations
1970-1980	More than 620 EVs tested
1977	Hydrogen-fueled postal jeep evaluated in Utah and Missouri
1979	54 natural gas vehicles operated in 5 locations
1980	40 postal vehicles converted to ethanol and methanol fuel for DOE's Alcohol Fuels Reliability Test Program
1982-1987	More than 500 gasoline postal jeeps converted to natural gas bi-fuel vehicles
1987	USPS, NASA, and DOE collaborate to develop an LLV with a Stirling multifuel engine; USPS tests vehicle in 1989
1990	Clean Air Act: fleets of more than 10 light-duty vehicles must begin to use clean-fuel vehicles as of 1999
1990-1996	Nearly 7,000 gasoline LLVs converted to bi-fuel CNG use
1992	Energy Policy Act: federal fleets must reach 75% AFVs by 2006
1993	USPS wins Natural Gas Vehicle Coalition Achievement Award for outstanding advancement of natural gas as vehicle fuel USPS tests 6 electric Ford Ecostar delivery vans
1994	8 medium-duty CNG vehicles from Tecogen, Inc., deployed
1995	6 gasoline LLVs converted into EVs to test advanced lead-acid battery 5 ethanol-fueled Ford Taurus sedans tested
1997	54 medium-duty CNG vehicles from Freightliner Corporation deployed 6 ethanol-fueled Ford minivans tested



This brochure has been reviewed by representatives of vehicle manufacturers, fuel providers, fleet operators, and federal and state governments.

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Disclaimer

This case study is intended only to illustrate approaches that organizations could use in adopting AFVs in their fleets. The data cited here, although real experience for the fleet discussed in this case study, may not be replicated for other fleets. For more comprehensive information on the performance of AFVs and other related topics, please call (800/423-1363) or e-mail (hotline@afdc.nrel.gov) the National Alternative Fuels Hotline. To learn more about DOE's role in alternative-fuel vehicle research, visit the Alternative Fuels Data Center on the World Wide Web at <http://www.afdc.doe.gov>.

TAKING AN ALTERNATIVE ROUTE. FUELING THE FUTURE.