

AFDC UPDATE

News of the Alternative Fuels Data Center

NREL Takes a Look at Conversions

Because original equipment manufacturer (OEM) vehicles designed to run on compressed natural gas (CNG) and liquefied petroleum gas (LPG) have only been available in limited models in past years, many fleets have had to rely on conversions as a source for alternative fuel vehicles (AFVs). The Federal fleet is no different—so far it has converted approximately 900 vehicles to CNG or LPG, providing the National Renewable Energy Laboratory (NREL) with an opportunity to test a variety of conversion kits.

When buying a new AFV or having a gasoline vehicle converted, fleet managers need to ask the right questions about the emissions performance they can expect, according to researchers at NREL.

“Question them. Don't take [good emissions performance]

for granted,” said Robert Motta, NREL's senior project engineer. When having a vehicle converted, “ask about the emissions levels and ask them to prove it,” he said. This may include getting proof that the vehicle was certified by the U.S. Environmental Protection Agency's (EPA's) new conversion standards to at least Tier 1 levels, or better yet, low-emission-vehicle (LEV) or ultra-low-emission-vehicle (ULEV) standards.

That advice stems from disappointing emissions data NREL acquired from converted Federal fleet vehicles that were tested using the Federal Test Procedure. Through tests of 13 CNG and 3 LPG conversions, NREL researchers have discovered that while the fuels do have the potential to drastically reduce vehicle emissions, this does not tell the whole story. According to Motta, “the equipment is just as important as the fuel.”

To establish an emissions baseline, each vehicle was tested on California Phase 2 reformulated gasoline (RFG), the most advanced gasoline available. The conversion kits were installed within 2,000 (odometer) miles of the initial emissions test, and the vehicles were then tested on the RFG and the alternative fuel.

In general, the 13 CNG bi-fuel conversion kits tested did not affect the vehicles' performance while running on gasoline. When running on CNG, the vehicles generally showed a significant reduction in nonmethane hydrocarbon

(NMHC) emissions, while carbon monoxide (CO), or oxides of nitrogen (NO_x), or both emissions increased.

“The results do not reflect the potential of CNG,” Motta said. Other NREL tests on OEM vehicles (reported in the January 1996 *AFDC Update*) have shown that CNG can significantly reduce overall emissions compared to gasoline.

The small number of LPG vehicles in NREL's program makes it difficult to draw general conclusions about conversions, but the three kits tested showed increased emissions on gasoline and mixed results on LPG. CO emissions greatly decreased with LPG, but NMHC emissions and/or NO_x emissions greatly increased.

The Federal fleet vehicles converted through NREL contracts were equipped with higher quality, “closed-loop, feedback”

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How to Reach Us

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- To speak to a human being, call the National Alternative Fuels Hotline at (800) 423-1DOE.



conversion kits produced by GFI Control Systems and IMPCO Technologies. "There are a lot of different reports out there on conversions. We wanted to look at what a fleet manager could expect, from the best kits installed by the best people out there," Motta said. Conversion costs vary depending on the number and size of the fuel tanks, but the average total cost for each of the Federal fleet CNG conversions was \$4,500, and each LPG conversion was \$2,800.

To convert a gasoline vehicle to CNG or LPG, converters add a fuel tank (or tanks), fuel lines, a pressure regulator, and a mixer or carburetor. Like those performed for the Federal fleet, most modern conversions include an electronic control system to control the fuel/air ratio to precise levels. A switch is installed to allow the

driver to select gasoline or the alternative fuel. All existing emissions-control equipment must be left on the vehicle.

Most of the Federal conversions were bifuel, which enabled them to run on gasoline or the alternative fuel, but Motta said that factor had little to do with the increased emissions. "It is a fallacy that a dedicated CNG vehicle is automatically clean," he said. "The CNG system needs to be optimized to the vehicle."

The alternative fuels conversion industry will find it increasingly difficult to compete with the improved emissions of new, sophisticated gasoline vehicles, Motta noted. If improved emissions is a fleet manager's goal for incorporating AFVs into a fleet, the manager should look to vehicles certified by the EPA or

the California Air Resources Board (CARB)—EPA uses the ILEV designation (for inherently low-emission vehicles) and ULEV designations, and CARB uses LEV and ULEV.

Based on the results of NREL's tests, and with the increasing availability of specifically designed OEM vehicles, the Federal fleet conversion program will be phased out this year.

NREL plans to publish a more detailed account of its experience with conversions. This report, entitled *Compressed Natural Gas and Liquefied Petroleum Gas Conversions: The National Renewable Energy Laboratory's Experience*, will be available through the National Alternative Fuels Hotline and through our Web site (see "How to Reach Us" on page 1) in late May.

State and Fuel-Provider Fleets to Acquire AFVs in 1997

The long-anticipated final rule for several provisions of the 1992 Energy Policy Act (EPA) was recently released. Starting with the 1997 model year (MY), most state governments and certain alternative fuel providers will be required to include alternative fuel vehicles (AFVs) in their light-duty-vehicle fleet purchases. (An MY is defined as September 1 of the previous year to August 31.)

"With this nation's increasing reliance on imported oil, and the increasing foreign trade deficit, it is important that we develop and use clean, domestic alternative fuels for transportation," said Deputy Secretary of Energy Charles Curtis. "This program should go a long way toward achieving that goal by helping to make alternative-fueled vehicles a commonplace occurrence and dramatically increasing the use and

acceptance of alternative fuels." The U.S. Department of Energy (DOE) has published a guide entitled *Alternative Fueled Vehicles for State Government and Fuel Provider Fleets: A Guide*, for meeting the requirements of the rule. The information provided in Tables 1-5 in this issue is taken from this guide.

To give these fleets the most flexibility, the final rule includes more opportunities for credits that can be traded or used for future requirements than had been indicated in the proposed rule published last year.

Vehicles that count toward compliance include any AFV new to the fleet, whether it is original equipment manufacturer or a conversion, of any model year. Existing fleet vehicles that are newly converted do not count unless the conversion was

performed within 4 months of the vehicle's acquisition.

Neat biodiesel was also added to the list of alternative fuels.

State Government Fleets

State governments must incorporate AFVs into their fleets in accordance with the information in Table 1.

States that are covered under the rule include those with 50 or more light-duty vehicles, 20 of which are used primarily within a metropolitan statistical area with 1980 populations of 250,000 or more, and are capable of being centrally fueled.

Instead of meeting the requirements on its own, a state can use an approved alternative plan that could include voluntary local and private fleets, or vehicles such as

Table 1. State Government AFV Schedule

Percentage of Vehicle Acquisitions	Model Year
10	1997
15	1998
25	1999
50	2000
75	2001 and thereafter

Table 2. Fuel Provider AFV Schedule

Percentage of Vehicle Acquisitions	Model Year
30	1997
50	1998
70	1999
90	2000 and thereafter

police cars that are exempt. States must file their Alternative State Plan for the 1997 MY requirement by March 14, 1997.

Fuel Providers

Alternative fuel providers must incorporate AFVs into their fleets in accordance with the information in Table 2.

The definition of who falls under this category was the subject of much comment when the proposed rule was published. According to the final rule, a covered fuel provider includes any business whose principal business is:

- Producing, storing, refining, processing, transporting, distributing, importing, or selling (wholesale or retail) any alternative fuel, or
- Generating, transmitting, importing, or selling (wholesale or retail) electricity, or
- Producing and/or importing an average of 50,000 barrels or more of petroleum and obtaining 30% or more of its gross annual revenue from producing alternative fuels.

Table 3. Electric Utility AFV Schedule

Percentage of Vehicle Acquisitions	Dates
30	January 1, 1998, to August 31, 1998
50	1999 model year
70	2000 model year
90	2001 model year and thereafter

Electric Utilities

Most electric utilities will want to comply by using electric vehicles (EVs). EPAAct allows utilities to apply for a 2-year delay if they plan to comply with the AFV acquisition requirements by purchasing or leasing

EVs. Those that take advantage of this option will be required to incorporate AFVs into their fleets in accordance with the information in Table 3.

Credits

AFVs acquired by mandated fleets after EPAAct's passage on October 24, 1992, and before the 1997 MY may be credited toward compliance at the rate of one credit each year the AFV was acquired early. AFVs, including

medium- and heavy-duty vehicles, that are acquired in excess of compliance can also earn credits. These credits can be traded to another covered fleet or used against future requirements.

Enforcement

It is DOE's goal to help fleets comply with the mandates by being flexible. However, there are fines for those who willfully violate the rule, ranging from \$5,000 to \$50,000 for each violation.

☛ *The rule was published in the March 14, 1996, Federal Register, and copies are now available through the Alternative Fuels Data Center's home page on the Internet at <http://www.afdc.doe.gov>. For more information, call the National Alternative Fuels Hotline at (800) 423-1DOE.*

NREL Forms New Center for Transportation Technologies and Systems

As part of the reengineering effort at the National Renewable Energy Laboratory (NREL), the new NREL centers were officially announced on February 22, 1996. The center director for the Center for Transportation Technologies and Systems is Barbara Goodman. NREL's former Advanced Vehicle Systems Branch, the Alternative Fuels Utilization Program, and the Alternative Fuels Data Center have been brought together under this center. Center staff members met in early March to design a team structure, now in place, for carrying out their work.

Catching Up with the Federal Fleet

This year's Congressional budget battles left many wondering what would happen to the Federal fleet's alternative fuel vehicle (AFV) program. Despite uncertainties within Federal agencies, the government's use of AFVs will continue to increase and build on the more than 20,000 already incorporated into the fleet.

Compressed natural gas (CNG) and methanol (M85 [85% methanol, 15% gasoline]) have dominated the Federal program, but other alternative fuels, including ethanol, propane, and electricity, will play a greater role because

auto manufacturers are offering a wider variety of vehicles. Plans for 1996 include purchasing more than 1,300 E85 vehicles (vehicles that run on up to 85% ethanol and 15% gasoline), 100 propane, and 350 electric vehicles.

To date, almost half of the Federal fleet's more than 11,000 CNG vehicles belong to the U.S. Postal Service. The next largest CNG program is that of the Defense Department. The U.S. Department of Energy (DOE) was responsible for funding about 2,300 of the Federal fleet CNG acquisitions, but that program

is expected to end soon because of a lack of funding.

Instead of relying on DOE reimbursement for the incremental costs of AFVs, an executive order may require agencies to continue their AFV acquisitions to meet the goals of the Energy Policy Act of 1992. Additional costs could be averaged over the entire Federal fleet so agencies with aggressive AFV programs are not penalized.

The 1996 fiscal year is expected to be an important one for the Federal program, when almost 8,000 AFVs are expected to join the fleet.

Table 4. Federal Alternative Fuel Vehicle Acquisitions

Fiscal Year	CNG	M85	E85	LPG	EV	Total
91	104	70	0	103	0	277
92	199	2,520	25	7	35	2,786
93	2,273	2,974	89	13	78	5,427
94	4,446	3,727	25	106	17	8,321
*95	4,276	366	250	0	0	4,892
Totals	11,298	9,657	389	229	130	21,703

*Based on preliminary estimates

Table 5. Planned Fiscal Year 1996 Federal Alternative Fuel Vehicle Acquisitions

Fiscal Year	CNG	M85	E85	LPG	EV	Total
General Services Administration	1,056	0	1,352	100	100	2,608
U.S. Postal Service	3,246	0	0	0	0	3,246
Defense Department	1,840	0	0	0	250	2,090
Totals	6,142	0	1,352	100	350	7,944

Students Bring New Ideas to the Search for Better Cars

In their quest to find new ways to look at the personal automobile, auto manufacturers are turning to the newest generation of automotive engineers. Students at 12 universities are putting their classroom theories to the test as they develop ways to transform Dodge Intrepids, Ford Tauruses, and Chevrolet Lumina into a "FutureCar" for a long evaluation and competition in June of 1996 and 1997. "It's like brainstorming on a national scale," said Peter Rosenfield, program manager for Chrysler Corporation. "The students are limited only by their creativity and innovation," said Christine Ervin, assistant secretary for the U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy. "They may incorporate hybrid vehicle technologies such as ultracapacitors, flywheels, and alternative energy conversion devices, but they must keep in mind the vehicles should be capable of mass production by 2007."

The FutureCar Challenge is part of a joint effort by industry and government called Partnership for a New Generation of Vehicles (PNGV). PNGV was started in 1993 to develop a marketable

vehicle that may offer up to three times the fuel efficiency of today's mid-sized cars while maintaining the price, performance, and utility of conventional vehicles. Concept cars for this "80-miles-per-gallon car" are targeted for the year 2000 and production prototypes for 2004. "Right now fuel efficiency is about 14 or 15 on the consumers' list of what they want in a car," Rosenfield said, and that priority does not change "until they have to stand in line for fuel."

Most of the student teams are incorporating alternative fuels into their plans for hybrid vehicles. Fuels include propane, compressed natural gas, E85 (85% ethanol, 15% gasoline) and diesel, with the goal of using dimethyl ether in the second year.

The University of Maryland team is designing its 1995 Dodge Intrepid as a hybrid electric vehicle that uses ethanol fuel to power its small internal combustion engine. "Your choice of fuel may be more interesting than you think," Richard Moorer, DOE associate deputy assistant secretary, told the students. DOE's National Renewable Energy Laboratory is working to produce ethanol from cellulosic biomass in a cost-competitive manner.

Students acquired their vehicles last September and will have prototypes ready for an extensive week of testing at the competition in Dearborn, Michigan, this June. Events include quality and execution of design, emissions, fuel economy, range, handling, consumer acceptance, and cost/manufacturability. The vehicles will then participate in a parade in downtown Detroit organized by the American Automotive Centennial Commission, celebrating the first 100 years of the automobile. "They're the first 100 years, and we're the next 100 years," said Scott Fosgard, a spokesman for U.S. Council on Automotive Research, which is a joint effort of Chrysler, Ford Motor Company, and General Motors Corporation.

The schools will build on their design for a second competition in 1997. "The exercise closely mirrors what the car companies are going through," Fosgard said. "We encourage students to think unencumbered with the experiences of someone who has been in the business 50 years," he said. Ideas from past competitions have already been incorporated into production vehicles.

New Standards for CNG, LPG Training Centers Released

Entry-level technician training programs for compressed natural gas (CNG) and liquefied petroleum gas (LPG) can now earn Automotive Service Excellence (ASE) certification.

The certification program is the latest development of the U.S. Department of Energy's (DOE's) Certification of Higher-learning in Alternative Motorfuels Program

(CHAMP). CHAMP was outlined in the Energy Policy Act of 1992 to help meet the anticipated need for qualified technicians to keep alternative fuel vehicles (AFVs) running in good order.

To meet this goal, DOE enlisted the help of the National Automotive Technician Education Foundation (NATEF) to establish national uniform standards and

manage the voluntary certification program.

"We put this together with input from a lot of different players," said Don Dew, program manager for NATEF. Participants included conversion-kit manufacturers, auto manufacturers, and educators.

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New AFVs on the Market

A detailed listing of the alternative fuel vehicles (AFVs) produced by U.S. auto manufacturers was published in the January 1996 issue of *AFDC Update*. Since then, several new propane, compressed natural gas (CNG), and electric vehicles (EVs) have been announced.

Electric Vehicles

After an extensive demonstration program, General Motors Corporation (GM) will reenter the AFV market this fall with two new EVs.

Fleet managers may want to consider an electric version of GM's S-10 pickup for model year (MY) 1997. And AFVs will finally enter the mainstream retail market with GM's electric EV1. "The EV1 will be the first modern-era passenger car developed specifically as an electric vehicle and brought to market by a major automaker," said GM Chairman John F. Smith, Jr.

When given the opportunity to test the EV1's predecessor, the



Photo Courtesy of General Motors Corporation/PIX 03970

General Motors plans to market the EV1, designed to operate on electricity, to the public later this year. In GM tests, consumers have been overwhelmingly impressed with the vehicle.

Impact, participants in GM's PrEView demonstration did not want to give up their vehicles after 2 weeks of driving. This fall, they can join other consumers and acquire their own EV1 at Saturn dealerships in Tucson, Phoenix, San Diego, and Los Angeles. The EV1 will be priced at about \$35,000, but GM may offer them for lease instead of sale.

GM's EVs will use an inductive charging system. This is the quickest system currently available and can fully charge a vehicle

in 3–4 hours using a plastic paddle instead of a metal connection to the vehicle.

Later this year, Ford Motor Company will make gliders—vehicles without the gasoline components—of its Ranger pickup truck available to the vehicle engineering and design company TDM. TDM will modify the vehicle at its Manhattan, Kansas, headquarters and market it as an EV. Next year, Ford will offer the electric Ranger off its own assembly line. Ford's EVs are conductively

Electric Vehicle Workshops Scheduled

As part of an industry effort to bring 5,000 electric vehicles (EVs) to the road by 1997, community leaders in 10 selected cities will hold workshops to address the framework needed to support high EV populations. This includes issues such as building and health codes, fire and rescue personnel training, and public information.

Sponsored by the U.S. Department of Energy (DOE), the U.S. Department of Transportation, the Electric Transportation Coalition, and the Electric Vehicle Association of the Americas, the first workshop in the EV Market Launch was held in Washington, D.C., last December. During the year, the program will continue in Los Angeles, Sacramento, Atlanta, Phoenix, New York City, Richmond, Boston, Detroit, and Fort Lauderdale.

For more information and workshop dates, call Marcy Rood, DOE's Clean Cities program manager at (202) 586-8161 or check the Clean Cities Home Page current events calendar at <http://www.ccities.doe.gov>.

charged, which is a less expensive method, and uses a plug (similar to home appliance connections) that charges a vehicle in 4–6 hours.

Chrysler is preparing its assembly line to produce an electric version of the new Dodge Caravan/Plymouth Voyager van called the "EPIC" (Electric-Powered Interurban Commuter) for MY 1998. Like Ford's EVs, the EPIC will be conductively charged.

Propane

Despite the lack of an original equipment manufacturer (OEM) light-duty vehicle in the past, propane has dominated the AFV market. This year, consumers will be able to choose from more than just conversions. Ford Motor Company became the first to offer a light-duty propane vehicle when it approved the aftermarket fuel-system manufacturer, IMPCO Technologies, to equip specially prepped F-Series trucks with propane fuel systems. Through Ford's qualified-vehicle-modifier arrangement, the trucks will be warrantied and sold by selected Ford dealers.

The trucks' 4.9-liter, 6-cylinder engines will be bifuel, allowing them to operate on gasoline or propane. Ford has offered a propane medium-duty F-700 truck for more than 30 years.

Compressed Natural Gas

Ford also plans to expand its CNG options in MY 1997 with a bifuel Contour model. At press time, the vehicle was still undergoing certification and no details were available.

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Training programs earn national recognition by following NATEF's guidelines and passing an on-site evaluation. Aspects to be covered include curriculum, equipment, facilities, and instructional staff. Because there are no national guidelines on safety and building codes in place, NATEF requires schools to seek input from proper local authorities.

Perhaps the most important aspect is the program's self-evaluation, which is performed by following a NATEF manual that can be purchased for \$60, according to Dew. Schools considering programs can tailor them according to the guidelines, and schools with existing programs can make improvements before applying for NATEF review. If NATEF finds deficiencies, the program has as much as 1 year to make corrections and be approved.

NATEF then recommends the program to ASE for certification in diagnosis, repair, maintenance, and conversion. The certification is aimed at secondary and post-secondary schools. The cost for the whole process is

minimal, Dew said. After paying the manual and application fees, the only remaining cost is travel for the on-site evaluator.

According to a survey NATEF performed last year, about 30 schools have CNG and LPG programs in place across the country, and another 60 have plans to add programs within 3 years. Some have already begun the certification process. "I anticipate the interest level will increase quite a bit as we begin promotion efforts," Dew said. As part of that effort, NATEF will hold 10 regional workshops.

Meanwhile, NATEF is working on other certification programs. Standards for in-service mechanic training are expected to be completed this spring. Participants are also designing standards for heavy-duty CNG and LPG applications.

☛ *For more information on the standards, call NATEF at (703) 713-1114. For more information on CHAMP, call the National Alternative Fuels Hotline at (800) 423-1DOE, e-mail hotline@afdc.nrel.gov, or check the AFDC Website at <http://www.afdc.doe.gov>.*

Alternative Fuel Stakeholders Meet in Atlanta

Stakeholders in the U.S. Department of Energy's Clean Cities program will meet again in Atlanta, Georgia, on June 18-21. There are 45 designated Clean Cities throughout the United States.

Atlanta was the first to join the program when it began in 1993. By hosting the conference, the local coalition can highlight its biggest effort to get alternative fuel vehicles on the road: using alternative fuel cars and buses to help transport the millions of athletes and attendees who will inundate the city for the upcoming 1996 Summer Olympic Games.

There are several opportunities for sponsorship and exhibition. Registration is \$200, but there are special discounts as low as \$100 for early birds and fleet managers.

☛ *For more information, call the Clean Cities Hotline at 1-800-CCITIES.*

Alternative Fuels for Forklifts

Alternative fuels such as compressed natural gas, propane, and electricity can clean up the air indoors as well as outdoors. But the benefits of alternative fuel forklifts are best realized in equipment that is properly maintained, according to a recent study conducted by the Southwest Research Institute.

“During the study, no matter how the engine-test configuration was set up, emissions were reduced with a lean air-to-fuel ratio. Operators need to keep their engines tuned lean,” said Steve Jaeger, assistant director of research for the Texas Railroad Commission’s Alternative Fuels Research and Education Division.

Several industry representatives are issuing guidelines on maintenance. “The message the propane industry wants to deliver is that a regular preventive maintenance program is the cost-effective way to keep costs lowest and indoor air clean,” said Larry Osgood, chairman of the National Propane Gas Association’s Engine Power Committee.

Alternative fuels can also save fleet operators money, according to the Gas Research Institute’s (GRI’s) new brochure, *Case Studies of Cost-Effective Forklift Truck Fleets*. In the brochure, GRI highlights the experiences of four companies with natural gas forklifts, including a Chrysler Corporation production plant.

✦ *To obtain a copy of GRI’s report, call Jayne Herring at (312) 399-8239 or e-mail jherring@gri.org.*

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