

AFDC UPDATE

News of the Alternative Fuels Data Center

AMFA Heavy-Duty Data: E95, CNG Fuel Economies Virtually Same as Diesel

According to new data being published by the Alternative Fuels Data Center (AFDC), a fleet of heavy-duty vehicles running on E95 (95% ethanol/5% gasoline) and another running on compressed natural gas (CNG) have virtually the same fuel economy as diesel control vehicles on an energy equivalent basis.

These fleets are participating in the U.S. Department of Energy's (DOE) Alternative Fuel Truck Commercial Application Program, part of the Alternative Motor Fuels Act demonstration and data collection program. The AFDC oversees the data collection effort for DOE.

Archer Daniels Midland, a grain processor and ethanol producer based in Decatur, Illinois, ran four line-haul trucks on E95. These trucks had an average fuel economy of 5.3 miles per equivalent gallon (mpge)*, while a diesel control



Driver fuels E95 line-haul truck

Photo by: Warren Gretz

vehicle in the same fleet averaged 5.7 miles per gallon (mpg) (see Table 1). The fuel economy of the five vehicles was averaged over 10 consecutive refuelings. The trucks (E95 and diesel control) all operate on Detroit Diesel Corporation's 6V92 compression ignition engine and have been in service since the third calendar quarter of 1992. The ethanol truck program is running in cooperation with the Illinois Department of Energy and Natural Resources.

Similar positive fuel economy results were found with six New York Department of Sanitation garbage packer trucks and snow plows running on CNG. The fleet of nine trucks (including three diesel control vehicles), had an average fuel economy of 1.5 mpeg, versus 1.6 mpg for diesel control vehicles (see Table 2). The trucks, which

have been in service since the fourth quarter of 1992, all operate on Cummins L-10 spark ignition engines.

"These fuel economies are so close to the diesel controls they indicate a high level of development of these engines by the manufactur-

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DOE to Fund Heavy-duty Demonstration Program

The U.S. Department of Energy (DOE) announced the availability of up to \$924,000 through its Heavy-Duty State/Municipal Vehicle Alternative Fuel Demonstration Program. *(continued on page 3)*

AMFA Heavy-Duty Data

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ers," according to NREL Fuel-Engine Systems Engineer Mark Riechers. "We have learned through these cases that the CNG vehicles have a level of reliability that has resulted in considerable uptime and availability for use," he said, adding that "Emissions data on these vehicles will be available at a later date."

Other projects under DOE's Commercial Truck Program are currently underway. The objectives of this program are to:

- generate data on alternative fuels for heavy-duty vehicles (primarily methanol, ethanol, and natural gas) in a comprehensive test and evaluation;
- conduct a geographically broad-based demonstration program with test sites throughout the country;
- involve as many user sectors and industry members as possible; and
- generate data on alternative fuel heavy-duty vehicles and heavy-duty engines and make this information available to users, potential users, and hardware manufacturers through the AFDC.

Other fleets are currently running in conjunction with DOE's program:

- The California-based VONS grocery company fleet includes two line-haul (one CNG and one diesel control) trucks with Caterpillar G3406 spark ignition engines. The vehicles have been in service since the fourth quarter of 1992.
- The American Trucking Association's Trucking Research Institute has two E95 snowplows/dump trucks and one diesel control operating in the Hennepin County, Minnesota, fleet. These vehicles also run on Detroit Diesel Corporation's 6V92 compression ignition engines and have been in service since late 1993.
- The Federal Express Company,

in conjunction with the South Coast Air Quality Management District, is operating 111 vehicles on liquefied petroleum gas, M85 (85% methanol/15% gasoline), CNG, reformulated gasoline, electricity and gasoline.

These are pickup and delivery vehicles with various original equipment manufacturer (OEM) engines and have been running since the third quarter of 1992 (see *AFDC Update*, Fall 1993, p.1). □

** An equivalent gallon takes into consideration the energy content between the British thermal unit (Btu) content of the alternative fuel versus diesel or gasoline so they may be compared.*

*Illinois Department of Energy and Natural Resources/
Archer Daniels Midland E95 and Diesel Control Fleet*

Ethanol (E95) Line Haul Truck	Truck Mileage (as of 11/30/93)	Average Fuel Economy (Last 10 refuelings)
Truck No. 92002	164,920	3.3 mpg
Truck No. 92004	105,623	3.1 mpg
Truck No. 92006	142,434	3.1 mpg
Truck No. 92008	127,967	2.8 mpg
Average		3.1 mpg
Energy Equivalent		5.3 mpeg*
Truck No. 92010 Control	184,050	5.7 mpg

**miles per equivalent gallon (diesel)*

New York Department of Sanitation/CNG and Diesel Control Fleet

Truck No.	Truck Mileage (as of 12/16/93)	Average Fuel Mileage (Last 10 refuelings)
25CNG-001	3,951	1.3 mpeg*
25CNG-002	3,473	1.4 mpeg
25CNG-003	5,424	1.3 mpeg
25CNG-004	5,959	2.0 mpeg
25CNG-005	1,843	1.8 mpeg
25CNG-006	4,567	1.3 mpeg
Average		1.5 mpeg
25AYX-603 Control	3,387	1.6 mpg

**miles per equivalent gallon (diesel)*

DOE Funds Heavy-Duty Demonstration Program

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The funding, expected to translate into about 10 financial assistance awards, will support state and municipal fleet managers in acquiring heavy-duty alternative fuel vehicles. DOE Regional Support Offices will distribute solicitations to all state energy offices, requesting applications from parties interested in participating in the program. Award recipients will be required to submit weekly vehicle logs to DOE's

National Renewable Energy Laboratory for five years beginning on the date the vehicle starts operation. Data on mileage, maintenance, reliability, and exhaust emissions will be compiled and catalogued in the Alternative Fuels Data Center in Golden, CO.

Parties interested in participating in the program should contact their state energy office for a copy of solicitation number DEPS4194R110637. Applications must be returned to the energy office, postmarked by May 30, 1994. Awards are expected to be issued by late this fiscal year. □

DOE Funding Effort to Create Clean, Safe School Bus

The U.S. Department of Energy (DOE) is funding a project to develop an inherently safe, commercially competitive, alternative fuel school bus that will meet future low emissions and safety standards for the year 2000 and provide energy efficiency equivalents resembling conventional fuels (on a heating value basis).

The National Renewable Energy Laboratory (NREL) will manage the project, and is now evaluating proposals submitted by companies hoping to develop these buses.

Under NREL's request for proposal, buses may be designed to run on compressed natural gas, liquefied natural gas, liquefied petroleum gas, methanol, ethanol, biodiesel, or hydrogen. However, most of the proposals received by NREL are for natural gas designs.

The buses must have ultra-low emissions and must meet all

applicable school bus safety standards, such as the National Highway Safety Transportation Administration's proposed Federal Motor Vehicle Safety Standard Number 303. Although the safety standards have not yet been written, the bus developed for this project must meet those standards as they come into effect sometime this year.

The bus also must be "commercially competitive," meaning that, independent of fuel cost, the vehicle must meet technical requirements for competitive performance, refueling times, vehicle range, driveability, durability, fuel handling, safety, and overall emissions performance.

The project is expected to be a 2- to 3-year effort, completed in four phases:

- systems design;
- prototype hardware assembly and testing;
- full-scale systems testing and integration; and
- a 10,000-mile vehicle demonstration.

Although a number of alternative fuel buses are already in

For more information about articles in this newsletter, or to become an AFDC user, please contact the National Alternative Fuels Hotline at 800-423-1DOE, P.O. Box 12316, Arlington, Virginia 22209.

service, the new bus will be an innovative design. For example, the fuel tanks and system will be placed in the vehicle for maximum safety. The body of the bus will be designed to accommodate this configuration, rather than placing the tanks and fuel system in to fit an existing vehicle structure. "We will be using existing components but modifying their position in a design to maximize safety," says NREL Project Manager Chris Colucci.

While crash tests will not be required, the vehicle designer must do a complete engineering analysis on the vehicle's "crash-worthiness." "The objective of this effort is to demonstrate that alternative fuels can be used in a centrally fueled bus fleet, and have safe operations for school children," says Colucci. □

A large number of National Alternative Fuels Hotline callers are looking for funding to convert fleets to alternative fuels and to develop alternative fuel vehicle (AFV) refueling sites. The following questions and answers provide some insight into how public alternative fuel fleets can qualify for funding under the Congestion Mitigation and Air Quality Improvement (CMAQ) Program sponsored by the U.S. Department of Transportation (DOT).



Q. What is the CMAQ program?

A. CMAQ is an innovative \$6 billion program (\$1 billion over six years) established by the Intermodal Surface Transportation Efficiency Act (ISTEA). These funds are allocated to the states, which may use them for transportation control measures and programs designed to help states implement their transportation/air quality plans and attain the national standards for air pollutants. The funding focuses on investment in, or services for, air quality improvements and provides funds for projects that expand or initiate transportation services with air quality benefits.

Q. Can CMAQ funds be used for alternative fuel vehicle conversions?

To order reports related to these Questions and Answers call the National Alternative Fuels Hotline at 800-423-1DOE.

A. In general, conversion of individual conventionally-powered vehicles to alternative fuels is not eligible under the CMAQ program. However, the conversion of centrally-fueled fleets to alternative fuels is eligible provided that the fleet is publicly owned (or leased) and operated; i.e. buses, paratransit vans, and city or state vehicle fleets. One of the following conditions also must be met: (1) the fleet conversion is in response to a specific requirement in the Clean Air Act Amendments of 1990 or (2) the fleet conversion is specifically identified in the State Implementation Plan as part of the emissions reduction strategy of a non-attainment area. The proposal for funding must demonstrate that the proposed conversion is effective in reducing the specific pollutant(s) causing the air quality violation.

Q. What about CMAQ funding to establish refueling sites/infrastructure?

A. The establishment of AFV refueling facilities and other infrastructure is also eligible for funding if at least one of the two previously mentioned conditions are met. The facility must be publicly owned (or leased) and AFV use must be either required under the Clean Air Act Amendments or identified in the State Implementation Plan. However, if convenient, reasonably accessible, private alternative fuel refueling stations exist, CMAQ funds may not be used to fund publicly-owned fueling stations. According to information from DOT, "such an activity would interfere with private enterprise, and needlessly use transportation/air quality funds for services duplicated in the area."

For further information and a copy of the U.S. DOT's document, A Guide to the Congestion Mitigation and Air Quality Improvement Program, contact the National Alternative Fuels Hotline at 800-423-1DOE.

Callers also often ask questions about converting their vehicles to run on alternative fuels. The following are typical questions:

Q. What is a converted vehicle?

A. A converted vehicle is one that was originally designed to operate on gasoline but has been altered to run on an alternative fuel such as compressed natural gas (CNG) or liquefied petroleum gas (LPG), also commonly referred to as propane, the two most common types of fuel conversions.

Some conversion systems are designed to run on either an alternative fuel or conventional gasoline. These **bi-fuel** systems are advantageous for drivers who do not always have access to an alternative fuel refueling station.

Dual-fuel systems are designed to run on combinations of an alternative fuel with gasoline. Unlike bi-fuel vehicles, which allow the use of only one fuel at a time, dual-fuel systems inject both fuels into the combustion chamber at the same time. Dual-fuel systems are used mostly in heavy-duty or diesel engines, while bi-fuel systems are usually used in passenger cars or trucks.

Dedicated conversion systems run on only one fuel. Generally, dedicated vehicles have improved emissions performance because they are tuned to optimize operations on only one fuel.

Open-loop conversion systems are used in older model-year vehicles that do not have computerized fuel control systems. Open-

loop systems do not provide optimum emissions performance and are slowly becoming obsolete as older cars are taken out of service. Newer **closed-loop** systems provide optimum emissions performance by carefully controlling the fuel/air mixture to the engine. Closed-loop systems are, therefore, preferable to open-loop. These systems carefully control the air/fuel ratio in the engine to optimize emissions performance, whereas an open-loop system is throttle regulated and does not allow for optimal emissions performance.

More than 30,000 CNG vehicles and 300,000 LPG vehicles are in use today in the United States, according to estimates by the American Gas Association and the National Propane Gas Association.

Q. How much will it cost to convert my car?

A. CNG conversion kits cost anywhere from \$2,500 to \$4,000; LPG kits cost about \$1,500-\$2,000. Closed-loop conversions are generally more expensive than open-loop systems. The number of tanks used is also a cost factor.

To help offset the cost, the federal government has set up financial incentives for individuals converting their own vehicles and companies converting fleets. Under

the National Energy Policy Act of 1992 (P.L. 102-486), a person or business can take a tax deduction for up to \$2,000 for a passenger vehicle and up to \$50,000 for a heavy-duty truck.

Q. Is it legal to convert my vehicle?

A. Federal tampering provisions under Section 203 of the Clean Air Act explain that the U.S. Environmental Protection Agency (EPA) is concerned with emissions effects created by altering or modifying motor vehicles from their original certified configuration.

EPA's position has been outlined in "*Mobile Source Enforcement Memorandum No. 1A*" (*Memo 1A*) and in the fact sheet entitled "*Conversions of Vehicles and Engines to Operate on Natural Gas and Propane.*" When deciding on a conversion company, make sure the company knows about Memo 1A and has followed the requirements. It is best to get this in writing.

Also note that EPA requires emission control devices, such as catalytic converters, to remain on converted vehicles. It is a violation of tampering laws to remove these devices, and a manufacturer or dealer could be fined up to \$25,000 and any other person up to \$2,500 for such a violation.

For additional information regarding federal tampering laws, contact Mr. Pat Childers at U.S. EPA, FOSSD, 401 M. Street SW, Washington, DC 20460, or call 202-233-9100.

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Questions & Answers

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Q. Are converted vehicles required to meet federal emissions standards?

A. EPA does not yet have emissions standards in place for converted AFVs. However, the agency has proposed a regulation that would require CNG and LPG converted vehicles to meet new proposed emissions standards. These standards are expected to be published within the year. Retrofits, done prior to that date, will not be required to meet the standards.

In the interim, EPA recommends drivers use equipment that has been certified for emissions by the **California Air Resources Board (CARB)** or that has been tested to comply with Memo 1A. These tests must be performed at a testing laboratory recognized by EPA as being capable of following the Federal Test Procedures found in 40

CFR (Code of Federal Regulations) part 86. The test results should prove that the use of these kits does not adversely affect the emissions from a properly maintained similar motor vehicle.

For a copy of Memo 1A, contact the **National Alternative Fuels Hotline** at 1 800 123-1DOE (1363) or 703-528-3500. For a list of CARB approved aftermarket parts and kits call CARB at 916-322-2990. For a list of high-altitude approved conversion kits, contact **Martin Boyd** at 303-692-3125 at the **Colorado Department of Health**.

Q. Who regulates the safety of converted vehicles?

A. The National Highway Traffic Safety Administration (NHTSA), a division of DOT, is the federal agency that regulates safety issues for all vehicles including conversions. NHTSA has issued a proposed rule establishing a safety standard for natural gas vehicles

and natural gas vehicle fuel tanks. The proposed rule would require original equipment manufactured CNG vehicles to meet a 30-mph barrier crash test with limited damage. The regulation also focuses on the strength and durability of CNG containers or fuel tanks. The rule is still in the proposed stage, but is expected to be acted upon in 1994. NHTSA is currently reviewing safety issues for LPG conversions, but has not yet taken any action.

Although there are not yet any government safety certification standards for conversion kits, the **National Fire Protection Agency (NFPA)** has issued NFPA52, an industry safety standard that was updated in 1992.

In addition, 10 industry standards developed by the **American Gas Association (AGA)** regulate natural gas vehicles. While there are no federal laws that require conversion companies to follow set industry standards, industry standardized equipment and procedures reduce uncertainty and assure reliability and safety.

For more information on NHTSA regulations, call **Gary Woodford** at 202-366-4804. For a complete copy of NFPA 52, call the NFPA at 703-516-4346. To get a breakdown of AGA

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If you are interested in becoming an Alternative Fuels Data Center user,

please detach, fill out this form, and return to:

AFDC, P.O. Box 12316, Arlington, VA 22209

Phone: 800-423-1DOE Fax: 703-528-1953

Date _____

Name _____ Company _____

Address _____ City _____

State _____ Zip _____ Phone _____ Fax _____

In order to use AFDC/View for Windows, your PC must meet the following minimum specs: 80386 Processor, DOS 3.3, Windows 3.1, 2 MB RAM (4 recommended), Mouse, 1200 baud modem (minimum).

Please send me: AFDC/View disk

Questions & Answers

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industry standards or a list of AGA certified equipment, call the American Gas Association at 703-841-8600.

Q. How do I know if a mechanic is qualified to convert my car?

A. Because the safety of a converted vehicle depends greatly on the quality of the workmanship, the DOE is in the process of developing national minimum standards for technician certification and conversion training programs.

In the meantime, the **National Institute for Automotive Service Excellence (ASE)** has developed a written certification test to measure the knowledge and skill of technicians in installing, diagnosing, and

repairing converted CNG vehicles. This is a voluntary test.

Additionally, some states, such as Texas and Oklahoma, require training certification for technicians who install, modify, repair, or renovate equipment used in the conversion of any alternative fuel engine. It is important to check with your state air quality agency to see if there are any certification requirements for technicians in your area. □

Table 3
Average Miles per Gallon by Vehicle Type
as of January 20, 1994

Vehicle Type	Model Year	Average MPG (Gasoline)/Average Equivalent MPG (AFVs)	Standard Deviation MPG	Number Samples	Refuel Index
CNG GMC Pickup/C2500	1992	11.8	3.85	2747	
Gasoline Control GMC Pickup	1993	13.4	4.24	105	
M85 Ford Econoline	1992	14.6	7.49	13	0.48
Gasoline Control Ford Econoline	1993	15.1	3.91	32	
E85 FFV* Chevrolet Lumina	1992	22.8	6.82	195	0.60
Gasoline Control Chevrolet Lumina	1991 & 1993	24.7	5.59	549	
M85 FFV Chevrolet Lumina	1991 & 1993	23.7	6.32	2305	0.84
M85 Control Chevrolet Lumina	1991	22.4	6.05	245	
CNG Dodge Van/B200	1992	12.8	2.52	4033	
Gasoline Control Dodge Van	1994	10.4	3.49	94	
M85 Dodge Spirit	1993	23.4	6.16	601	0.50
Gasoline Control Dodge Spirit	1993	26.4	4.18	148	
M85 FFV Ford Taurus	1991 & 1993	23.2	6.19	2245	0.82
M85 Control Ford Taurus	1991	21.5	5.01	183	
Gasoline Control Ford Taurus	1991 & 1993	23.2	5.37	505	

*A Flexible fuel vehicle can run on any combination of either E85 and gasoline or M85 and gasoline.

Fuel Economies of Light-Duty AFVs Compared in AFDC

How do the average miles per gallon of alternative fuel vehicles (AFVs) stack up against gasoline control vehicles?

The Alternative Fuels Data Center (AFDC) is now publishing data that tracks the average miles per vehicle.

The data, collected from more than 600 vehicles from 10 different sites, reports average odometer readings, months in use, estimated mileage at 36 months, and the gasoline equivalent miles per gallon.

As of January, the vehicles had average current odometer readings ranging from 630 to 40,700 miles. Table 3 presents a summary of the average miles per gallon by vehicle type. The data reflect a simple average that "does not take into consideration differences in highway and city driving, differences between the sites reporting and how the vehicles are being used" (i.e., multiple passengers, payload, weather conditions), according to AFDC engineer Lee Schrock. This has led to large variations or standard deviations in the data, says Schrock. □

Meetings and Conferences

May 11-13: Second Annual NGV Institute Educational Symposium, Fairmont Hotel, Dallas, Texas. For information, call Annalloyd Thomason at 702-254-4180 or 800-279-1367, or write to: NGV Institute, 6867 West Charleston Boulevard, Suite B, Las Vegas, Nevada 89117.

May 15-17: 1994 Clean Air Vehicle Conference, Exposition & Grand Prix, Galleria Centre, Stouffer Waverly Hotel, & Atlanta Motor Speedway, Atlanta, Georgia. For information, call Kent Igleheart at 404-237-1980, or write to: Clean Air Vehicle Association, 14 Piedmont Center, Suite 1205, Atlanta, Georgia 30305.

May 17: National Alternative Fuels Teleconference, 12:00 p.m. to 3:30 p.m. Eastern Time. Contact your state energy office or your U.S. Department of Energy Regional Support Office for information on the location of down-link sites.

May 21-28: 1994 American Tour de Sol Solar and Electric Car Championship, New York, New Jersey, and Pennsylvania. For information, call Northeast Sustainable Energy Association, 414-774-6051.

June 13-15: 1994 Windsor Workshop on Alternative Fuels, Ramada Hotel, Toronto, Canada. For information, call Susan Horton at 905-822-4111 (ext. 515), or write to: ORTECH

Corporation, 2395 Speakman Drive, Mississauga, Ontario, Canada L5K 1B3.

June 17-19: Midwest Renewable Energy Fair, Portage County Fairgrounds, Amherst, Wisconsin. For information, call 715-824-5166, or write to: Midwest Renewable Energy Association, 116 Cross Street, P.O. Box 249, Amherst, Wisconsin 54406.

June 28-July 1: International Alternative Fuels Conference, Hyatt Regency Hotel, Milwaukee, Wisconsin. For information, call Greg Haigwood at 800-872-3835 or 703-528-3500, or write to: Information Resources, Inc., 1925 N. Lynn Street, Suite 1000, Arlington, Virginia 22209.

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