

Alternative **FUELS**

Volume 6, Number 3



Ethanol Fuel Demonstration in Hennepin County, Minnesota

In previous issues of *Alternative Fuels in Trucking*, we reported on several demonstration projects that used different alternative fuels in actual trucking operations. We now have data highlights from the first completed project, a demonstration comparing ethanol with diesel in three snowplow and road maintenance trucks in Hennepin County, Minnesota (see *Alternative Fuels in Trucking*, Volume 2, Number 4).

From November 1993 to October 1996, Hennepin County (which includes the city of Minneapolis) field-tested two snowplow and road maintenance trucks fueled with E95 (a 95%/5% blend of ethanol and gasoline). The test was designed to compare ethanol truck performance with diesel truck performance in all weather environments. The U.S. Department of Energy (DOE) funded the project through the National Renewable

Energy Laboratory (NREL). The ATA Foundation's Trucking Research Institute (TRI) managed the project.

Ethanol, an alcohol produced from grain, has been used as a fuel additive to gasoline for years. It is a worthy prospect as an alternative fuel for several reasons. It is produced in the United States, and it is renewable because its feedstock crops can be regrown and harvested annually (more often in some cases). It also has more desirable emissions characteristics than conventional automotive fuels. However, it has rarely been tested in heavy-duty vehicles in high percentage blends.

The Hennepin County road test used three trucks in all. Two were fueled with E95 and one diesel-fueled truck was used as a control vehicle. Engine modifications were needed for the engine control module, fuel system, glow plugs, by-pass air system, and compression ratio. No special safety precautions were necessary.

During the winter, the trucks ran in 8-hour shifts plowing snow off the urban and suburban roads of Hennepin County and hauling the snow to a dump site. The rest of the year, the three trucks were used for paving and road maintenance. On a weekly basis



Photo courtesy of Ag Processing, Inc./PIX04978

This snowplow in Hennepin County, Minnesota, runs on E95.

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throughout the project, drivers rated the trucks on operational characteristics and documented fuel use, oil use, and maintenance frequencies. These data were collected and stored in the Alternative Fuels Data Center at NREL.

Researchers from West Virginia University ran the trucks through a series of tests, using a dynamometer to simulate general truck driving patterns and test the emissions. The researchers found that the ethanol trucks produced fewer oxides of nitrogen (NO_x) emissions and particulates, but more carbon monoxide (CO) and hydrocarbons (see Table 1).

The Hennepin County drivers reported that the E95 trucks performed nearly as well as the diesel truck, producing about the same quality of work in the same amount of time. Exceptions they noted resulted from the primary and secondary fuel filters in the E95 trucks, which clogged frequently, causing the trucks to starve for fuel, hesitate, stall, and sometimes be harder to start. Fuel economy was also a concern. The ethanol trucks used about twice as much fuel as the diesel truck based on the volume of fuel per mile (#2 diesel contains about 1.5 times as much energy as E95).

Maintenance and repair costs for the E95 trucks were consistently higher than those for the diesel control. Additional costs are attributed mainly to the fuel system. Frequent fuel filter replacement was the biggest expense and fuel pump replacement on both E95 trucks added significantly to the total costs. Although these were the most expensive maintenance and repair items in the demonstration, commercialization would surely bring refinement and reduced prices in this area.

A complete final report on the project will soon be available from NREL.

CO	7.4	6.4	9.0	28.7	4.3	5.2
NO₂	12.3	11.6	14.8	11.6	13.2	13.2
PM	0.30	0.37	0.45	0.56	0.83	0.8
HC	4.98	3.94	5.69	7.12	1.35	1.44
	1994	1995	1994	1995	1994	1995
	E95		E95		Diesel	

Table 1. Emissions Comparisons Between E95 and Diesel



EPA Releases Definitive Reference Guide to Emissions Standards

The Environmental Protection Agency recently released a colorful, comprehensive, and easy-to-follow reference guide to emissions standards for heavy-duty and nonroad engines. The guide, which is available free of charge in two formats—a folded brochure and a poster—can be obtained from:

Jennifer Barker
U.S. EPA
Office of Mobile Sources
2565 Plymouth Road
Ann Arbor, MI 48105
(313) 668-4510

The guide can also be found on the World Wide Web at <http://www.epa.gov/OMSWWW/nonroad.htm>



EPA Revises Tampering Policy for Alternative Fuel Conversions

On September 4, 1997, the U.S. Environmental Protection Agency (EPA) issued its Addendum to the Mobile Source Enforcement Memorandum 1A (Memo 1A). Memo 1A was originally released in 1974 to clarify the EPA's policy on the tampering prohibition contained in Section 203(a) of the Clean Air Act. The September 1997 addendum revises and clarifies the tampering policy directed at vehicles and engines converted to use alternative fuels. The regulation in Memorandum 1A states that if manufacturers alter a vehicle or engine in any way, they must have a "reasonable basis" to believe the modification will not adversely affect emissions performance or the EPA may consider it tampering. The tampering policy defines a "reasonable basis" as either successfully passing emissions testing under the 40 CFR 86 regulations, or obtaining a representation that a reasonable basis exists from a federal, state, or local environmental control agency. Historically, when doing aftermarket conversions, mechanics have used the second definition and often follow test procedures established by the states of California and Colorado.

In 1996, the National Renewable Energy Laboratory published a study that showed that vehicles converted under the provisions of Memo 1A (prior to the addendum) exhibited higher emissions of some constituents when tested on the alternative fuel compared to reformulated gasoline. The EPA subsequently reviewed this information, along with other available data, and determined that vehicles modified to run on

alternative fuels may be exceeding one or more of the applicable federal emissions standards.

After review, the EPA issued the Addendum to Memo 1A with new conversion guidelines for manufacturers and installers. The revised policy states that the EPA will no longer accept representations based on pre-1994 California certification procedures, or procedures under Colorado's Regulation Number 14 as providing a "reasonable basis." Furthermore, they limit the criteria for a "reasonable basis" to one of these three options:

1. Manufacturers must obtain a federal certificate under CFR Part 86 showing that they comply with the standards.
2. For California vehicles, manufacturers and installers must have a retrofit system certification under the "California Certification and Installation Procedures for Alternative Fuel Retrofit Systems for Motor Vehicles Certified for 1994 and Subsequent Model Years."
3. Until December 31, 1998, they must perform specific emissions tests as defined in the addendum.

The installers must keep the records of each converted vehicle or engine, including the vehicle identification number, make and year of vehicle or engine, the installer's name, the date of installation, and a copy of the manufacturer's or marketer's representation.

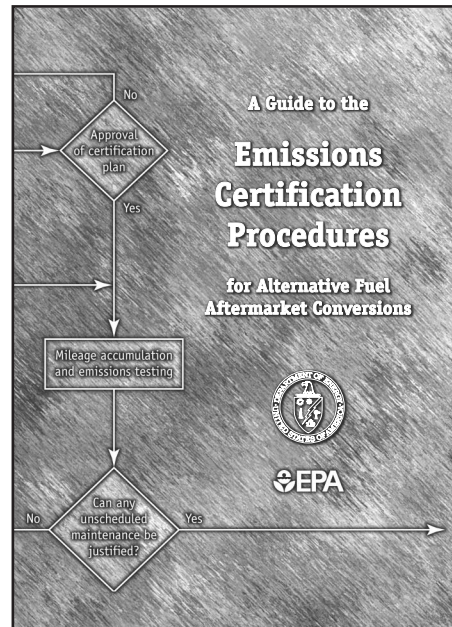
The EPA believes that aftermarket conversions of vehicles and engines will meet federal emissions standards

only if they comply with 40 CFR Parts 86 or 88. However, because of the time and money it takes to set up and perform the necessary test procedures, some may not be able to meet these standards in the short term. Option 3, mentioned above, allows some leeway in getting vehicles and engines ready to conform to the new EPA standards. After December 31, 1998, however, all manufacturers, marketers, and installers must use equipment that conforms to either option 1 or 2 covered by the tampering policy of the new Addendum.

The EPA plans a thorough review of the policy soon to see if additional regulatory changes are needed for other types of vehicle or engine modifications, parts, or systems. Questions regarding this policy should be directed to the Mobile Source Enforcement Branch at (202) 564-2255. The full text of Addendum to Memorandum 1A is available on the EPA's web page at

<http://es.inel.gov/oeca/ore/aed/comp/jcomp>. It was also published in the *Federal Register* on October 27, 1997 (Volume 62, Number 207).

The Department of Energy and the National Renewable Energy Laboratory have published *A Guide to the Emissions Certification Procedures for Aftermarket Conversions*, which provides a "user friendly" explanation of the certification procedures required by the EPA and the California Air Resources Board. The guide is available through the National Alternative Fuels Hotline (1-800-423-1DOE), and on the World Wide Web at <http://www.afdc.doe.gov> (click on What's New).



This guide leads the reader through the procedures for emissions certifying aftermarket conversions to alternative fuels.

Evolution of the ATA's Alternative Fuels Task Force

Do you know what the ATA Foundation's Alternative Fuels Task Force is, who its members are, and what it does? As the Task Force marks its eighth year, we would like to review its history and describe its current work.

Those new to the trucking industry may not have vivid memories of the gasoline crises that bogged down our country in the 1970s. Back then, political instabilities in the Middle

East triggered a massive oil embargo that created historic disruptions in U.S. transportation fuel supplies. The era became known for its "gas lines," expensive fuel, and attendant inconveniences. At the time, the United States imported about 30% of its oil—today, we import about 50%.

The fuel supply disruptions of the 1970s spawned a national resolve to explore energy and fuel options and to move the country toward energy

independence and develop alternative fuels and products not tied to petroleum resources. However, lower oil prices and increased economic prosperity soon allowed the specter of the nation's energy vulnerability to fade.

By the late 1980s, national concern had turned to environmental and health issues and modifying the Clean Air Act to improve air quality more rapidly. Gaseous emissions

from cars, trucks, and buses received critical attention. Alternative fuels and systems again presented a potential solution—they could not only be produced domestically, but they produced fewer toxic emissions. This fact renewed interest in alternative fuel research. By the late 1980s, the alcohol fuels, especially methanol, were being touted as the best alternative fuels, chiefly because of widespread availability and ease of distribution.

The trucking industry, being totally dependent on diesel and gasoline for its livelihood, was keenly interested in learning all it could about all types of alternative fuels—alcohols, natural gas, biodiesel, and others—before encouraging a switch from conventional fuels.

Motor carriers, engine manufacturers, parts suppliers, and maintenance crews also needed to know what would be involved in developing alternative fuel products. Everyone connected with the industry needed information about the fuels themselves—availability, cost, safety, and infrastructure requirements.

To meet the information needs, the ATA Foundation, the research affiliate of the American Trucking Association, commissioned Battelle Memorial Institute to conduct a study and convened the Alternative Fuels Task Force. The Task Force's purpose was twofold: first, to provide Battelle the necessary industry input and access to help with the study; and second, to act as an alternative fuels information conduit from the Foundation to industry motor carriers and suppliers.

The Battelle study, *Effects of Alternative Fuels on the U.S. Trucking Industry*, was published in April 1991 and the Foundation's role in alternative fuels research grew. The Task Force expanded both in membership and scope. The ATA Foundation, through its Trucking Research Institute (TRI), partnered with DOE's National Renewable Energy Laboratory (NREL) to pursue a testing demonstration program using several different alternative fuels in various trucking operations. As the information conduit role expanded to include federal, state, and local governments, Task Force membership grew. And as the scope of needed information grew, representatives from the associated industries joined the group. New members included representatives from industries such as natural gas, alcohol fuels, biodiesel, and cryogenic tank and compressed gas cylinder suppliers and distributors.

With this growth and expanded scope, it became appropriate to create subcommittees to deal with technical issues. Although the Task Force focuses on informing industry members about any alternative fuels developments that might affect them, the Manufacturers' Technical Subcommittee plays a specific role in advancing the production and use of natural gas in heavy-duty vehicles.

Truck and engine manufacturers have expressed strong interest in liquefied natural gas (LNG) because of its low cost (competitive with petroleum fuels) even though the physical properties of this alternative fuel require significant infrastructure investment and vehicle systems modifications. The Manufacturer's Technical Subcommittee, in partnership with

the Society of Automotive Engineers (SAE), addressed these issues with a Recommended Practice to guide the industry in producing LNG trucks. The guide helps industry members to meet the highest safety standards and comply with appropriate regulations. The subcommittee also works with regulatory agencies, particularly at the state and local level, to help them in formulating regulations that ensure safety and compliance without an undue burden. The LNG work culminated in January 1997 with the publication of SAEJ2343 ("Recommended Practices for LNG-Powered Heavy-Duty Trucks"). The subcommittee is currently working with the Gas Research Institute to prepare similar guidance to the industry for medium heavy-duty trucks fueled with compressed natural gas.

The ATA Foundation's Alternative Fuels Task Force has become a large organization with a membership that reflects the breadth and complexity of the industry. The members share the kind of information that will lead them to intelligent decisions on how, when, where, and why to use alternative fuel vehicles. Alternative fuel decisions are highly complex, and members gain valuable insights from each other because of their varied backgrounds. Anyone interested in obtaining further information on the Task Force or the Manufacturers' Technical Subcommittee may call Bill Peerenboom at the Trucking Research Institute, (703) 838-1863, or contact the ATA Foundation by e-mail at ata_found@aol.com.

John Deere Introduces Two New Natural Gas Engines

At the June 1997 National Clean Cities Stakeholders' Conference and Expo in Long Beach, California, the John Deere Company presented information on its two natural gas engines. The engines are a major step toward increasing the trucking industry's use of alternative fuels. John Deere started manufacturing natural gas engines in 1994 with the 6081H PowerTech 8.1L. In early 1998, the company will introduce its 6068H PowerTech 6.8L engine.

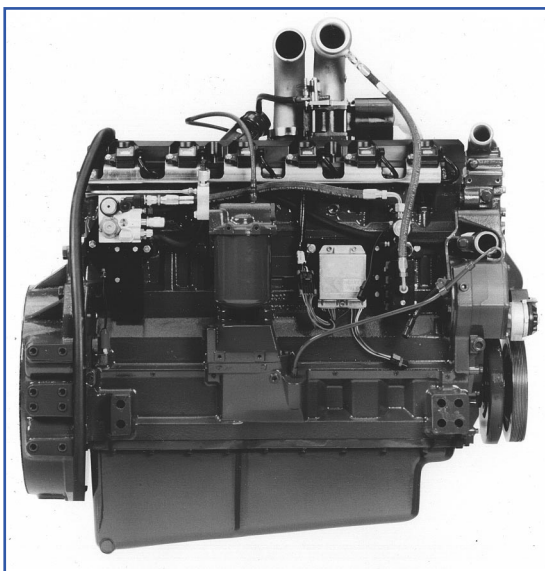
Because performance is a major concern for the trucking industry, John Deere designed the engines with enough power and torque to carry heavy loads and climb hills like conventional diesels. Additionally, both engines already meet the U.S. Environmental Protection Agency's 1998 emissions standards for heavy-duty vehicles. The PowerTech 6.8L

and the 8.1L engines also promise fewer emissions and quieter operation than conventional diesel fuel engines. The individual wet cylinder liners of the 6.8L model act to dissipate heat from the engine quickly. And, because the liners are individual, the engine can be rebuilt, extending engine life.

The PowerTech 8.1L engine is the more powerful of the two, with 250 horsepower at 2200 rpm (see Table 2 for technical specifications). Both engines feature turbo-charged aspiration, air-to-air charge-air cooling, and a spark-ignited combustion system. They have a lean-burn, closed-loop adaptive learn technology and electronically controlled emissions management systems. Figures 1 and 2 illustrate the performance curve for both engines. The 6.8L model is smaller and lighter, with a low idle

speed of 650 rpm. It also features lean-burn, closed-loop adaptive learn technology and an electronically controlled emissions management system. These latter features give both engines more constant performance, emissions control, and the potential for better fuel economy than a conventional diesel engine.

The Deere 6068H PowerTech 8.1L engine is currently operating in school buses in northern California. The 8.1L is also available for trucks and the manufacturer recommends this engine for centrally fueled fleets that make urban deliveries. The PowerTech 6.8L engine will become available in early 1998 and will also be used in school buses and heavy-duty truck markets.



8.1 L CNG (6081 H) PowerTech engine

	6081H PowerTech 8.1L	6068H PowerTech 6.8L
Horsepower	250@ 2200 rpm	225 @ 2400 rpm
Length	45.5 in.	43.5 in.
Width	32.0 in.	32.2 in.
Height	48.1 in.	32.9 in.
Dry Weight	1470 lb	1290 lb
Compression Ratio	10:1	11:1
Peak Torque	800 lb-ft @ 1350 rpm	640 lb-ft @ 1500 rpm

Table 2. Technical Specifications of John Deere Natural Gas Engines

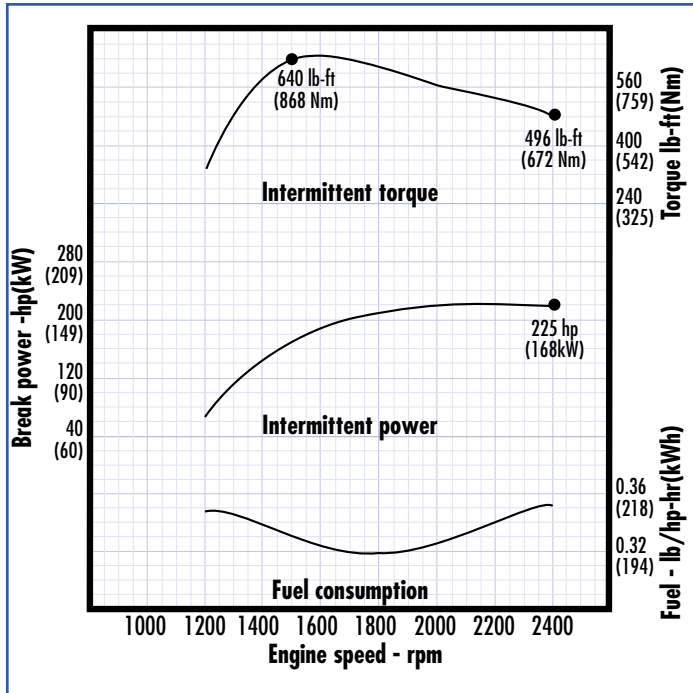


Figure 1.
PowerTech natural gas 6.8L engine performance curve.

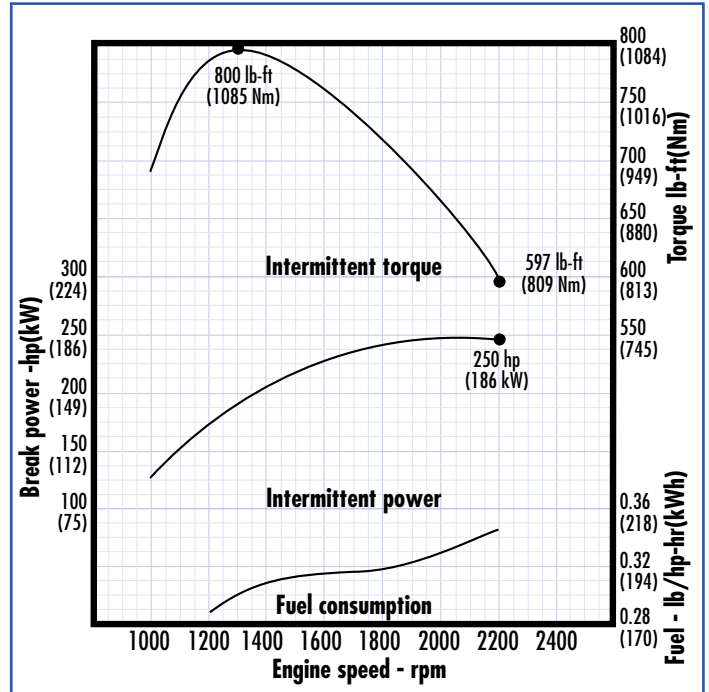


Figure 2.
PowerTech natural gas 8.1L engine performance curve.

Alternative Fuel Taxes Reduced in Taxpayer Relief Act of 1997

On August 5, 1997, President Clinton signed the "Taxpayer Relief Act of 1997." Several provisions in the Act directly affect the trucking industry. Beginning October 1, 1997, the tax rate for liquefied petroleum gas or propane was lowered to 13.6 cents per gallon (instead of being taxed at the same rate as gasoline, 18.4 cents per gallon). The tax rate for liquefied natural gas has also been reduced from 18.4 cents to 11.9 cents per gallon. On a Btu basis, the reductions make the tax rate on these alternative fuels the same as the tax

on gasoline. Because LNG competes principally with diesel, its tax rate is now less than that for diesel fuel on a Btu basis. The rate for methanol produced from natural gas has also been lowered from 11.3 cents to 9.15 cents per gallon.

Beyond these changes, several other stipulations from the Act will directly and indirectly affect the trucking industry. The Act designates that 4.3 cents of the tax will go into the Highway Trust Fund, split between

the Highway Account (3.45 cents) and the Mass Transit Account (0.85 cents). No fuel tax money will go to support Amtrak; however, the organization will receive income tax refunds to be enacted through future authorizing legislation. Also, from October 1, 1997, through March 31, 2005, the 0.1 cent-per-gallon Leaking Underground Storage Tank tax will be reinstated, and starting July 1, 1998, kerosene will be subjected to the same tax-or-dye rules as diesel fuel.

Alternative **FUELS**

I N T R U C K I N G

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The aim of **Alternative Fuels in Trucking** is to inform fleet owners and operators, equipment suppliers, government officials, and other interested parties about important developments in the use of alternative fuels in heavy-duty trucks. Suggestions and comments are welcome and may be directed to the National Alternative Fuels Hotline at 800-423-1DOE. Views expressed by guest authors are their own, and not those of ATAF, DOE, or NREL.

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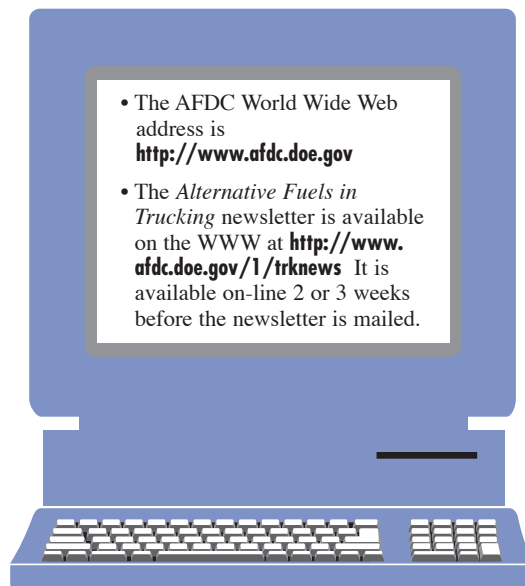


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How to Reach Us



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



- The AFDC World Wide Web address is <http://www.afdc.doe.gov>
- The *Alternative Fuels in Trucking* newsletter is available on the WWW at <http://www.afdc.doe.gov/1/trknews>. It is available on-line 2 or 3 weeks before the newsletter is mailed.

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