Final Technical Report

Project Title: Hydrogen-Enhanced Natural Gas Vehicle Program

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I. INTRODUCTION

There are many implementation technologies being proposed and developed for utilizing hydrogen as a fuel. Of these technologies, HCNG (hydrogen-natural gas mixtures) offers the greatest near term possibilities, both technical and economic. HCNG can be combusted in an internal combustion engine (ICE) that has been modified with a conversion kit. This supports the deployment of hydrogen refueling infrastructure, while the cost of fuel cell vehicles decreases, and the use of HCNG fuel also reduces tailpipe emissions. To further the use of this near-term technology, the US Department of Energy (DoE) has included in their hydrogen infrastructure programs, the ability to not only dispense natural gas and hydrogen for vehicle refueling, but controlled mixtures of the two. The City of Las Vegas is one of those locations where DoE has implemented this capability. This report documents the vehicle conversions, operations and results of nine light-duty vehicles converted from CNG to HCNG operation. Performance, reliability, safety, efficiency and tailpipe emissions data was collected. This project was jointly accomplished by the City of Las Vegas and Collier Technologies.

II. PROJECT OBJECTIVE

The project objective is to demonstrate the viability of HCNG fuel (30 to 50% hydrogen by volume and the remainder natural gas) to reduce emissions from light-duty on-road vehicles with no loss in performance or efficiency. Collier Technologies Inc (CT) is to supply the latest design retrofit kits capable of converting nine compressed natural gas (CNG) fueled, light-duty vehicles powered by the Ford 5.4L Triton engine. CT will install the kits on the first two vehicles in Las Vegas, train personnel at the City of Las Vegas (the City) to perform the additional seven retrofits, and develop materials for allowing other entities to perform these retrofits as well. These vehicles will be used in normal service by the City documenting driver impressions, reliability, fuel efficiency and emissions for a minimum of one year after conversion.

III. BACKGROUND

The technology behind HCNG was developed in the early 1990's by the principals of CT while at the University of Central Florida. The concept is based on using hydrogen to extend the lean limit of combustion of natural gas. This phenomenon has the ability to allow engines using this fuel to operate at equivalent engine power with drastically lower engine-out NOx emissions. The physical principle involved is called "charge dilution."

Originally, this technology was targeted at lean burn engine applications. That is, operating the engine with large amounts of excess air. Lean burn results in the highest engine efficiency of the common charge dilution mechanisms. A business case can be made for converting existing lean burn engines to operate on HCNG with only changes to the engine management system. These engines

tend to be heavy-duty, turbocharged applications. However, light to medium-duty applications are dominated by stoichiometric, three-way catalyst engine systems. Converting these engines to lean burn results in very expensive hardware being employed with only marginal improvements in overall performance. As a result, CT has developed technology that allows the potential engine benefits of HCNG fuel to be achieved with a methodology that is much more cost-effective than lean burn conversions. The methodology chosen is to use exhaust gas recirculation (EGR) as the charge dilution mechanism. EGR dilution maintains stoichiometric engine operation which results in being able to take advantage of the existing three-way catalyst emissions control system on the vehicle. In addition, the OEM engine management systems have a capability called “adaptive learn” which allows the existing controller to maintain stoichiometric combustion with the HCNG fuel without modification of the controller algorithms.

The previous work in Florida with HCNG identified 30% by volume hydrogen as the best compromise between the amount of hydrogen used and the emissions benefits that can be obtained through charge dilution. Concomitantly, work performed at CT laboratories with EGR determined that employing 30% hydrogen HCNG fuel limits the maximum efficient EGR rates to about 35%. That is, 35% of the gaseous intake of the engine is composed of exhaust gases. The design of hardware for this project targeted 30% as the desired EGR rate to allow for variations in actual EGR rates on the vehicle that may result in inefficient engine operation if 35% was the targeted value.

The hydrogen energy fueling station was brought online in November 2002, built under a separate cooperative agreement¹ (DE-FC36-99NV13578) between DoE and Air Products and Chemicals, Inc. in partnership with the City of Las Vegas and Plug Power, Inc. as a commercial demonstration of hydrogen as a safe and clean energy alternative. The site originally featured the co-production of hydrogen fuel and electric power. In February 2004, the on-site steam reformer used to generate the hydrogen fuel was disengaged. Liquid fuel deliveries were started at that time and continue today. The site provides fuel for both hydrogen and compressed HCNG vehicles from separate dispensers. The nine light-duty HCNG vehicles were refueled at this hydrogen energy station.

Questions arise concerning the efficacy of such a system. Will the use of HCNG and large quantities of EGR adversely affect reliability, safety, fuel economy, and drivability? Will the hardware and procedures required to convert existing CNG vehicles be easily implemented by existing technicians? This project answers these questions.

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¹ The final technical report for the hydrogen energy station can be found at the Office of Scientific and Technical Information website <http://www.osti.gov/bridge/advancedsearch.jsp> (identifier number DE-FC36-99NV13578).

IV. TECHNICAL APPROACH

One of the goals of this technology demonstration is to be able to offer an affordable kit to convert existing Ford natural gas vehicles to operate using HCNG fuel with much lower exhaust emissions (most notably NO_x) and with no loss in vehicle performance. Additionally, the technology should be simple enough to be installed by current automotive technicians with minimal training.

The technology employed to accomplish this methodology consists of the following features.

1. Cooling the EGR Gases

Engine exhaust gas is very hot compared to ambient air used by the engine for combustion. Therefore it must be cooled to avoid water condensation within the engine and very low volumetric efficiency due to a hot, less dense air charge. To solve this problem in the least expensive manner, EGR gases are pulled from the rear of the vehicle in close proximity (>18 inches) from the end of the vehicle exhaust. This exhaust gas is then plumbed using standard exhaust pipe back to the engine compartment. This plumbing is purposely routed outside the frame rails of the vehicle to allow the maximum cooling effect from the ambient air. Performing the EGR sampling and cooling in this manner takes advantage of the inherent cooling effect of the existing exhaust system along with routing the return piping in the ambient air stream. This design avoids the cost and engine bay space requirements of incorporating a heat exchanger with a water cooling loop.

2. Removing Condensed Water from the EGR Gases

Before routing the EGR gases to the engine, the water vapor that results from the combustion process and condenses in the exhaust and EGR piping must be removed. This is accomplished by inserting a canister into the EGR return line. Condensed water will fall to the bottom of the canister while EGR gases will pass through. The canister utilizes a “goose neck” water removal system similar to that in household plumbing. The purpose of the goose neck is to keep air from being drawn into the EGR plumbing through the use of a water column. When the water level inside of the canister exceeds the top of the goose neck, condensed water is free to flow out of the trap.

3. Recuperation of Lost Engine Power

Any form of charge dilution will reduce maximum engine output power. In addition, hydrogen in the fuel will displace more combustion air than methane, thereby reducing maximum engine output power as well. To overcome this consequence, some sort of air charging system must be employed. These most often take the form of super or turbo charging. Turbo charging in this

application will defeat the objective of the conversion by being extremely difficult to implement in the confines of the limited space available in the vehicle engine bay. Therefore, a supercharger was chosen to increase maximum engine output power. Ford natural gas vehicles were chosen because of their ability to efficiently incorporate the supercharger and associated hardware. By incorporating overhead camshafts for their V8 engine series, considerable space between the cylinder banks is available. This space allows the supercharger, intercooler heat exchanger and intake manifold to fit without engine bay modifications. Because this hardware configuration is commercially available from Allen Engine Company, it is included as part of the retrofit kit.

4. Control of EGR Gas Flow

The EGR gases are routed from the water removal canister to a specially-designed EGR flow control valve. This valve incorporates a rotating butterfly valve of cross-sectional area sized to provide the 30% EGR desired. It is placed in the EGR line near the engine air throttle. A linkage and bolt-on plumbing adapter rotates the EGR butterfly valve proportional to the engine air intake butterfly valve and contains gas ports to allow the EGR gases to mix with the intake air downstream of each valve. The design goal is to achieve near one atmosphere pressure at the entrance to the EGR butterfly valve such that the pressure difference across both the throttle and EGR valves is the same. This design results in nearly constant EGR ratio throughout the engine operating range.

Descriptions of the hardware involved along with the detailed instructions for installing this hardware are shown in Appendix A. The vehicle service technicians with the City of Las Vegas were trained by CT to perform the retrofits at the City maintenance facility. CT supplied the mechanical, electrical, and software components necessary for the conversions.

V. PROJECT RESULTS

A. Installation:

A total of nine Ford F150 pickup trucks were converted. One was converted at Collier Technologies facility in Reno NV, one was converted by Collier Technologies at the City of Las Vegas automotive facility, and seven were converted by the City of Las Vegas. The installation manual shown in Appendix A was used for these conversions.

Early problems with the retrofit kits were almost exclusively associated with the EGR control valve. The valves would either be very difficult to rotate or would not seal completely when closed. This latter condition would cause the vehicle to idle in a rough condition. All of these problems associated with the retrofit kits

have been resolved. CT rebuilt all but one of the EGR valves. The other valve was modified in Las Vegas and ball bearings were installed on the valve shaft. No problems with any of these valves have been experienced during the remainder of the project.

The conversion of each of the nine vehicles is described below and summarized in Table 1.

Vehicle 2860, a 2000 Ford CNG F-150 with 30,000 miles, was converted by CT in October 2005 at the CT facility. This vehicle had noticeable performance problems after it was delivered to the City. CT thought it may have had a weak coil or weak fuel injector. CT recommended changing the coils and sending the fuel injectors back for testing. The recommended changes were made and there were still problems with the vehicle. Eventually, it was found that most of the problems were with the fuel hydrogen composition from the fueling site (see "Section B. Fuel Station Experience" below). Air Products resolved those problems. The vehicle still had a noticeable rough idle. This vehicle has been used in the City's West yard pool and has had many different drivers. Most are pleased with the performance.

Vehicle 2856, a 2000 Ford F-150 CNG with 6,700 miles, was also converted at the CT facility in November 2005. This was the second vehicle converted. This vehicle had the rough idle problem and poor performance when the fueling station hydrogen content was incorrect. This vehicle is used by the City's parts runner and goes over 100 miles daily when driven. The driver has had very few complaints since the initial bugs were worked out. According to the driver, the vehicle now gets about 20 to 30 more miles per fill than before the conversion.

Vehicle 2767, a 1999 Ford F-250 with 17,900 miles, was converted by City staff in January 2006 and was used as the training project by Collier. CT had a trainer in Las Vegas for a week. It was found at this time that some of the parts CT sent were not made to specification. These parts were reworked and the City was able to complete the conversion and put the vehicle into service in the City pool.

Vehicle 2771, a 1999 Ford F-250 with 55,000 miles, started to be converted by City staff in March 2006. This vehicle conversion proved to be the most problematic. After conversion, there was noticeable poor running at idle and just off idle. All the recommended adjustments and changes suggested by CT were completed. It was discovered at this time that the EGR pipes were too short and extensions had to be fabricated. Collier was to supply them; however, the ones CT sent were too small. By May 2006, the idle problem was still not resolved. The City finally had to issue the operator a different vehicle. The kit was removed and the vehicle was put back on pure CNG.

In late June 2006, the City was contacted by CT about the problems with the EGR pipes on the remaining kits and the idle problem on the three converted

vehicles. A Collier representative came to Las Vegas to troubleshoot the problems. While here, the problem with the EGR pipe was investigated and the idle problems were addressed. It was found that the EGR butterfly valve blocks were out of specification and allowed too much EGR at idle, causing poor idle. CT sent the City EGR pipe extensions for the remaining kits and the City sent all the butterfly valve blocks back to CT to be repaired. In August 2006, the City reinstalled the repaired butterfly blocks on the three converted vehicles. This corrected the idle problems.

With the EGR pipe extensions and the reworked EGR valves, the City reconverted vehicle 2771 during April 2007. This vehicle is in the City's West service center's loaner pool. There have been no complaints from the drivers, although this vehicle has not been driven much since it is only used in case of a vehicle shortage.

Vehicle 2858, a 2000 Ford F-150 truck with 52,600 miles, was converted the first week of May 2007. There were problems resulting from this conversion. The engine would loose power intermittently. CT suggested changing the position of the bell crank pivot arm to change the rate of EGR. The adjustment did fix most of the problem, although there are still times when the idle is rough. A department outside of Fleet Services is driving this truck. The drivers indicate the vehicle runs rough when the engine is cold.

At this point in the project, the only complaints resulting from converting these vehicles was an intermittent rough idle condition. Because rough idle can mean different things to different people, this condition is not quantifiable and not entirely consistent between drivers.

Vehicle 2864, a 2000 Ford F-150 with 64,100 miles, was converted late in May 2007. A department outside of Vehicle Services drives this vehicle. The conversion was made without problems and no operational problems have been experienced with the vehicle.

Vehicle 2861, a 2000 Ford F-150 with 8,545 miles, was converted in July 2007. The biggest problem with this conversion was missing parts in the conversion kit. Most of the missing parts were fittings, which were obtained from a local Las Vegas vendor. Truck 2861 is also in the City's West service center loaner pool and therefore is not driven as much as the other converted trucks.

Vehicle 2780, a 1999 Ford F-250 with 52,111 miles, was converted in August 2007. The conversion kit for this vehicle had parts missing as well. Other than the missing parts, the conversion was again successful. A department outside of Fleet Services is driving this truck. There has not been any negative feedback from the driver.

The last vehicle to be converted was *Vehicle 2784*, a 1999 Ford F-250 with 65,997 miles. This conversion was started during August 2007, but it was not completed until mid October 2007 due to problems with the conversion. The kit was missing a bracket as well as some fittings. The supercharger in this kit did not look new like those in the other kits. It was painted and had small holes in the intercooler area that were sealed with silicone.

After the kit was installed on vehicle 2784, the exhaust gas oxygen sensor reading was out of specification. An air leak was discovered where the intercooler water lines come through the manifold in the supercharger. CT informed us that the company that made the supercharger assembly is no longer in business. Since another supercharger or parts could not be obtained quickly, the City mechanics removed the supercharger, opened it up, resealed the cooler, and reinstalled the supercharger. After the repair, the vehicle ran fine. This last conversion was completed and the vehicle was placed in service on October 16, 2007.

Table 1. Summary of Vehicle Conversions to HCNG

Vehicle#	Year	Model	Miles at Start	Conversion Date	Issues Encountered	Miles Operated During Project	General Performance Level / Operator Satisfaction
2860	2000	F-150 CNG	30,000	Oct05	Rough idle due to hydrogen fuel composition from fueling site and EGR butterfly valve blocks weren't made to specifications.	11,293	After issues were corrected, most drivers were pleased with the driving performance.
2856	2000	F-150 CNG	6,700	Nov05	Rough idle due to hydrogen fuel composition from fueling site and EGR butterfly valve blocks weren't made to specifications.	37,278	After issues were corrected, driver had few complaints with the driving performance.
2767	1999	F-250 CNG	17,900	Jan06	EGR pipe extensions and EGR butterfly valve blocks weren't made to specifications, causing idle problems.	13,288	After issues were corrected, there were no driver complaints with performance.

Vehicle#	Year	Model	Miles at Start	Conversion Date	Issues Encountered	Miles Operated During Project	General Performance Level / Operator Satisfaction
2771	1999	F-250 CNG	55,360 1 st time 62,210 2 nd time	Mar06	Most problematic of the conversions. Poor running at idle and just off idle. EGR pipes extensions were too short.	5,966	Poor running was not corrected by May06 and kit was removed. After the parts were repaired 2771 was reconverted May07. No complaints from drivers after the repairs.
2858	2000	F-150 CNG	52,600	May07	Engine lost power intermittently, rough idle.	9,739	Drivers indicate rough idle when engine is cold.
2864	2000	F-150 CNG	64,100	May07	No problems.	3,418	Drives fine.
2861	2000	F-150 CNG	8,545	Jul07	Parts (mostly fittings) missing from the conversion kit.	4,920	No comments from the drivers.
2780	1999	F-250 CNG	52,111	Aug07	Parts (mostly fittings) missing from the conversion kit.	8,653	No negative comments from the driver.
2784	1999	F-250 CNG	65,997	Oct07	Parts (a bracket and fittings) missing from the conversion kit. Exhaust gas oxygen sensor reading out of specification. Air leak was where the intercooler water lines come through the manifold in the supercharger.	7,099	Ran fine after the repair to the supercharger.

B. Fuel Station Experience:

Over the first two years of operating the HCNG portion of the fueling station, the control of the hydrogen content of the fuel was unreliable. Both very low and very high fractions of hydrogen in the fuel mixture were experienced. When the

hydrogen content was very low, the vehicles would run very poorly, experiencing lack of power and misfiring. When the hydrogen content was very high, the engines would detonate badly with the possibility of serious engine damage if continued. This problem with the fueling station was resolved in the summer of 2006. Since that time, no further problems have been experienced with the hydrogen content of the fuel.

In November 2007, the fuel pump handle started leaking. The handle was replaced and the leak was fixed. The fuel station was also down a couple of days in December 2007 due to no pressure. It turned out the problem was with the CNG lines. A valve had come loose on the main CNG lines and there was not enough CNG to mix with the hydrogen. The problem was fixed and the City has not had any problems with the fueling site since.

C. Post-Conversion Results:

With the various problems causing a delay in the conversion of all nine trucks, the City requested a no-cost extension of the project to allow time to evaluate each of the vehicles' performance over a one year time span after the final truck conversion was completed. DOE did grant the no-cost extension to give the project an end date of September 30, 2008.

The vehicles are still in service and running reasonably well. Since all conversions were completed, the only work done on the trucks other than scheduled maintenance was on vehicles 2861, 2771 and 2767. Truck 2861 was brought in with a complaint of a rough idle and no "take off" power. The City mechanic adjusted the EGR valve to correct the problem. On vehicle 2771, a vacuum leak on the supercharger was repaired. At the beginning of June 2008, the driver of 2767 indicated a loud vibration noise coming from under the cab area when the engine was idling. The mechanic checked the vehicle and adjusted the EGR exhaust tube. This seems to have fixed the problem.

D. Compiling Fueling Data:

The data collected for fueling is recorded by two sources. One source is the manual logs completed by the drivers, which allow the possibility for human error. Also, the converted vehicles are sometimes in the City's Fleet loaner pool or assigned to an outside department, where the driver might not log a fill.

The other means of collecting the fueling data is from the fueling systems themselves. The hydrogen refueling site records the fills for the blended dispensers, but there is no way to identify which vehicle is associated with each fill. The company that provides the CNG also records the fill, but they record the CNG portion of the fill only. The CNG file does include the vehicle number, date, and time information for the fills. The CNG and hydrogen files are recorded in different measurements so conversion factors must be applied to compare the

two files. The readings recorded in the CNG data file are off slightly from the gasoline gallon equivalent (GGE) calculated from the hydrogen file.

In addition, the driver uses the readings displayed on the blended pumps for the manual log. Even with the fuel site being recalibrated early in 2008, there is not an exact 1:1 match between the pump display, the CNG system readings, and the hydrogen system readings.

No fueling data from the hydrogen refueling site was reported to the City from the vendor until mid March 2007. It was not possible to cross check any manual log entries between the fueling systems for reasonableness before that time.

VI. DATA RESULTS

The data results from this project are summarized below. Detailed documentation of vehicle data collection is shown in Appendix B. On-Road Fuel Economy, Maintenance Summary, Safety Summary, and Emissions Readings are shown.

A. On-Road Fuel Economy:

The data is compiled based on gasoline gallon equivalent (GGE). This measurement is supplied by the fueling station and is calculated based on supplying HCNG with the equivalent heating value of a gallon of gasoline. Although some of the recorded data is obviously not applicable, the average fuel consumption of the converted vehicles in service varies between 9 and 18 mpgge (miles per gasoline gallon equivalent). Much of the variation in fuel consumption could be attributed to the aggressiveness of different drivers. Although not as all-inclusive as the data recorded for the HCNG vehicles, fueling data on some of the vehicles before conversion were able to be accessed. This data along with the data for the same HCNG vehicles are shown below in Table 2. There is no conclusive answer as to the effect that the HCNG conversion has on fuel economy as some of the vehicles experienced improved fuel economy and some experience reduced fuel economy after conversion. However, it is clear that the fuel economy varies a great deal for each vehicle. This is consistent with the earlier hypothesis that the driving characteristics of each driver can have a large effect on fuel economy. The addition of the supercharger not only overcomes the power loss due to high levels of EGR, it also overcomes the power loss due to the use of a gaseous fuel when compared to gasoline. This result makes the converted vehicles accelerate very rapidly when compared to the unconverted vehicles. This can result in much more aggressive driving for the converted vehicles, which will have a definite deleterious effect on fuel economy.

Table 2. Summary of Fuel Economy, before and after conversion

Vehicle Number	Pre-Conversion "In Range" MPG	Post Conversion "In Range" MPG	Difference MPG
2767	no data	no data	no data
2771	13.11	11.1	-2.01
2780	11.16	9.01	-2.15
2784	8.67	11.7	3.03
2856	no data	no data	no data
2858	no data	no data	no data
2860	no data	no data	no data
2861	14.9	15.2	0.3
2864	10.94	9.6	-1.34

B. Maintenance Summary:

No unusual maintenance requirements were encountered other than initial problems with the EGR throttle assembly. No maintenance issues were encountered that would indicate that operating the vehicles on HCNG had any deleterious effects on reliability.

C. Safety Summary:

No safety issues of any kind were experienced during the project.

D. Emissions Readings:

Emissions readings from the vehicle tailpipes were recorded at various intervals during the project. The protocol used was that defined by the State of Nevada. Two engine states are tested, idle and 2450 rpm, both under no engine load. It would have been much more meaningful to have performed IM240 test procedures, but that program was abandoned by federal mandate many years ago.

The average NOx emissions from the converted vehicles is clearly less than 1 ppm for both NO and NO2. Most of the vehicles in the program show these readings throughout the life of the project. Vehicle 2771 initially showed NOx emissions higher than the average, but appeared to produce lower emissions later in the project. Vehicle 2784 showed similar tendencies, but did not improve with time. This vehicle was not operated as long as 2771 on HCNG however.

Vehicle 2861 began the project with less than 1 ppm NO_x, but showed very small increases of 3 to 4 ppm at the end of the project. It is not clear if these extremely small changes are the result of catalyst degradation or normal tolerance in the emissions equipment.

No emissions data from these vehicles before conversion is available; therefore comparisons are not possible here. The data taken at idle should be no different between CNG and HCNG as the kit is designed to supply no EGR at idle. The same cannot be said for the 2450 rpm testing condition however. Unfortunately, no definitive explanations can be derived without testing under load and comparing before and after conversion.

VII. CONCLUSIONS

This project has shown the efficacy of operating vehicles originally designed to operate on compressed natural gas with HCNG fuel incorporating large quantities of EGR. No safety or additional maintenance issues with these vehicles were experienced once the “bugs” with the conversion hardware were resolved. These issues with the kits, as delivered, were addressed and corrected by CT. As a result of these issues, the kit design has been modified and improved significantly. CT is no longer producing the EGR valves in-house. These valves and their proper adjustment were the main negative issues experienced during the project. Commercially available throttle control valves for small engines are now used for controlling EGR flow. In addition, the control linkage associated with the EGR valve has been eliminated. The existing air throttle shaft now directly drives the EGR valve. The only adjustment required is during the initial installation.

Once installed and adjusted properly, the conversions did not show any reliability issues. Also, the installation did not require any special skills by the technicians once trained.

The effect of the conversions on fuel economy is not easily discerned as the variation of the fuel efficiency of individual vehicles varied a great deal, with some showing an improvement and others showing a reduction in fuel efficiency. This result is very encouraging given the added power provided by the superchargers on the converted vehicles. Driver feedback for the conversions was very favorable. The additional power provided by the HCNG vehicles was greatly appreciated, especially in traffic. The drivability of the HCNG vehicles was considered to be superior by the drivers.

Most of the converted vehicles show zero oxides of nitrogen through the life of the project using the State of Nevada testing procedure. This procedure involves only tailpipe measurements under idle and at 2450 rpm, with both conditions being under no engine load. Also, no emissions data was recorded for the vehicles before conversion. It is anticipated that NO_x emissions would also be

measured as zero or near zero for the unconverted vehicles. Without testing these vehicles under load, no real conclusions about the effects of HCNG on actual on-the-road tailpipe emissions can be made. Although the data is not indicative of actual driving emissions, they do indicate that there is no observable degradation of the engine control or exhaust catalyst systems by the use of HCNG and EGR.

It is anticipated that CO and CO₂ emissions would be reduced by HCNG for no other reason than the reduction in the carbon content of the fuel. Hydrocarbon emissions are a complete unknown due to the complication of using EGR with HCNG. However, without pre-conversion emissions testing and emissions measurements using a driving cycle such as IM240, no conclusions in these areas can be drawn.

VIII. LESSONS LEARNED

This demonstration project has created major benefits to implementation of HCNG technology. It has demonstrated the efficacy of using hydrogen-natural gas mixtures using conventional hardware, long term without sacrificing the reliability of the overall system. Fuel economy was not determined to be compromised and the NO_x emissions were as low as possible per the tests conducted.

The design of the hardware for these conversions was improved significantly and the partnership established between a supplier of technology (Collier Technologies) and the user of that technology (City of Las Vegas) has been extremely beneficial to both entities.

In addition, the City of Las Vegas has gained valuable experience in participating in demonstration projects that require accurate and reliable data collection. Their ability to continue these activities has been significantly enhanced.

IX. RECOMMENDATIONS FOR FUTURE WORK

The issues that need to be addressed to continue the commercialization of hydrogen as a motor vehicle fuel using HCNG as that mechanism are as follows:

- Definitive vehicle emissions and fuel economy data for HCNG vehicle conversions.
- Development of conversion hardware for manufacturers other than Ford.
- Determination of optimum EGR rate and the effect that this rate will have on emissions and fuel efficiency.
- Determination of EGR rate as a function of engine load (i.e. whether the current strategy of designing for constant EGR rate be continued or whether a non-linear rate is chosen).

Appendix A

Collier Technologies, Inc
5b Cal Lane
Sparks, NV 89431
Phone 775-741-0555 8:00 am – 5:00 pm PST
HCNG Kit Installation Manual

Ford 5.4L F-150 Natural Gas 1997-2002 model years

We encourage you to read this manual thoroughly before you begin work, and perform the following:

1. A quick parts check to make certain your kit is complete (See shipper parts list). If you discover shipping damage or shortage, please call our office immediately. 775-857-1937
2. Take a look at exactly what you are going to need in terms of tools, time, and experience.

Tools and Materials Required

You're going to need a few basic tools and supplies as follows:

- * #3 Phillips screwdriver, Flat head screwdriver, Stubby flat screw driver & Pliers
- * Metric wrench set
- * 1/4" & 3/8" Ratchet and Metric socket set (deep and standard)
- * 3", 6", and 9" extensions (1/4" and 3/8" drive)
- * Universal joint for sockets (1/4" and 3/8" drive)
- * Metric Allen wrench set
- * Drill, 3/16", 3/8" drill bit, 2" hole saw and 3/8-16" tap
- * Hose-cutting tool
- * Tubing cutter
- * Belt tensioner tool or 1/2" drive breaker bar
- * Tools for removal of fuel rail spring fittings (Listle P/N 3700 or Snap On P/N ACT1370)
- * 1-gallon of antifreeze/coolant or reclaimed antifreeze from vehicle.
- * Shop Vac
- * Compressed air blowgun, Anti-seize compound
- * Thread lube and masking or duct tape

A few very important items you should know:

Our Collier Technology, Inc HCNG kits are designed for engines in good mechanical condition only. Installation on worn or damaged engines is not recommended and may result in engine failure. Collier Technology, Inc. is not responsible for engine damage or consequential damages. Aftermarket engine recalibration devices such as chips and programmers are not compatible with this

kit and may cause engine damage. Our kits are designed to work best with factory stock vehicles. Headers/exhaust systems, air boxes, and thermostats may conflict with our calibration. If you have any questions, call us!

All fuel connections **MUST** be leak checked before driving the converted vehicle!
Use only HCNG₃₀ hydrogen by volume balance natural gas fuel for this engine conversion.

IMPORTANT WARNING:

Do not smoke or carry lighted tobacco or open flame of any type when working on or near any fuel-related component. Highly flammable mixtures may be present and may be ignited, resulting in possible personal injury. Fuel in the fuel system remains under high pressure even when the engine is not running. Please refer to Ford's manual on defilling the vehicle before attempting this conversion. Before servicing or disconnecting any of the fuel lines or fuel system components, the fuel system pressure must be relieved to prevent accidental release of fuel, causing personal injury or a fire hazard.

So... let's get started! Any questions? Call first! We're here Mon-Fri, 8:00 a.m. to 5:00 p.m. Pacific time! 775-741-0555 or e-mail kirkcollier@yahoo.com

Front engine view before conversion

Installation Instructions:

The fuel system is under high pressure; relieve the fuel pressure before disconnecting the fuel lines (Follow the directions from Ford's Natural gas manual for defilling the vehicle!!).

1. Disconnect battery Disconnect the negative (-) battery cable, then the positive (+) battery cable and remove the battery

2. Intake manifold removal Remove the air inlet assembly by removing the 4 mounting bolts, disconnecting the mass air meter plug, inlet air temperature sensor, two plastic tubes in front of the throttle body, loosening the hose clamp at the throttle body and unlatching the clamp at the air filter housing and remove clamp from air inlet side. (Note: keep your fasteners in a plastic bag with the parts you removed)

Drain the engine coolant into a container from the radiator petcock valve located on the lower passenger side of the radiator. Remove radiator cap to speed drainage rate. When half of the antifreeze has been drained, remove heater hoses from intake manifold.

Disconnect the throttle and cruise control cable (if equipped) from the throttle body, the cable mounting bracket and power steering reservoir bracket. Remove throttle/cruise control cable bracket from intake manifold, using 10mm socket. Set bracket and mounting hardware to be re-installed in a later step. Disconnect the Throttle Position Sensor (TPS), Vacuum lines; Idle air hoses and the Idle Air Control (IAC) plugs from the intake manifold throttle body.

Remove the vacuum line assembly by removing it from passenger side of the throttle body, Set toward the passenger side, out of the way. Be sure to note location of each vacuum line.

Depending on model and year, if your vehicle is so equipped, disconnect the 1/4" coolant hose on the passenger side of the throttle body.

Remove the 4 bolts holding down throttle body and remove with gasket from vehicle. Apply tape over the opening to prevent parts from falling in manifold.

Remove the ground strap from intake if equipped. Unplug all injectors, ignition coils, fuel solenoid and sensors on the intake. Using a 7mm socket, remove all of the ignition coils. Push all wires over valve cover out of the way.

Using fuel line removal tool disconnect fuel line from solenoid.

Remove fuel rail pressure and temperature sensor connectors

Remove 2 each side fuel rail bolts using an 8mm wrench or socket and remove fuel rail assembly with solenoid and bracket.

Finish draining coolant from radiator and remove the upper radiator hose.

Remove the serpentine belt by rotating the tensioner clockwise using a 1/2" breaker bar. Using a 10mm socket, remove the three tensioner mounting bolts. Using a small file or grinder, remove the small boss, to allow a greater range of travel. Re-install the tensioner using stock hardware.

Disconnect the alternator wiring and remove alternator using a 10mm socket. Using the two lower alternator mounting bolts, bolt the supercharger drive housing support bracket to the lower alternator mounting points on the engine, positioning the snout saddle on the passenger side.

Depending on the year of the vehicle: disconnect the temperature sensor and remove it from the coolant crossover pipe, and install sensor in the water crossover where the 3/8" pipe plug is on the supercharger manifold. If the sensor is located in the valley on the driver's side cylinder head, simply unplug.

Remove the PCV hose assembly from the passenger side valve cover, leaving the PCV valve in the valve cover.

Disconnect the large (5/8") heater hose from the intake manifold. (Depending on year will be at the front or rear on the passenger side).

Using a 10mm socket, remove the thermostat housing, thermostat and O-ring seal noting the order of assembly (as in photo). Set aside to be re-installed in a later step.

3. Intake Manifold Removal from vehicle Before removing intake manifold. If shop air is available, blow debris away from intake manifold. Using a 10mm socket, remove the intake bolts. Note: there are five on the passenger side and four on the driver's side. If a shop vac is available, vacuum any dirt or debris from intake flange. Remove intake gaskets and inspect gasket o-rings for damage. (I.E. wear, rips, or swollen). Carefully clean gaskets using a soft rag. Use a vacuum cleaner to remove dirt or debris from in and around intake ports. Using tape cover the intake port openings to prevent any parts

or debris from entering the engine

4. New Intake Preparation: Remove the fuel and temperature sensors from the old fuel rails and install in the fuel rails. Install in reverse position to clear the alternator. Cap the vacuum fitting on the passenger side of the new intake using the cap provided in the kit. Test fit the throttle body adapter to the supercharger manifold.

The Ford throttle body adapter casting is quite rough and in some cases may need slight grinding for a proper fit.

Route the PVC hose that is under the new manifold thru the middle of the driver's side of the intake as shown below.

Remove the fuel solenoid coil, quill and Schrader valve from the old fuel assembly (shown below) and install in the new solenoid block provided in the kit.

Install the provided 5/8" hose fitting in the crossover pipe on the front of the intake manifold. Connect the three water hoses to the intercooler and tightened with hose clamps provided.

6. Installing manifold in truck Verify that the water pipe in the valley of the engine is seated all the way on the boss behind the water pump. Remove tape from intake ports; install gaskets (verify there is no cuts or damage, replace if necessary) and install the supercharger manifold assembly from the front of the truck using care as not to damage gaskets. Separate the throttle body from the adaptor and fit the supplied EGR block between using the new bolts and gasket provided. Adjust linkage to achieve maximum opening at wide-open throttle.(picture shown below)

Torque the manifold and install thermostat housing Install the supplied intake manifold bolts and torque to 17-22 ft-lbs. It is advisable to initially start the entire bolts finger tight, and then torque them once all bolts are threaded in place. It may help if you move the intake manifold around slightly during this process. Re-install the stock thermostat, O-ring seal and housing, sandwiching the two supplied .050" thick washers (PN 77-00-070) between the thermostat housing and intake manifold as shown in photo below.

Installing throttle body adaptor on manifold Before sliding throttle body assembly into place, connect the idle air pipe and connector and the long bolt in the assembly.

Finalizing supercharger manifold installation Loosen drive housing mount bolts. Gently pull upward until drive mount contacts nose drive in proper position. Tighten the drive-housing mount to the engine block at 17-22 ft-lbs.

Installing coils, injectors and electrical connections-install coils. Inspect fuel injectors, lubricate o-rings with white lithium grease, and install injectors then fuel rails making sure you do not kink or twist the fuel lines. Install new fuel rails pushing the fuel rails down over the injectors and tighten. Visually inspect fuel rails and verify that the injectors are seated. Connect all fuel injector and coil electrical connections. Connect the temperature sensor connection. The fuel pressure wires might need to be extended wires have been provided in the kit.

Install the new fuel lines as per instructions included.

Reinstalling hoses and connections Attach the power brake hose, EVAP hose and the IAC electrical connection. Connect throttle body coolant hose, if so equipped. Install the supplied 90-degree fitting in the front of coolant crossover pipe. If your vehicle does not have a coolant hose that runs up to the throttle body, install the supplied pipe plug into the coolant crossover pipe. Trim the hose coming from the supercharger to achieve best fit. Route the hose carefully as not to kink or cause abrasion of the hose.

Vacuum lines Re-install the vacuum line assembly removed previously to all vacuum ports.

Installing the alternator Remove nut on indicated stud. Install the alternator as shown in its new location. Use supplied bolt to attach alternator to boss on front of Allen intake manifold. A bolt and bracket are supplied for the other leg of the alternator; the upper bolt is installed from the rear, and threads into the bracket. Reinstall the nut removed from the lower stud. Torque fasteners to 17-22 ft/lbs.

New belt installation Using a 22mm deep socket, remove the bolt/stud located between the power steering pulley and the crankshaft pulley. Replace it with the supplied bolt using a 17mm socket. Install the accessory drive belt in accordance with the new belt diagram. Remove and replace idler pulley with pulley supplied.

Installing the Heat Exchanger: Install the two brass fittings supplied, using sealant to the heat exchanger. Remove the plastic cover panel from the front of the truck. Unbolt the latch panel and ECU and move aside and slide the heat exchanger in front of the core. The two brackets are bolted to the heat exchanger hooking over the panel edge at the bottom and over the cross member at the top, hold the exchanger so there is a slight gap between the core and exchanger, then with the self tapping screws provided attach the top of the brackets to the cross member. Replace ECU and latch panel. See Photo's Below

Water Tank installation Apply sealant and install fittings provided into tank. Mount tank using self tapping screws provided, to cross member as shown checking the hood clearance for closing. Place plastic cover over and mark, drill 3" hole.

Tank Plumbing and Pump install

Connect the hoses following the diagram below.

EGR plumbing and setup (always use jack stands !!) Jack up and remove passenger rear tire and visually inspect exhaust system for holes or damage repair as needed before attempting EGR installation. Using saddle bracket as a guide mark exhaust system in the center of the rear upward section from the exit of the muffler. Debur hole and apply high temperature silicone to bracket and install as shown below.

Drop the rear axle to assist in drilling the 2" hole in the exhaust system, use plenty of cutting fluid. (Do not overheat the hole saw) Carefully removing the slug and any debris that might enter the exhaust system.

EGR can installation Remove passenger side wheel (using jack stands) Remove inner fender (remember to disconnect ABS sensor wire from inner fender) The tab on the outrigger by the body mount must be knocked over to clear the EGR pipe. Behind the outrigger there is a ground strap, remove the bolt attaching this to the body as shown below.

EGR pipe installation Bolt the primary EGR pipe to the EGR block using sensor safe high temperature silicone. Attach the longer piece of silicone hose to the other end. Remove the dipstick bracket from the engine block. Feed the secondary EGR pipe from the wheel well so it meets and connects to the silicone hose from the primary pipe and the other end lines up with the EGR can outlet. Once in place slip the short piece of silicone hose over the pipes, replace the bolt thru the pipe and dipstick brackets and tighten hose clamps. Photos below.

EGR cooling pipe installation Feed the EGR cooling pipe (pinch bolt end to the exhaust end) over the chassis rail next to spring mount. The end must be bent to go into the exhaust. The other end goes to the EGR can. Short pieces of silicone hose provided in the kit are to be installed in the areas where the tube could rub the chassis. Using the brackets provided mount the cooling tube as shown in photos below.

Reconnect negative (-) cable to battery then the (+) positive cable. The vehicle should be started and all connections checked for leaks or loose connections. Be sure everything has adequate clearance and is properly tightened. Run the heat exchanger coolant pump for a few minutes verifying that the coolant is circulating. Check the fluid level and top off if required. When properly filled, you will be able to see coolant circulating when looking into the heat exchanger tank. Then install coolant cap. If by chance the Check Engine light is illuminated, recheck all your connections and vacuum routing. Once the problem is located reset the engine's computer by disconnecting the negative (-) battery cable for a couple of minutes.

Always verify your HCNG fuel blend mix, this kit has been designed for 30% hydrogen by volume with the balance natural gas.

If for any reason you need to operate this vehicle on natural gas only you must perform the follow steps before attempting to start the vehicle.

1. **De-fuel the vehicle completely of the HCNG mix.**
2. **Disconnect the EGR cable from the rear of the supercharger.**
3. **Refill the vehicle with natural gas and operate normally**

To convert back to HCNG reverses the steps above.

After any of these changes, your vehicle will need to be driven for approx 10 to 20 minutes for the vehicle computer to update the changes and operate smoothly.

Appendix B

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Oct-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2860				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
3/5/2008	1	36433	5.95		Vehicle is a loaner; Fuel logs are not complete.
3/6/2008	2	36524	5.74	15.9	o.k.
3/7/2008	3	36616	6.26	14.7	o.k.
3/10/2008	4	36714	6.18	15.9	o.k.
3/10/2008	5	36779	4.09	15.9	o.k.
3/13/2008	6	36842	4.25	14.8	o.k.
3/14/2008	7	36907	4.90	13.3	o.k.
3/18/2008	8	36968	5.40	11.3	o.k.
4/22/2008	9	37749	5.87		no log entries between 3/18/08 and 4/22/08
4/24/2008	10	37854	8.26	12.7	o.k.
4/25/2008	11	37922	4.38	15.5	o.k.
4/28/2008	12	37972	4.11	12.2	o.k.
4/29/2008	13	38018	4.10	11.2	o.k.
5/14/2008	14	38357	3.82		no log entries between 4/29/08 and 5/14/08
5/15/2008	15	38412	4.23	13.0	o.k.
5/19/2008	16	38462	2.89	17.3	o.k.
5/29/2008	17	38528	6.00	11.0	o.k.
6/19/2008	18	38802	6.20		no log entries between 5/29/08 and 6/19/08
6/23/2008	19	38848	5.80	7.9	o.k.
6/25/2008	20	38888	6.80	5.9	o.k.
6/27/2008	21	38935	7.10	6.6	o.k.
7/1/2008	22	38977	5.00	8.4	o.k.
7/7/2008	23	39011	6.10	5.6	o.k.
7/8/2008	24	39056	6.10	7.4	o.k.
7/9/2008	25	39082	4.50	5.8	o.k.
7/11/2008	26	39099	3.50	4.9	o.k.

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
1/5/2006	1	5934	6.73		had to fuel 3x's
1/5/2006	2	5979	4.42	10.2	had to fuel 2x's
1/5/2006	3	6043	6.52	9.8	had to fuel 3x's
1/20/2006	4	6260	1.90	114.2	only able to fuel between 1/2 - 3/4 (no explanation for low fill amount on log)
1/23/2006	5	6302	6.40	6.6	had to fuel 3x's
1/24/2006	6	6381	5.88	13.4	
1/27/2006	7	6539	8.48	18.6	
2/1/2006	8	6697	8.57	18.4	
2/3/2006	9	6845	10.45	14.2	
2/6/2006	10	6983	10.64	13.0	
2/7/2006	11	7120	9.71	14.1	engine running in park - put in gear & truck stalled - one time
2/8/2006	12	7259	8.92	15.6	
2/10/2006	13	7387	9.90	12.9	
2/13/2006	14	7500	7.94	14.2	
2/14/2006	15	7627	9.07	14.0	
2/15/2006	16	7793	9.98	16.6	
2/16/2006	17	7928	10.36	13.0	
2/21/2006	18	8078	10.49	14.3	
2/22/2006	19	8196	9.51	12.4	
2/23/2006	20	8355	10.01	15.9	
2/24/2006	21	8465	6.77	16.2	
2/27/2006	22	8576	8.64	12.8	
2/28/2006	23	8685	8.16	13.4	
3/1/2006	24	8805	8.72	13.8	
3/3/2006	25	8953	10.63	13.9	
3/6/2006	26	9054	9.00	11.2	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
3/7/2006	27	9201	9.75	15.1	
3/9/2006	28	9327	9.72	13.0	
3/10/2006	29	9456	9.21	14.0	
3/13/2006	30	9607	9.30	16.2	
3/15/2006	31	9733	7.25	17.4	had to fuel 4x's
3/16/2006	32	9814	6.75	12.0	had to fuel 4x's
3/17/2006	33	9942	5.15	24.9	had to fuel 3x's - 1/2 tank
3/17/2006	34	9980	5.01	7.6	had to fuel 3x's
3/20/2006	35	10079	5.14	19.3	had to fuel 3x's - 3/4 tank
3/22/2006	36	10159	1.74	46.0	very slow fill (no explanation for low fill amount on log)
3/23/2006	37	10253	1.69	55.6	very slow fill - engine pings w/acceleration. Went 28 miles service engine light came on & was already at 1/2 tank. (no explanation for low fill amount on log)
4/5/2006	38	10368	8.04	14.3	
4/10/2006	39	10518	11.30	13.3	
4/11/2006	40	10641	8.50	14.5	
4/12/2006	41	10786	10.01	14.5	
4/13/2006	42	10912	7.99	15.8	
4/14/2006	43	11002	6.67	13.5	
4/17/2006	44	11086	7.70	10.9	
4/18/2006	45	11196	7.75	14.2	
4/19/2006	46	11324	8.78	14.6	
4/20/2006	47	11455	7.83	16.7	
4/21/2006	48	11575	8.01	15.0	
4/24/2006	49	11722	9.12	16.1	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
4/25/2006	50	11831	7.30	14.9	
4/26/2006	51	11929	6.78	14.5	
4/28/2006	52	12076	8.79	16.7	
5/1/2006	53	12187	8.94	12.4	
5/2/2006	54	12330	8.30	17.2	
5/4/2006	55	12445	10.08	11.4	
5/5/2006	56	12557	8.31	13.5	
5/8/2006	57	12670	8.02	14.1	
5/9/2006	58	12782	7.00	16.0	
5/11/2006	59	12883	7.15	14.1	
5/12/2006	60	12948	6.00	10.8	
5/15/2006	61	13037	7.19	12.4	
5/16/2006	62	13136	7.65	12.9	
5/17/2006	63	13265	8.24	15.7	
5/18/2006	64	13330	7.02	9.3	
5/19/2006	65	13444	8.89	12.8	engine revving up high before it will shift/slow shifting - checked fluid - ok
5/22/2006	66	13533	6.26	14.2	
5/23/2006	67	13642	8.36	13.0	
5/24/2006	68	13737	6.80	14.0	
6/2/2006	69	13917	7.99	22.5	
6/6/2006	70	14015	8.00	12.3	
6/12/2006	71	14138	10.00	12.3	1st fill up after servicing site
6/13/2006	72	14230	6.50	14.2	
6/14/2006	73	14349	10.13	11.7	
6/15/2006	74	14445	7.30	13.2	
6/19/2006	75	14552	7.95	13.5	
6/20/2006	76	14650	8.12	12.1	

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Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
6/21/2006	77	14709	5.38	11.0	
6/22/2006	78	14789	6.26	12.8	
6/26/2006	79	14914	9.36	13.4	
6/27/2006	80	15019	8.88	11.8	
6/28/2006	81	15122	9.05	11.4	
7/3/2006	82	15315	7.62	25.3	
7/5/2006	83	15410	7.62	12.5	
7/6/2006	84	15485	6.81	11.0	
7/7/2006	85	15570	7.26	11.7	
7/10/2006	86	15724	9.55	16.1	
7/12/2006	87	15843	10.65	11.2	
7/13/2006	88	15935	8.25	11.2	
7/19/2006	89	16140	9.04	22.7	
7/20/2006	90	16246	4.46	23.8	not fueling right - pumping very slowly - low pressure (2500) stopped before full. Got a little over 1/2 tank.
7/21/2006	91	16289	8.48	5.1	
7/24/2006	92	16384	6.08	15.6	
7/25/2006	93	16466	7.48	11.0	
7/27/2006	94	16571	9.83	10.7	
7/28/2006	95	16700	9.03	14.3	
7/31/2006	96	16791	7.04	12.9	
8/1/2006	97	16887	9.44	10.2	
8/2/2006	98	16983	7.53	12.7	
8/3/2006	99	17076	7.68	12.1	
8/4/2006	100	17160	6.93	12.1	
8/7/2006	101	17240	6.07	13.2	
8/8/2006	102	17354	7.82	14.6	
8/10/2006	103	17465	8.39	13.2	

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Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2856				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
8/11/2006	104	17550	7.90	10.8	
8/15/2006	105	17636	6.47	13.3	
8/16/2006	106	17743	8.85	12.1	
8/18/2006	107	17879	10.75	12.7	fuel station not working properly
8/30/2006	108	17970	7.09	12.8	1st fuel after new compressor put in @ fuel station
8/31/2006	109	18098	9.76	13.1	
9/1/2006	110	18191	8.00	11.6	
9/6/2006	111	18272	6.33	12.8	
9/7/2006	112	18379	9.57	11.2	
9/8/2006	113	18483	8.67	12.0	
9/11/2006	114	18568	6.95	12.2	
9/12/2006	115	18662	7.07	13.3	
9/13/2006	116	18781	9.04	13.2	
9/14/2006	117	18864	6.11	13.6	
9/15/2006	118	18967	9.72	10.6	
9/18/2006	119	19091	8.72	14.2	
9/19/2006	120	19220	9.70	13.3	
9/20/2006	121	19348	9.33	13.7	
9/22/2006	122	19451	7.54	13.7	
9/25/2006	123	19568	7.70	15.2	
9/26/2006	124	19678	9.02	12.2	
9/27/2006	125	19792	7.98	14.3	
9/28/2006	126	19892	7.20	13.9	
9/29/2006	127	19974	6.93	11.8	
10/3/2006	128	20072	7.29	13.4	
10/4/2006	129	20166	7.55	12.5	
10/6/2006	130	20289	8.90	13.8	
10/9/2006	131	20402	8.70	13.0	

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Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2856				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
10/10/2006	132	20514	7.86	14.2	
10/12/2006	133	20654	9.18	15.3	
10/16/2006	134	20789	10.39	13.0	
10/17/2006	135	20894	7.84	13.4	
10/18/2006	136	21010	8.13	14.3	
10/20/2006	137	21147	8.28	16.5	site down yesterday
10/23/2006	138	21247	6.57	15.2	
10/25/2006	139	21325	6.76	11.5	
10/30/2006	140	21455	10.11	12.9	
10/31/2006	141	21544	6.96	12.8	
11/1/2006	142	21647	7.00	14.7	
11/2/2006	143	21721	5.86	12.6	
11/6/2006	144	21831	8.79	12.5	
11/7/2006	145	21928	7.50	12.9	
11/13/2006	146	22063	10.43	12.9	site down on Thursday
11/14/2006	147	22152	6.89	12.9	
11/15/2006	148	22251	5.77	17.2	
11/16/2006	149	22358	8.24	13.0	
11/20/2006	150	22469	8.94	12.4	
11/21/2006	151	22562	7.02	13.2	
11/27/2006	152	22687	7.25	17.2	
11/28/2006	153	22813	8.37	15.1	
11/29/2006	154	22958	10.24	14.2	
11/30/2006	155	23074	8.93	13.0	
12/1/2006	156	23165	6.48	14.0	
12/4/2006	157	23258	6.91	13.5	
12/6/2006	158	23395	9.71	14.1	
12/7/2006	159	23497	6.86	14.9	
12/8/2006	160	23634	10.00	13.7	
12/11/2006	161	23748	8.65	13.2	

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Data since inception of the program, all vehicles

Report Date		9/30/2008			
Deployment Start		Nov-05			
H2 Tank Pressure		5000 psi			
Vehicle Model:			Ford F-150 CNG		
Location of Operation:			Las Vegas, NV		
Vehicle #	2856				
	Fill-up	Odometer	GGE		
Date	Number	at Fill	hythane	miles/GGE	Comments ⁽¹⁾
		(miles)	filled	hythane	
12/13/2006	162	23871	10.14	12.1	
12/14/2006	163	23988	8.76	13.4	
12/18/2006	164	24098	9.27	11.9	
12/19/2006	165	24194	7.70	12.5	
12/20/2006	166	24284	7.74	11.6	
12/22/2006	167	24427	10.56	13.5	
1/2/2007	168	24540	8.52	13.3	
1/4/2007	169	24658	9.00	13.1	
1/5/2007	170	24776	9.51	12.4	rough intermittent idle
1/8/2007	171	24892	8.12	14.3	rough idle x2 in AM
1/10/2007	172	25012	9.40	12.8	almost stalled out yesterday in PM
1/11/2007	173	25116	7.31	14.2	rough idle, surging
1/12/2007	174	25238	8.75	13.9	
1/16/2007	175	25345	7.75	13.8	
1/17/2007	176	25448	7.57	13.6	rough idle in PM
1/18/2007	177	25513	5.10	12.7	surging
1/19/2007	178	25600	6.20	14.0	
1/22/2007	179	25602			p/u truck after service
1/23/2007	180	25701	7.29	13.9	runs great
1/24/2007	181	25815	6.97	16.4	
1/26/2007	182	25952	9.61	14.3	
1/29/2007	183	26067	7.60	15.1	
1/30/2007	184	26180	8.17	13.8	surging
2/6/2007	185	26301	8.86	13.7	1st fill after service on truck
2/7/2007	186	26398	6.68	14.5	
2/8/2007	187	26522	7.76	16.0	
2/12/2007	188	26646	9.10	13.6	
2/13/2007	189	26763	6.79	17.2	
2/14/2007	190	26892	7.93	16.3	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2856				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
2/15/2007	191	26986	7.67	12.3	
2/16/2007	192	27122	8.65	15.7	
2/21/2007	193	27250	10.16	12.6	
2/22/2007	194	27377	10.53	12.1	
2/26/2007	195	27506	8.65	14.9	
2/28/2007	196	27649	10.98	13.0	
3/1/2007	197	27796	9.83	15.0	
3/5/2007	198	27926	8.88	14.6	
3/6/2007	199	28033	7.51	14.2	
3/8/2007	200	28159	7.95	15.8	
3/9/2007	201	28274	7.68	15.0	
3/13/2007	202	28380	7.70	13.8	
3/14/2007	203	28498	8.33	14.2	
3/16/2007	204				site down - nozzle leaking
3/20/2007	205				site up - fueled o.k.
3/21/2007	206	28756	8.55	30.2	
3/26/2007	207	28903	1.60	n/a	won't fuel - site down (CNG side)
3/26/2007	208	28903	7.73	15.8	fuel site up (miles/GGE is for both fills on 3/26/07 combined)
3/27/2007	209	29006	9.24	11.1	
3/29/2007	210	29148	7.85	18.1	
3/30/2007	211	29249	8.02	12.6	
4/2/2007	212	29369	7.42	16.2	
4/3/2007	213	29505	9.56	14.2	
4/5/2007	214	29638	9.17	14.5	
4/9/2007	215	29771	10.36	12.8	
4/10/2007	216	29904	9.51	14.0	
4/12/2007	217	30028	8.09	15.3	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
4/13/2007	218	30164	9.49	14.3	
4/16/2007	219	30278	7.01	16.3	
4/18/2007	220	30420	9.20	15.4	
4/19/2007	221	30575	9.33	16.6	
4/20/2007	222	30667	6.32	14.6	
7/20/2007	223	30822	8.35	18.6	had to reset pump to fuel
7/24/2007	224	30957	11.34	11.9	fueled o.k. - site worked on today
7/25/2007	225	31043	6.75	12.7	had to reset pump to fuel
7/26/2007	226	31144	7.57	13.3	had to reset pump to fuel
7/30/2007	227	31270	8.46	14.9	fueled o.k.
7/31/2007	228	31377	9.32	11.5	fueled o.k.
8/1/2007	229	31502	9.68	12.9	fueled o.k.
8/7/2007	230	31655	10.49	14.6	fueled o.k.
8/8/2007	231	31746	8.33	10.9	fueled o.k.
8/9/2007	232	31872	8.69	14.5	fueled o.k.
8/10/2007	233	31974	8.31	12.3	fueled o.k.
8/14/2007	234	32075	7.31	13.8	had to reset pump to fuel pressure @ 4500
8/16/2007	235	32167	7.48	12.3	had to reset pump to fuel pressure @ 4500
8/17/2007	236	32237	4.79	14.6	fueled o.k. - pressure 4500
8/22/2007	237	32357	9.98	12.0	o.k. - pressure 4200
8/23/2007	238	32424	5.62	11.9	o.k. - pressure 4500
8/24/2007	239	32519	6.72	14.1	o.k.
8/28/2007	240	32614	7.05	13.5	o.k.
8/29/2007	241	32705			o.k. (no filled amount on the log)
8/29/2007	242	32787	6.34	12.9	o.k.

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
8/30/2007	243	32894	9.00	11.9	o.k.
9/4/2007	244	33000	8.13	13.0	o.k.
9/5/2007	245	33117	8.43	13.9	o.k.
9/6/2007	246	33209	7.12	12.9	had to reset pump to fuel
9/7/2007	247	33297	6.44	13.7	o.k.
9/11/2007	248	33413	8.89	13.0	had to reset pump to fuel
9/12/2007	249	33536	8.01	15.4	o.k.
9/13/2007	250	?	?	#VALUE!	fueled o.k. (no fill information recorded for this day)
9/14/2007	251	33768	9.00	#VALUE!	o.k. (cannot calculate without prior fill data)
9/17/2007	252	33853	7.28	11.7	o.k.
9/18/2007	253	33989	8.24	16.5	o.k.
9/19/2007	254	34092	8.08	12.7	o.k.
9/20/2007	255	34215	8.09	15.2	o.k.
9/24/2007	256	34320	7.77	13.5	had to reset pump to fuel
9/26/2007	257	34419	7.08	14.0	o.k.
9/27/2007	258	34569	8.92	16.8	o.k.
9/28/2007	259	34697	8.19	15.6	o.k. - overall good power, rough idle
10/1/2007	260	34778	6.75	12.0	o.k.
10/2/2007	261	34904	7.96	15.8	o.k.
10/8/2007	262	35026	9.48	12.9	o.k.
10/9/2007	263	35109	5.51	15.1	o.k.
10/10/2007	264	35198	5.65	15.8	o.k.
10/22/2007	265	35378	9.02	20.0	o.k.
10/23/2007	266	35483	6.90	15.2	o.k.
10/24/2007	267	35564	5.65	14.3	o.k.

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
10/25/2007	268	35656	6.36	14.5	<i>o.k.</i>
10/29/2007	269	35766	7.56	14.6	<i>o.k.</i>
10/30/2007	270	35860	4.90	19.2	<i>o.k.</i>
10/31/2007	271	35923	5.99	10.5	<i>o.k.</i>
11/1/2007	272	36027	7.26	14.3	<i>o.k.</i>
11/2/2007	273	36168	8.44	16.7	<i>o.k.</i>
11/8/2007	274	36247	5.15	15.3	<i>o.k.</i>
11/9/2007	275	36366	7.05	16.9	<i>o.k.</i>
11/14/2007	276	36469	7.72	13.3	<i>o.k.</i>
11/15/2007	277	36555	7.11	12.1	<i>o.k.</i>
11/16/2007	278	36644	6.67	13.3	<i>o.k.</i>
11/19/2007	279	36756	7.66	14.6	<i>o.k.</i>
11/20/2007	280	36886	8.09	16.1	<i>o.k.</i>
11/26/2007	281	37033	9.79	15.0	<i>fuel pump handle leaking</i>
11/30/2007	282	37234	6.58	30.5	<i>new handle - o.k.</i>
12/3/2007	283	37353	7.39	16.1	<i>o.k.</i>
12/4/2007	284	37445	6.08	15.1	<i>o.k.</i>
12/5/2007	285	37547	7.05	14.5	<i>o.k.</i>
12/7/2007	286	37688	8.03	17.6	<i>o.k.</i>
12/12/2007	287	37806	9.76	12.1	<i>site was down for 2 days - no pressure</i>
12/13/2007	288	37916	7.41	14.8	<i>o.k.</i>
12/14/2007	289	37991	5.89	12.7	<i>o.k.</i>
12/17/2007	290	38124	8.15	16.3	<i>o.k.</i>
12/18/2007	291	38234	7.10	15.5	<i>o.k.</i>
12/19/2007	292	38327	6.66	14.0	<i>o.k.</i>
12/21/2007	293	38434	7.51	14.2	<i>o.k.</i>
12/24/2007	294	38512	5.53	14.1	<i>o.k.</i>
12/26/2007	295	38596	6.15	13.7	<i>o.k.</i>

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2856			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
12/27/2007	296	38701	6.02	17.4	<i>o.k.</i>
12/28/2007	297	38791	6.35	14.2	<i>o.k.</i>
1/9/2008	298	39280	9.52	51.4	<i>o.k.</i>
1/11/2008	299	39367	5.88	14.8	<i>o.k.</i>
1/15/2008	300	39477	8.44	13.0	<i>o.k.</i>
1/16/2008	301	39636	10.10	15.7	<i>o.k.</i>
1/22/2008	302	39790	8.92	17.3	<i>o.k.</i>
1/23/2008	303	39899	8.12	13.4	<i>o.k.</i>
1/28/2008	304	40029	9.11	14.3	<i>o.k.</i>
1/29/2008	305	40166	9.81	14.0	<i>o.k.</i>
1/30/2008	306	40285	8.11	14.7	<i>o.k.</i>
1/31/2008	307	40383	7.28	13.5	<i>o.k.</i>
2/1/2008	308	40467	5.46	15.4	<i>o.k.</i>
2/26/2008	309	40612	11.24	12.9	<i>o.k.</i>
2/27/2008	310	40685	6.32	11.6	<i>o.k.</i>
3/4/2008	311	40771	8.00	10.8	<i>o.k.</i>
3/6/2008	312	40932	9.86	16.3	<i>o.k.</i>
4/22/2008	313	41271	8.44		<i>no log entries between 3/6/08 and 4/22/08</i>
5/2/2008	314	41400	7.65		<i>no log entries between 4/22/08 and 5/2/08</i>
5/5/2008	315	41507	9.65	11.1	<i>o.k.</i>
5/6/2008	316	41609	7.07	14.4	<i>o.k.</i>
5/7/2008	317	41714	7.42	14.2	<i>had to reset pump</i>
5/8/2008	318	41804	6.73	13.4	<i>o.k.</i>
5/9/2008	319	41834	3.02	9.9	<i>o.k.</i>
5/20/2008	320	41915	6.79		<i>no log entries between 5/9/08 and 5/20/08</i>
5/23/2008	321	42000	7.78	10.9	<i>o.k.</i>
6/23/2008	322	42582	8.22	70.8	<i>no log entries between 5/23/08 and 6/23/08</i>

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	Nov-05				
H2 Tank Pressure	5000 psi				
Vehicle Model:			Ford F-150 CNG		
Location of Operation:			Las Vegas, NV		
Vehicle #	2856				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
6/30/2008	323	42883	7.26	41.5	no log entries between 6/23/08 and 6/30/08
7/1/2008	324	42966	5.55	15.0	o.k.
7/2/2008	325	43064	7.47	13.1	o.k.
7/8/2008	326	43155	6.66	13.7	o.k.
7/9/2008	327	43212	3.79	15.0	o.k.

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	1/17/2006				
H2 Tank Pressure	5000 psi				
Vehicle Model:			Ford F-250 CNG		
Location of Operation:			Las Vegas, NV		
Vehicle #	2767				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
3/16/2006	1	19479	6.80		good
3/30/2006	2	19558	4.27	n/a	
3/30/2006	3	19558	4.16	9.4	(both fills on 3/30/06 together)
4/19/2006	4	19622	5.82	11.0	
4/21/2006	5	19707	7.16	11.9	
4/27/2006	6	19789	6.15	13.3	fine
5/17/2006	7	19953	12.00	13.7	good
5/21/2006	8	20083	12.07	10.8	good

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date		9/30/2008			
Deployment Start		1/17/2006			
H2 Tank Pressure		5000 psi			
Vehicle Model: Location of Operation:		Ford F-250 CNG			
		Las Vegas, NV			
Vehicle #	2767				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
5/23/2006	9	20128	5.05	8.9	good
5/31/2006	10	20233	10.11	10.4	good
6/2/2006	11	20412	9.05	19.8	o.k. (rough idle)
6/6/2006	12	20526	8.81	12.9	good
6/8/2006	13	20644	8.10	14.6	good
6/12/2006	14	20744	8.51	11.8	good
6/14/2006	15	20855	9.10	12.2	good (rough idle)
6/19/2006	16	20966	7.03	15.8	good
6/22/2006	17	21084	9.66	12.2	fine
6/27/2006	18	21214	10.57	12.3	good
6/30/2006	19	21334	7.23	16.6	fine
9/26/2006	20	21405	6.10	11.6	
9/27/2006	21	21442	5.10	7.3	
1/19/2007	22	22103	8.46	78.1	runs great (no fill information between 9/27/06 fill and this one)
3/28/2007	23	22371	7.82	34.3	o.k. (no fill information between 1/19/07 fill and this one)
4/11/2007	24	22534	7.54	21.6	runs good (most likely filled between 3/2/07 fill and this one)
4/16/2007	25	22690	11.78	13.2	o.k.
4/23/2007	26	22813	8.73	14.1	good
4/30/2007	27	22948	7.23	18.7	1st fuel since site serviced
5/1/2007	28	23074	8.98	14.0	
5/3/2007	29	23204	9.62	13.5	wouldn't fuel 1st time - had to reset & then o.k.

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	1/17/2006				
H2 Tank Pressure	5000 psi				
Vehicle Model: Location of Operation:			Ford F-250 CNG		
			Las Vegas, NV		
Vehicle #	2767				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
5/4/2007	30	23367	9.23	17.7	wouldn't fuel 1st time - had to reset & then o.k.
5/7/2007	31	23492	7.79	16.0	o.k.
5/9/2007	32	23628	7.87	17.3	o.k.
5/10/2007	33	23769	9.95	14.2	had to reset to fuel
5/11/2007	34	23875	7.00	15.1	had to reset to fuel
5/15/2007	35	23966	7.32	12.4	had to reset to fuel
5/16/2007	36	24112	9.10	16.0	had to reset to fuel
5/17/2007	37	24221	6.81	16.0	had to reset to fuel
5/21/2007	38	24324	8.26	12.5	had to reset to fuel
5/22/2007	39	24461	7.61	18.0	had to reset to fuel
5/24/2007	40	24583	9.43	12.9	had to reset pump to fuel
5/25/2007	41	24695	7.64	14.7	had to reset pump to fuel
5/29/2007	42	24836	8.85	15.9	fueled o.k.
5/30/2007	43	24928	8.28	11.1	had to reset pump to fuel
6/1/2007	44	25109	10.92	16.6	had to reset pump to fuel
6/5/2007	45	25240	8.77	14.9	had to reset pump to fuel
6/6/2007	46	25347	8.45	12.7	had to reset pump to fuel
6/7/2007	47	25483	8.47	16.1	had to reset pump to fuel
6/8/2007	48	25598	7.21	16.0	had to reset pump to fuel
6/12/2007	49	25751	10.05	15.2	had to reset pump to fuel
6/13/2007	50	25861	7.24	15.2	had to reset pump to fuel
6/14/2007	51	25919	4.73	12.3	had to reset pump to fuel

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	1/17/2006				
H2 Tank Pressure	5000 psi				
Vehicle Model:				Ford F-250 CNG	
Location of Operation:				Las Vegas, NV	
Vehicle #	2767				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
6/18/2007	52	26059	9.91	14.1	had to reset pump to fuel
6/19/2007	53	26161	6.26	16.3	had to reset pump to fuel
6/20/2007	54	26277	7.76	14.9	fueled o.k.
6/21/2007	55	26370	7.87	11.8	had to reset pump to fuel
6/22/2007	56	26479	7.18	15.2	had to reset pump to fuel
6/27/2007	57	26711	8.37	27.7	had to reset pump to fuel
6/28/2007	58	26820	7.24	15.1	had to reset pump to fuel
6/29/2007	59	26915	7.47	12.7	had to reset pump to fuel
7/3/2007	60	27044	9.78	13.2	had to reset pump to fuel
7/10/2007	61	27169	9.12	13.7	had to reset pump to fuel
7/11/2007	62	27249	5.95	13.4	fueled o.k.
12/6/2007	63	29445	6.20		Vehicle is back in the loaner pool. No fill information between 7/11/07 and 12/6/07. Fuel logs may not be complete.
12/13/2007	64	29546	8.55	11.8	Good
12/27/2007	65	29598	6.23	8.3	Top off to check pump
2/6/2008	66	29887	9.50	30.4	Missing fuel records from log sheets. Vehicle is still in loaner pool.
2/20/2008	67	30018	9.30	14.1	
2/25/2008	68	30133	7.72	14.9	
2/26/2008	69	30240	5.77	18.5	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	1/17/2006				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2767				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
3/6/2008	70	30263	4.33	5.3	
3/17/2008	71	30469	8.94		no log entries between 3/6/08 and 3/17/08
4/29/2008	72	30731	10.31		no log entries between 3/17/08 and 4/29/08
5/23/2008	73	31245	3.33		no log entries between 4/29/08 and 5/23/08
6/1/2008	74	31573	7.30		no log entries between 5/23/08 and 6/1/08
6/2/2008	75	31672	7.85	12.6	
6/4/2008	76	31820	11.11	13.3	
6/17/2008	77	31889	6.20	11.1	
6/18/2008	78	31944	5.43	10.1	
6/19/2008	79	32007	6.54	9.6	
7/7/2008	80	32447	5.30	83.0	no log entries between 6/19/08 and 7/7/08
7/9/2008	81	32523	7.74	9.8	
7/11/2008	82	32629	7.75	13.7	
7/14/2008	83	32693	6.11	10.5	
7/15/2008	84	32767	6.83	10.8	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	4/18/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2771				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
4/18/2007	1	62208	5.4		Conversion complete. Fuel log not available until Q/E 12/31/07. Vehicle is a loaner; Fuel logs may not be complete.
4/19/2007	2	62209	8.84	0.1	Top tank off after conversion
5/18/2007	3	62455	8.3	29.6	Top off to return loaner
5/29/2007	4	62583	9.6	13.3	Top off to return loaner
6/21/2007	5	62950	11	33.4	Fill up for travel/work
7/3/2007	6	63434	7.2	67.2	Top off to return loaner
8/9/2007	7	63512	10.7	7.3	Fill up for travel/work
9/26/2007	8	63801	7.47	38.7	Top off to return loaner
10/3/2007	9	63880	7.11	11.1	Fill up for travel/work
10/4/2007	10	63955	5.54	13.5	Fill up for travel/work
10/8/2007	11	64063	9.09	11.9	Fill up for travel/work
10/10/2007	12	64146	7.45	11.1	Fill up loaner
10/23/2007	13	64243	12.28	7.9	Fill up for travel/work
11/15/2007	14	64420	5.7	31.1	Test fill hose
12/5/2007	15	64515	8.14	11.7	Fill up for travel/work
12/6/2007	16	64634	9.06	13.1	Top off loaner
12/12/2007	17	64750	12.28	9.4	
12/17/2007	18	64850	11	9.1	
12/20/2007	19	65005	12.1	12.8	
12/27/2007	20	65156	13.6	11.1	
1/9/2008	21	65415	12.50	20.7	
1/11/2008	22	65563	13.80	10.7	
1/16/2008	23	65728	13.30	12.4	
1/22/2008	24	65848	12.80	9.4	
1/28/2008	25	65975	12.00	10.6	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date		9/30/2008			
Deployment Start		4/18/2007			
H2 Tank Pressure		5000 psi			
Vehicle Model: Location of Operation:		Ford F-250 CNG			
		Las Vegas, NV			
Vehicle #	2771				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
1/31/2008	26	65994	2.40	7.9	Check engine light on
2/13/2008	27	66137	13.15	10.9	
2/19/2008	28	66282	11.77	12.3	
2/28/2008	29	66379	6.03	16.1	
	30				no log file last quarter
8/4/2008	31	68174	5.87		log file for this quarter had only one entry

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	5/8/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:			Ford F-150 CNG		
Location of Operation:			Las Vegas, NV		
Vehicle #	2858				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
5/8/2007	1	52635	15.00		conversion complete
5/21/2007	2	52703	9.70	7.0	fill tank
5/29/2007	3	52724	6.58	3.2	fill tank
6/13/2007	4	52838	11.20	10.2	fill tank - runs rough when cold
6/19/2007	5	52937	9.70	10.2	fill tank - runs rough when cold

On-Road Fuel Economy: Rev 3 [2007-10-30]					
<i>Data since inception of the program, all vehicles</i>					
Report Date	9/30/2008				
Deployment Start	5/8/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2858			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
6/25/2007	6	53036	7.60	13.0	fill tank - runs rough when cold
6/28/2007	7	53112	8.60	8.8	fill tank - runs rough when cold
7/9/2007	8	53201	8.50	10.5	fill tank - runs rough when cold
7/11/2007	9	53276	8.30	9.0	fill tank - runs rough when cold
7/18/2007	10	53379	9.20	11.2	
7/23/2007	11	53447	7.90	8.6	
7/24/2007	12	53577	11.20	11.6	
7/29/2007	13	53668	9.70	9.4	
7/31/2007	14	53766	10.20	9.6	
8/6/2007	15	53843	7.60	10.1	
8/13/2007	16	53950	10.50	10.2	
8/15/2007	17	54030	9.70	8.2	
8/21/2007	18	54096	9.20	7.2	
8/23/2007	19	54183	10.10	8.6	
8/25/2007	20	54278	10.20	9.3	
8/27/2007	21	54382	7.90	13.2	
8/28/2007	22	54466	8.10	10.4	
8/30/2007	23	54544	10.10	7.7	
9/5/2007	24	54639	8.80	10.8	
9/6/2007	25	54725	8.10	10.6	
9/10/2007	26	54806	9.10	8.9	
9/12/2007	27	54920	5.00	22.8	
9/13/2007	28	54978	11.30	5.1	
9/17/2007	29	55067	8.40	10.6	
9/19/2007	30	55152	8.40	10.1	
9/24/2007	31	55247	9.30	10.2	
9/26/2007	32	55349	9.30	11.0	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	5/8/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2858			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
10/4/2007	33	55455	10.00	10.6	Fill tank
10/10/2007	34	55564	8.50	12.8	Fill tank
10/29/2007	35	55738	10.40	16.7	Fill tank
11/1/2007	36	55827	8.50	10.5	Fill tank
11/20/2007	37	55919	9.50	9.7	Fill tank
11/28/2007	38	56024	8.40	12.5	Fill tank
12/5/2007	39	56112	11.30	7.8	Fill tank
12/12/2007	40	56201	9.80	9.1	Fill tank
12/19/2007	41	56288	7.90	11.0	Fill tank
12/24/2007	42	56361	8.10	9.0	Fill tank
12/31/2007	43	56483	10.70	11.4	Fill tank
1/2/2008	44	56566	6.90	12.0	Fill tank
1/7/2008	45	56669	9.30	11.1	Fill tank
1/10/2008	46	56770	11.40	8.9	Fill tank
1/17/2008	47	56871	12.30	8.2	Fill tank
1/24/2008	48	56960	9.90	9.0	Fill tank
1/29/2008	49	57072	11.80	9.5	Fill tank
2/7/2008	50	57162	10.20	8.8	Fill tank
2/12/2008	51	57236	7.60	9.7	Fill tank
2/19/2008	52	57357	10.90	11.1	Fill tank
2/28/2008	53	57427	10.40	6.7	Fill tank
3/2/2008	54	57522	8.20	11.6	Fill tank
3/10/2008	55	57621	6.90	14.3	Fill tank
3/11/2008	56	57699	8.10	9.6	Fill tank
3/12/2008	57	57780	7.90	10.3	Fill tank
3/13/2008	58	57850	6.10	11.5	Fill tank
3/20/2008	59	57963	7.50	15.1	Fill tank
3/24/2008	60	58036	8.90	8.2	Fill tank
3/26/2008	61	58139	9.90	10.4	Fill tank
3/31/2008	62	58244	9.10	11.5	Fill tank

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	5/8/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2858			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
4/1/2008	63	58347	9.00	11.4	Fill tank
4/3/2008	64	58436	8.20	10.9	Fill tank
4/9/2008	65	58524	10.80	8.1	Fill tank
4/16/2008	66	58629	10.20	10.3	Fill tank
4/21/2008	67	58737	9.10	11.9	Fill tank
4/22/2008	68	58800	6.90	9.1	Fill tank
4/27/2008	69	58886	8.60	10.0	Fill tank
5/8/2008	70	58973	8.00	10.9	Fill tank
5/13/2008	71	59062	7.20	12.4	Fill tank
5/15/2008	72	59144	7.10	11.5	Fill tank
5/21/2008	73	59249	7.30	14.4	Fill tank
6/2/2008	74	59354	4.60		no log entries between 5/21/08 and 6/2/08
6/3/2008	75	59401	7.30	6.4	Fill tank
6/4/2008	76	59447	8.70	5.3	Fill tank
6/9/2008	77	59558	10.20	10.9	Fill tank
6/11/2008	78	59654	7.00	13.7	Fill tank
6/12/2008	79	59732	9.70	8.0	Fill tank
6/16/2008	80	59814	7.70	10.6	Fill tank
6/18/2008	81	59906	10.90	8.4	Fill tank
6/19/2008	82	59988	6.40	12.8	Fill tank
6/23/2008	83	60060	9.10	7.9	Fill tank
6/25/2008	84	60169	7.40	14.7	Fill tank
6/30/2008	85	60228	7.10	8.3	Fill tank
7/10/2008	86	60358	7.00	18.6	Fill tank
7/14/2008	87	60445	9.90	8.8	Fill tank
7/16/2008	88	60539	9.50	9.9	Fill tank
7/21/2008	89	60632	10.30	9.0	Fill tank
4/24/2008	90	60738	7.70	13.8	Fill tank

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	5/8/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2858			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
7/29/2008	91	60794	7.53	7.4	Fill tank
7/31/2008	92	60874			No fill amount on log entry. This fill was at 7:20 am per the log sheet.
7/31/2008	93	60959	8.05	10.6	This fill was at 1:55 pm per the log sheet.
8/5/2008	94	61024	7.84	8.3	Fill tank
8/7/2008	95	61137	7.41	15.2	Fill tank
8/11/2008	96	61188	6.85	7.4	Fill tank
8/14/2008	97	61309	9.61	12.6	Fill tank
8/18/2008	98	61418	9.91	11.0	Fill tank
8/20/2008	99	61514	9.47	10.1	Fill tank
8/27/2008	100	61619	9.07	11.6	Fill tank
9/2/2008	101	61699	9.17	8.7	Fill tank
9/3/2008	102	61831	9.48	13.9	Fill tank
9/10/2008	103	61932	7.82	12.9	Fill tank
9/15/2008	104	62004	7.95	9.1	Fill tank
9/22/2008	105	62219	8.96	24.0	Fill tank
9/25/2008	106	62374	10.02	15.5	Fill tank

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	5/31/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2864				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
5/31/2007	1	64147	13.40		Conversion complete
6/20/2007	2	64209	6.70	9.3	
7/29/2007	3	64278	9.16	7.5	
8/2/2007	4	64317	6.30	6.2	
8/2/2007	5	64337	2.70	7.4	
8/4/2007	6	64380	5.60	7.7	
8/5/2007	7	64420	6.00	6.7	
9/10/2007	8	64488	7.60	8.9	
9/12/2007	9	64500	6.10	2.0	Noisy & loud/Hard to fill/low MPG/Hard to start
9/13/2007	10	64569	4.60	15.0	Hard to start
10/1/2007	11	64620	5.90	8.6	
10/2/2007	12	64679	6.77	8.7	
10/22/2007	13	64755	8.90	8.5	Filled tank
10/24/2007	14	64836	8.40	9.6	Filled tank
10/30/2007	15	64910	9.68	7.6	Filled tank
11/19/2007	16	65014	11.50	9.0	
12/19/2007	17	65069.6	7.64	7.3	Filled tank
12/27/2007	18	65215	8.32	17.5	Filled tank
1/22/2008	19	65258	5.80	7.4	Filled tank
1/23/2008	20	65335	9.30	8.3	Filled tank
1/31/2008	21	65403	8.60	7.9	
2/11/2008	22	65468	6.01	10.8	
2/14/2008	23	65595	n/a		Driver did not enter fill amount on form.
2/19/2008	24	65710.7	9.45	12.2	
2/25/2008	25	65842	10.30	12.7	
2/27/2008	26	65973	9.46	13.9	
3/10/2008	27	66101	10.60	12.1	Filled tank
4/1/2008	28	66179	8.11	9.6	Filled tank

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	5/31/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2864			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
4/10/2008	29	66263			Driver did not enter fill amount on form.
4/21/2008	30	66346	7.20	11.5	Filled tank
4/28/2008	31	66415	4.50	15.3	Filled tank
4/30/2008	32	66502	10.00	8.7	Filled tank
6/12/2008	33	66579	9.72		no log entries between 4/30/08 and 6/12/08
6/23/2008	34	66672	8.40	11.1	Filled tank
6/24/2008	35	66757	10.20	8.3	Filled tank
6/26/2008	36	66816	6.81	8.7	Filled tank
7/1/2008	37	66946	9.98	13.0	Filled tank
7/2/2008	38	67024	8.33	9.4	Filled tank
7/8/2008	39	67080	7.47	7.5	Filled tank
7/9/2008	40	67141	6.10	10.0	Filled tank
7/10/2008	41	67212	9.97	7.1	Filled tank
8/7/2008	42	67299	8.28	10.5	Filled tank
9/16/2008	43	67565	8.42	31.6	Filled tank. No log entry between 8/7/08 and 9/16/08.

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	7/19/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-150 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2861				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
10/3/2007	1	9080	7.92		o.k.
10/5/2007	2	9205	8.85	14.1	o.k.
	3				Vehicle is a loaner; Fuel logs are not complete.
2/7/2008	4	10088	7.61		Had to reset handle 2x's. Handle hard to lock on.
2/8/2008	5	10190	6.70	15.2	Had to reset handle 2x's. Handle hard to lock on.
2/11/2008	6	10315	7.48	16.7	o.k.
2/12/2008	7	10414	6.61	15.0	Had to reset handle to pump.
3/14/2008	8	10652	9.05	26.3	Looks like a fuel record is missing from the log sheet.
3/18/2008	9	10769	8.20	14.3	o.k.
3/19/2008	10	10889	7.72	15.5	o.k.
3/21/2008	11	10995	6.00	17.7	o.k.
3/24/2008	12	11095	7.56	13.2	o.k.
5/28/2008	13	11803	6.40		no log entries between 3/24/08 and 5/28/08
5/28/2008	14	11873	3.17	22.1	
6/30/2008	15	12433	8.70		No log entries between 5/28/08 and 6/30/08
7/4/2008	16	12590			No fill amount on the log sheet.
8/12/2008	17	13163	8.53	67.2	No log entries between 7/4/08 and 8/12/08
9/24/2008	18	13465	8.01	37.7	No log entries between 8/12/08 and 9/24/08

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	8/23/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2780			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
8/21/2007	1	52125	13.00		Conversion complete
8/23/2007	2	52144	7.00	2.7	gas card does not fit
8/24/2007	3	52204	10.00	6.0	Gear selector needle is off (drive reads as 2nd gear)
8/28/2007	4	52279	9.00	8.3	
8/29/2007	5	52306	5.30	5.1	
9/4/2007	6	52359	8.00	6.6	
9/5/2007	7	52407	5.00	9.6	
9/7/2007	8	52506	7.50	13.2	
9/11/2007	9	52578	10.80	6.7	
9/13/2007	10	52630	7.00	7.4	
9/14/2007	11	52654	5.00	4.8	
9/17/2007	12	52699	5.20	8.7	
9/18/2007	13	52761	7.40	8.4	
9/21/2007	14	52799	7.00	5.4	
9/27/2007	15	52872	10.14	7.2	
10/2/2007	16	52988	6.50	17.8	1/2 tank
10/4/2007	17	53035	6.60	7.1	1/4 tank
10/5/2007	18	53061	5.20	5.0	1/2 tank 26.1 miles
10/8/2007	19	53121	8.80	6.8	E 86.8
10/9/2007	20	53169	6.30	7.6	1/2 tank
10/13/2007	21	53235	8.10	8.1	1/3 tank
10/15/2007	22	53345	9.20	12.0	1/4 tank
10/17/2007	23	53432	10.10	8.6	1/4 tank
10/18/2007	24	53466	4.30	7.9	3/4 tank

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	8/23/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2780			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
10/22/2007	25	53525	6.80	8.7	1/2 tank/bad O-Ring on truck; changed out by tech
10/25/2007	26	53616	11.00	8.3	Empty
10/30/2007	27	53672	6.46	8.7	1/2 tank
11/2/2007	28	53755	8.85	9.4	1/4 tank
11/6/2007	29	53808	6.50	8.2	1/4 tank
11/9/2007	30	53904	10.50	9.1	Empty
11/13/2007	31	53960	4.50	12.4	1/4 tank; pump leaking
11/14/2007	32	53986	4.70	5.5	3/4 tank
11/19/2007	33	54036	6.00	8.3	1/2 tank; pump still leaking
11/20/2007	34	54106	6.90	10.1	1/2 tank; no leaks today
11/26/2007	35	54182	9.90	7.7	1/4 tank; leaking filler hose
11/28/2007	36	54254	11.00	6.5	Empty; handle leaking
11/30/2007	37	54305	7.80	6.5	1/2 tank; no leaks
12/10/2007	38	54418	8.80	12.8	Empty
12/13/2007	39	54465	11.80	4.0	Empty
12/14/2007	40	54580	10.30	11.2	1/4 tank
12/17/2007	41	54638	66.00	0.9	1/2 tank
12/21/2007	42	54772	10.10	13.3	1/4 tank
12/24/2007	43	54821	7.20	6.8	1/2 tank
12/27/2007	44	54949	12.50	10.2	Empty
1/8/2008	45	55149	7.40	27.0	Looks like a fuel record is missing from the log sheet.
1/9/2008	46	55184	7.20	4.9	
1/11/2008	47	55259	8.30	9.0	
1/14/2008	48	55353	7.60	12.4	
1/17/2008	49	55417	9.10	7.0	
1/21/2008	50	55493	8.10	9.4	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	8/23/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2780			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
1/24/2008	51	55566	10.30	7.1	
1/25/2008	52	55619	8.80	6.0	
1/30/2008	53	55688	8.10	8.5	
1/31/2008	54	55768	12.10	6.6	
2/1/2008	55	55825	6.20	9.2	
2/6/2008	56	55902	8.90	8.7	
2/10/2008	57	55952	5.20	9.6	
2/15/2008	58	56104	8.20	18.5	
2/21/2008	59	56194	9.40	9.6	
2/22/2008	60	56223	6.10	4.8	
2/25/2008	61	56274	6.20	8.2	
3/5/2008	62	56325	7.20	7.1	
3/6/2008	63	56450	4.70	26.6	
3/10/2008	64	56525	8.40	8.9	
3/13/2008	65	56575	6.90	7.2	
3/18/2008	66	56646	7.50	9.5	
3/20/2008	67	56782	6.00	22.7	
(missing)	68	56959	7.90	22.4	
4/2/2008	69	57057	8.90	11.0	
4/7/2008	70	57093	5.30	6.8	
4/14/2008	71	57241	7.50	19.7	
4/17/2008	72	57334	10.20	9.1	
4/18/2008	73	57415	7.00	11.6	
4/21/2008	74	57448	5.20	6.3	
4/21/2008	75	57485	5.50	6.7	
4/22/2008	76	57591	11.00	9.6	
4/23/2008	77	57613	4.50	4.9	
4/24/2008	78	57686	7.50	9.7	
4/28/2008	79	57763	7.70	10.0	
4/30/2008	80	57870	5.20	20.6	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	8/23/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #		2780			
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
5/1/2008	81	57893	5.40	4.3	
5/7/2008	82	57965	7.50	9.6	
5/8/2008	83	58004	6.00	6.5	
5/14/2008	84	58074	4.00	17.5	
5/15/2008	85	58096	3.71	5.9	
5/16/2008	86	58125	4.10	7.1	
5/19/2008	87	58201	7.00	10.9	
5/22/2008	88	58250	3.90	12.6	
5/23/2008	89	58290	3.80	10.5	
5/27/2008	90	58314	7.20	3.3	
5/29/2008	91	58338	5.60	4.3	
6/3/2008	92	58435	8.00	12.1	
6/4/2008	93	58471	7.80	4.6	
6/6/2008	94	58512	7.50	5.5	
6/9/2008	95	58556	6.50	6.8	
6/13/2008	96	58603	7.40	6.4	
6/17/2008	97	58666	7.50	8.4	
6/18/2008	98	58720	7.60	7.1	
6/19/2008	99	58758	6.20	6.1	
6/24/2008	100	58800	5.10	8.2	
6/25/2008	101	58836	6.00	6.0	
6/26/2008	102	58882	5.30	8.7	
6/26/2008	103	58923	5.40	7.6	
6/27/2008	104	58963	4.90	8.2	
6/30/2008	105	59011	5.90	8.1	
7/1/2008	106	59100	9.20	9.7	
7/2/2008	107	59207	10.80	9.9	
7/3/2008	108	59257	5.80	8.6	
7/7/2008	109	59290	4.40	7.5	
7/7/2008	110	59355	10.30	6.3	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	8/23/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model: Location of Operation:			Ford F-250 CNG		
			Las Vegas, NV		
Vehicle #	2780				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
7/9/2008	111	59420	11.30	5.8	
7/15/2008	112	59477	5.60	10.2	
7/16/2008	113	59533	7.00	8.0	
7/18/2008	114	59597	6.50	9.8	
7/25/2008	115	59654	5.20	11.0	
7/28/2008	116	59685	4.50	6.9	

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	10/16/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model: Location of Operation:			Ford F-250 CNG		
			Las Vegas, NV		
Vehicle #	2784				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
10/10/2007	1	66048	4.27		Conversion done
10/23/2007	2	66123	12.84	5.8	Fill tank; Runs good at time of fill. In shop for engine running rough around this time.
11/6/2007	3	66206	11.00	7.5	Fill up
11/11/2007	4	66334	11.27	11.4	Fill up
11/16/2007	5	66487	12.22	12.5	Fill up
11/26/2007	6	66592	10.32	10.2	Fill up

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	10/16/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2784				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
12/3/2007	7	66714	13.49	9.0	Fill up
12/7/2007	8	66816	12.24	8.3	Fill up
12/17/2007	9	66927	13.22	8.4	Fill up
12/26/2007	10	67062	13.96	9.7	Fill up
12/31/2007	11	67152	8.76	10.3	Fill up
1/15/2008	12	67285	14.10	9.4	Fill up
1/22/2008	13	67360	9.68	7.7	Fill up
2/5/2008	14	67652	12.32	23.7	Looks like fuel records are missing from log sheet.
2/8/2008	15	67754	10.30	9.9	Fill up
2/12/2008	16	67851	9.10	10.7	Fill up
2/21/2008	17	67925	8.63	8.6	Fill up
2/24/2008	18	68022	9.99	9.7	Fill up
2/28/2008	19	68146	9.93	12.5	Fill up
3/6/2008	20	68264	11.71	10.1	Fill up
3/9/2008	21	68429	10.73	15.4	Fill up
3/12/2008	22	68498	9.59	7.2	Fill up
3/18/2008	23	68598	10.63	9.4	Fill up
3/21/2008	24	68665	7.19	9.3	Fill up
3/23/2008	25	68789	10.22	12.1	Fill up
3/27/2008	26	68906	10.24	11.4	Fill up
3/30/2008	27	69033	9.00	14.1	Fill up
4/3/2008	28	69129	9.58	10.0	Fill up
4/5/2008	29	69221	9.41	9.8	Fill up
4/12/2008	30	69325	10.61	9.8	Fill up
4/19/2008	31	69422	9.74	10.0	Fill up
4/19/2008	32	69533	10.24	10.8	Fill up
4/25/2008	33	69678	6.25	23.2	Looks like a fuel record is missing from the log sheet.

On-Road Fuel Economy: Rev 3 [2007-10-30]

Data since inception of the program, all vehicles

Report Date	9/30/2008				
Deployment Start	10/16/2007				
H2 Tank Pressure	5000 psi				
Vehicle Model:		Ford F-250 CNG			
Location of Operation:		Las Vegas, NV			
Vehicle #	2784				
Date	Fill-up Number	Odometer at Fill (miles)	GGE hythane filled	miles/GGE hythane	Comments ⁽¹⁾
4/28/2008	34	69776	8.02	12.2	Fill up
5/2/2008	35	69845	9.75	7.1	Fill up
5/10/2008	36	70083	10.60	22.5	Looks like a fuel record is missing from the log sheet.
5/13/2008	37	70185	10.60	9.6	Fill up
5/17/2008	38	70281	10.02	9.6	Fill up
5/22/2008	39	70375	9.87	9.5	Fill up
6/26/2008	40	70855	10.22		no log entries between 5/22/08 and 6/26/08
7/3/2008	41	70999	7.76	18.6	Fill up
7/15/2008	42	71155	9.08	17.2	Fill up
8/15/2008	43	71720	8.81		Fill up. No log entries between 7/15/08 and 8/15/08.
8/18/2008	44	71833	8.94	12.6	Fill up
8/25/2008	45	71994	5.88	27.4	Fill up
8/28/2008	46	72052	9.25	6.3	Fill up
8/31/2008	47	72168	7.83	14.8	Fill up
9/3/2008	48	72294	8.42	15.0	Fill up
9/6/2008	49	72416	9.01	13.5	Fill up
9/10/2008	50	72539	6.54	18.8	Fill up
9/13/2008	51	72654	8.81	13.1	Fill up
9/18/2008	52	72789	9.75	13.8	Fill up
9/21/2008	53	72904	6.34	18.1	Fill up
9/24/2008	54	73051	7.92	18.6	Fill up
9/25/2008	55	73096	9.18	4.9	Fill up

Maintenance Summary: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

		Report Date	9/30/2008				
		Automaker	Ford Motor Company				
#	Unique Vehicle Identifier	Maintenance Type	Associated with an on-road vehicle failure, shut-down?	Scheduled, Un-Scheduled	Date of Repair, Replacement	Vehicle Miles Traveled (with this component installed) at Repair, Replacement	Comments, Description of Maintenance
1	2860	Other	No	Scheduled	Oct 05	30,000	Converted at Collier Technologies.
2	2856	Other	No	Scheduled	Nov 05	6,700	Converted at Collier Technologies.
3	2860	Repair	No	Un-Scheduled	1/12/2006		Add/replace parts for CNG/H2 conversion. Replace spark plugs, coil packs, injectors.
4	2767	Other	No	Scheduled	1/17/2006	17,914	Converted to H2/CNG
5	2771	Other	No	Scheduled	3/14/2006	55,360	Converted to H2/CNG
6	2771	Adjustment	No	Un-Scheduled	Mar - May 06	55,360	Conversion kit removed due to performance problems.
7	2856	Repair	No	Un-Scheduled	1/23/2007	25,600	Engine runs rough, stalls, & surges intermittently. Replaced EGR valve.
8	2856	Replacement	No	Un-Scheduled	1/31/2007	26,297	Troubleshoot fuel system. Replaced throttle pos. sensor and idle air control valve
9	2860	Adjustment	No	Un-Scheduled	2/21/2007	32,067	Check engine light on. Troubleshoot codes, adjust EGR valve.
10	2771	Other	No	Scheduled	4/18/2007	62,210	Reinstalled conversion kit.

Maintenance Summary: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

		Report Date	9/30/2008				
		Automaker	Ford Motor Company				
#	Unique Vehicle Identifier	Maintenance Type	Associated with an on-road vehicle failure, shut-down?	Scheduled, Un-Scheduled	Date of Repair, Replacement	Vehicle Miles Traveled (with this component installed) at Repair, Replacement	Comments, Description of Maintenance
11	2858	Other	No	Scheduled	5/8/2007	52,633	Converted to H2/CNG
12	2858	Adjustment	Yes	Un-Scheduled	5/17/2007	52,724	Fuel conversion not working properly. Engine loses power intermittently.
13	2864	Other	No	Scheduled	5/31/2007	64,147	Converted to H2/CNG
14	2861	Other	No	Scheduled	7/19/2007	8,546	Converted to H2/CNG
15	2780	Other	No	Scheduled	8/23/2007	52,111	Converted to H2/CNG
16	2784	Other	No	Scheduled	10/16/2007	65,997	Converted to H2/CNG
17	2784	Repair	No	Un-Scheduled	10/25/2007	66,120	Engine runs rough. # 3 engine coil was bad. Replaced all 8 engine coils.
18	2858	Adjustment	No	Un-Scheduled	11/20/2007	55,858	Engine runs rough. Trouble shoot, modified EGR valve, and road tested.
19	2861	Adjustment	No	Un-Scheduled	3/4/2008	10,346	Engine has no "take off" power and runs rough when idling.
20	2771	Repair	No	Un-Scheduled	3/19/2008	66,399	Repair vacuum leak in the supercharger.
21	2767	Adjustment	No	Un-Scheduled	5/14/2008	30,859	SES light is on. Inspect bank 1 lean, clear codes and test drive.

Maintenance Summary: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

		Report Date	9/30/2008				
		Automaker	Ford Motor Company				
#	Unique Vehicle Identifier	Maintenance Type	Associated with an on-road vehicle failure, shut-down?	Scheduled, Un-Scheduled	Date of Repair, Replacement	Vehicle Miles Traveled (with this component installed) at Repair, Replacement	Comments, Description of Maintenance
22	2767	Adjustment	No	Un-Scheduled	6/4/2008	31,820	When engine is idling a loud vibration noise is coming from under the cab. Adjusted EGR exhaust tube.
23	2860	Repair	No	Un-Scheduled	8/29/2008	39,101	Throttle was sticking. Replaced bushings with bearings and re-designed the linkage.

Safety Summary: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

	Report Date	9/30/2008			
	Automaker	Ford Motor Company			
#	Event Type	Unique Vehicle Identifier	Associated with an on-road vehicle failure, shut-down?	Date of Event	Detailed Event Description/Result
	none to date				

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		Oct-05		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2860			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2464 RPM's
Date	<i>not available</i>	<i>not available</i>	7/18/2007	7/18/2007
Mileage			33,792	33,792
Air Temp °F			103	103
Gas Temp °F			259	294
HC ppm			21	0
O2 %			0.1	0.08
CO ppm			791	158
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.8	10.6
Combustion Efficiency %			87.0	86.4
Losses %			13.0	13.6
Exc. Air			1.02	1.00
Sensor Temp °F			110	111
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2508 RPM's
Date			10/24/2007	10/24/2007
Mileage			35,088	35,088
Air Temp °F			99	98
Gas Temp °F			293	335
HC ppm			6	2
O2 %			0.87	0.1
CO ppm			343	82
NO ppm			0	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		Oct-05		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2860			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2464 RPM's
NOx ppm			0	0
CO2 %			10.4	10.8
Combustion Efficiency %			86.2	85.5
Losses %			13.8	14.5
Exc. Air			1.04	1
Sensor Temp °F			95	95
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2491 RPM's
Date			12/13/2007	12/13/2007
Mileage			35,547	35,547
Air Temp °F			56	57
Gas Temp °F			265	310
HC ppm			1	1
O2 %			0.79	0.11
CO ppm			135	90
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.6	10.9
Combustion Efficiency %			85.9	85.1
Losses %			14.1	14.9
Exc. Air			1.03	1
Sensor Temp °F			62	62

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		Oct-05		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2860			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2507 RPM's
Date			3/12/2008	3/12/2008
Mileage			36,779	36,779
Air Temp °F			70	70
Gas Temp °F			374	315
HC ppm			0	0
O2 %			0.72	0.1
CO ppm			242	59
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.4	10.7
Combustion Efficiency %			86	85.3
Losses %			14	14.7
Exc. Air			1.03	1
Sensor Temp °F			76	76
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2506 RPM's
Date			7/10/2008	7/10/2008
Mileage			39,099	39,099
Air Temp °F			86	85
Gas Temp °F			328	449
HC ppm			7	15
O2 %			0.05	0
CO ppm			892	241
NO ppm			0	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008
Fuel Type:		CNG/H2
Deployment Start:		Oct-05
Vehicle Model:		Ford F-150 CNG
Location of Operation:		Las Vegas, NV
Vehicle #	2860	
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
		@ Idle
		2464 RPM's
NOx ppm		0
CO2 %		10.7
Combustion Efficiency %		85.3
Losses %		14.7
Exc. Air		1.02
Sensor Temp °F		89
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
		@ Idle
		2494 RPM's
Date		9/26/2008
Mileage		39,147
Air Temp °F		99
Gas Temp °F		291
HC ppm		12
O2 %		0.36
CO ppm		469
NO ppm		0
NO2 ppm		0
NOx ppm		0
CO2 %		10.6
Combustion Efficiency %		86.3
Losses %		13.7
Exc. Air		1.01
Sensor Temp °F		97

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		Nov-05		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2856			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2471 RPM's
Date	<i>not available</i>	<i>not available</i>	7/18/2007	7/18/2007
Mileage			30,719	30,719
Air Temp °F			97	96
Gas Temp °F			317	364
HC ppm			57	1
O2 %			0.09	0.02
CO ppm			769	171
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.8	10.9
Combustion Efficiency %			85.8	84.9
Losses %			14.2	15.1
Exc. Air			1.00	1.00
Sensor Temp °F			98	97
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2505 RPM's
Date			10/24/2007	10/24/2007
Mileage			35,564	35,564
Air Temp °F			83	82
Gas Temp °F			286	314
HC ppm			13	3
O2 %			0.18	0.02
CO ppm			985	141
NO ppm			0	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		Nov-05		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2856			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2471 RPM's
NOx ppm			0	0
CO2 %			10.8	10.9
Combustion Efficiency %			86.1	85.5
Losses %			13.9	14.5
Exc. Air			1.00	1.00
Sensor Temp °F			88	88
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2509 RPM's
Date			12/13/2007	12/13/2007
Mileage			37,916	37,916
Air Temp °F			55	54
Gas Temp °F			299	335
HC ppm			4	2
O2 %			0.15	0
CO ppm			1198	102
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.8	10.8
Combustion Efficiency %			85.3	84.6
Losses %			14.7	15.4
Exc. Air			1	1
Sensor Temp °F			59	58

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		Nov-05		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2856			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2471 RPM's
Date			3/21/2008	3/21/2008
Mileage			41,152	41,152
Air Temp °F			72	72
Gas Temp °F			294	337
HC ppm			41	3
O2 %			0.15	0
CO ppm			782	189
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.8	10.8
Combustion Efficiency %			85.8	84.9
Losses %			14.2	15.1
Exc. Air			1	1
Sensor Temp °F			78	77
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2506 RPM's
Date			7/10/2008	7/10/2008
Mileage			43,213	43,213
Air Temp °F			81	85
Gas Temp °F			296	397
HC ppm			33	0
O2 %			0.19	0.01
CO ppm			116	308
NO ppm			0	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		Nov-05		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2856			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2471 RPM's
NOx ppm			0	0
CO2 %			11	10.7
Combustion Efficiency %			85.9	84
Losses %			14.1	16
Exc. Air			1	1
Sensor Temp °F			84	88
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2516 RPM's
Date			9/26/2008	9/26/2008
Mileage			43,755	43,755
Air Temp °F			94	92
Gas Temp °F			253	266
HC ppm			1	0
O2 %			0.13	0.01
CO ppm			1179	250
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.8	10.8
Combustion Efficiency %			87	86.7
Losses %			13	13.3
Exc. Air			1	1
Sensor Temp °F			92	91

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008
Fuel Type:		CNG/H2
Deployment Start:		1/17/2006
Vehicle Model:		Ford F-250 CNG
Location of Operation:		Las Vegas, NV
Vehicle #	2767	
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2451 RPM's
Date	<i>not available</i>	<i>not available</i>
Mileage		7/19/2007 7/19/2007
Air Temp °F		27,731 27,731
Gas Temp °F		89 87
HC ppm		299 345
O2 %		9 1
CO ppm		0.16 0.03
NO ppm		19 94
NO2 ppm		0 0
NOx ppm		0 0
CO2 %		10.5 10.8
Combustion Efficiency %		86.0 85.0
Losses %		14.0 15.0
Exc. Air		1.00 1.00
Sensor Temp °F		90 89
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2510 RPM's
Date		12/13/2007 12/13/2007
Mileage		29,546 29,546
Air Temp °F		57 57
Gas Temp °F		288 352
HC ppm		0 0
O2 %		0.16 0.03
CO ppm		5 42
NO ppm		0 0
NO2 ppm		0 0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		1/17/2006		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2767			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2451 RPM's
NOx ppm			0	0
CO2 %			10.7	10.8
Combustion Efficiency %			85.6	84.3
Losses %			14.4	15.7
Exc. Air			1	1
Sensor Temp °F			61	61
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2514 RPM's
Date			3/27/2008	3/27/2008
Mileage			30,409	30,409
Air Temp °F			90	98
Gas Temp °F			174	356
HC ppm			43	0
O2 %			0.13	0
CO ppm			0	26
NO ppm			23	16
NO2 ppm			1	0
NOx ppm			24	16
CO2 %			10.7	10.8
Combustion Efficiency %			88.5	85
Losses %			11.5	15
Exc. Air			1.01	1
Sensor Temp °F			100	100

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008
Fuel Type:		CNG/H2
Deployment Start:		1/17/2006
Vehicle Model:		Ford F-250 CNG
Location of Operation:		Las Vegas, NV
Vehicle #	2767	
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2451 RPM's
Date		7/29/2008
Mileage		32,768
Air Temp °F		84
Gas Temp °F		313
HC ppm		6
O2 %		0.11
CO ppm		0
NO ppm		4
NO2 ppm		0
NOx ppm		4
CO2 %		10.6
Combustion Efficiency %		85.6
Losses %		14.4
Exc. Air		1
Sensor Temp °F		99
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2499 RPM's
Date		9/26/2008
Mileage		33,528
Air Temp °F		98
Gas Temp °F		250
HC ppm		1
O2 %		0.12
CO ppm		7
NO ppm		6
NO2 ppm		0

Emissions Comparison: Rev 2 [2007-4-20]				
<i>Data since inception of the program, all vehicles</i>				
Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		1/17/2006		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2767			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2451 RPM's
NOx ppm			6	5
CO2 %			10.8	10.9
Combustion Efficiency %			87.1	86.8
Losses %			12.9	13.2
Exc. Air			1.01	1
Sensor Temp °F			104	104

Emissions Comparison: Rev 2 [2007-4-20]				
<i>Data since inception of the program, all vehicles</i>				
Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		4/18/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2771			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2436 RPM's
Date	<i>not available</i>	<i>not available</i>	7/18/2007	7/18/2007
Mileage			63,403	63,403
Air Temp °F			100	101
Gas Temp °F			367	413
HC ppm			55	0
O2 %			0.24	0
CO ppm			0	52
NO ppm			10	1

Emissions Comparison: Rev 2 [2007-4-20]				
<i>Data since inception of the program, all vehicles</i>				
Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		4/18/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2771			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2436 RPM's
NO2 ppm			0	0
NOx ppm			10	1
CO2 %			10.6	10.8
Combustion Efficiency %			84.9	84.0
Losses %			15.1	16.0
Exc. Air			1.00	1.00
Sensor Temp °F			105	106
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2508 RPM's
Date			10/31/2007	10/31/2007
Mileage			64,399	64,399
Air Temp °F			84	83
Gas Temp °F			343	416
HC ppm			16	0
O2 %			0.07	0
CO ppm			0	67
NO ppm			22	1
NO2 ppm			0	0
NOx ppm			22	1
CO2 %			10.7	10.9
Combustion Efficiency %			84.9	83.5
Losses %			15.1	16.5
Exc. Air			1.01	1
Sensor Temp °F			85	84

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		4/18/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2771			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2436 RPM's
Date			12/13/2007	12/13/2007
Mileage			64,621	64,621
Air Temp °F			61	62
Gas Temp °F			237	266
HC ppm			55	1
O2 %			0.67	0.01
CO ppm			1	1
NO ppm			23	25
NO2 ppm			0	1
NOx ppm			23	26
CO2 %			10.6	10.9
Combustion Efficiency %			86.7	86.1
Losses %			13.3	13.9
Exc. Air			1	1
Sensor Temp °F			67	67
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2512 RPM's
Date			3/6/2008	3/6/2008
Mileage			66,399	66,399
Air Temp °F			70	70
Gas Temp °F			309	355
HC ppm			10	0
O2 %			0.08	0.05
CO ppm			32	14
NO ppm			1	1
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		4/18/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2771			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2436 RPM's
NOx ppm			1	1
CO2 %			10.5	10.6
Combustion Efficiency %			85.4	84.5
Losses %			14.6	15.5
Exc. Air			1	1
Sensor Temp °F			75	74
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2501 RPM's
Date			7/11/2008	7/11/2008
Mileage			68,107	68,107
Air Temp °F			73	75
Gas Temp °F			236	341
HC ppm			16	13
O2 %			0.36	0.06
CO ppm			153	0
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.7	10.8
Combustion Efficiency %			86.9	84.9
Losses %			13.1	15.1
Exc. Air			1.01	1
Sensor Temp °F			81	81

Emissions Comparison: Rev 2 [2007-4-20]				
Data since inception of the program, all vehicles				
Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		4/18/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #		2771		
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2436 RPM's
Date			9/26/2008	9/26/2008
Mileage			68,417	68,417
Air Temp °F			76	75
Gas Temp °F			374	445
HC ppm			35	0
O2 %			0.06	0
CO ppm			0	34
NO ppm			8	0
NO2 ppm			0	0
NOx ppm			8	0
CO2 %			10.8	10.9
Combustion Efficiency %			84.3	82.8
Losses %			15.7	17.2
Exc. Air			1	1
Sensor Temp °F			78	77

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		5/8/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2858			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2498 RPM's
Date	<i>not available</i>	<i>not available</i>	7/19/2007	7/19/2007
Mileage			53,424	53,424
Air Temp °F			85	84
Gas Temp °F			333	401
HC ppm			45	0
O2 %			0.06	0
CO ppm			3065	45
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.9	10.9
Combustion Efficiency %			85.3	83.9
Losses %			14.7	16.1
Exc. Air			1.00	1.00
Sensor Temp °F			87	86
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2503 RPM's
Date			10/24/2007	10/24/2007
Mileage			55,736	55,736
Air Temp °F			81	80
Gas Temp °F			368	425
HC ppm			24	0
O2 %			0.07	0
CO ppm			1594	64
NO ppm			0	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008
Fuel Type:		CNG/H2
Deployment Start:		5/8/2007
Vehicle Model:		Ford F-150 CNG
Location of Operation:		Las Vegas, NV
Vehicle #	2858	
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2498 RPM's
NOx ppm		0
CO2 %		10.8
Combustion Efficiency %		84.5
Losses %		15.5
Exc. Air		1.00
Sensor Temp °F		86
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2468 RPM's
Date		12/12/2007
Mileage		56,212
Air Temp °F		66
Gas Temp °F		228
HC ppm		13
O2 %		0.08
CO ppm		516
NO ppm		0
NO2 ppm		0
NOx ppm		0
CO2 %		10.8
Combustion Efficiency %		87
Losses %		13
Exc. Air		1
Sensor Temp °F		74

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		5/8/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2858			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2498 RPM's
Date			3/21/2008	3/21/2008
Mileage			57,998	57,998
Air Temp °F			65	64
Gas Temp °F			225	278
HC ppm			0	1
O2 %			0.09	0
CO ppm			222	90
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			11.2	11.2
Combustion Efficiency %			86.1	85.9
Losses %			13.9	14.1
Exc. Air			1.32	1
Sensor Temp °F			70	69
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2505 RPM's
Date			6/27/2008	6/27/2008
Mileage			60,228	60,228
Air Temp °F			77	77
Gas Temp °F			258	307
HC ppm			35	0
O2 %			0.07	0
CO ppm			725	66
NO ppm			0	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		5/8/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2858			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2498 RPM's
NOx ppm			0	0
CO2 %			10.8	10.9
Combustion Efficiency %			86.6	85.6
Losses %			13.4	14.1
Exc. Air			1	1
Sensor Temp °F			80	80
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2532 RPM's
Date			9/26/2008	9/26/2008
Mileage			62,383	62,383
Air Temp °F			105	103
Gas Temp °F			225	267
HC ppm			6	5
O2 %			0.08	0
CO ppm			1175	61
NO ppm			0	8
NO2 ppm			0	0
NOx ppm			0	8
CO2 %			10.9	10.9
Combustion Efficiency %			87.8	86.9
Losses %			12.2	13.1
Exc. Air			1	1
Sensor Temp °F			112	112

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008
Fuel Type:		CNG/H2
Deployment Start:		5/31/2007
Vehicle Model:		Ford F-150 CNG
Location of Operation:		Las Vegas, NV
Vehicle #	2864	
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2522 RPM's
Date	<i>not available</i>	<i>not available</i>
Mileage		7/18/2007 7/18/2007
Air Temp °F		64,239 64,239
Gas Temp °F		108 108
HC ppm		338 387
O2 %		99 1
CO ppm		0.04 0.01
NO ppm		1014 114
NO2 ppm		0 0
NOx ppm		0 0
CO2 %		10.6 10.6
Combustion Efficiency %		85.6 84.6
Losses %		14.4 15.4
Exc. Air		1.00 1.00
Sensor Temp °F		n/a 114
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2515 RPM's
Date		10/29/2007 10/29/2007
Mileage		64,909 64,909
Air Temp °F		81 79
Gas Temp °F		337 384
HC ppm		110 0
O2 %		0.07 0
CO ppm		1792 61
NO ppm		0 0
NO2 ppm		0 0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008
Fuel Type:		CNG/H2
Deployment Start:		5/31/2007
Vehicle Model:		Ford F-150 CNG
Location of Operation:		Las Vegas, NV
Vehicle #	2864	
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2522 RPM's
NOx ppm		0
CO2 %		10.8
Combustion Efficiency %		85.1
Losses %		14.9
Exc. Air		1.00
Sensor Temp °F		84
	Pre Conversion	Post Conversion
	@ Idle	xxxx RPM's
	@ Idle	2480 RPM's
Date		12/12/2007
Mileage		65,014
Air Temp °F		78
Gas Temp °F		311
HC ppm		35
O2 %		5.59
CO ppm		941
NO ppm		0
NO2 ppm		0
NOx ppm		0
CO2 %		10.6
Combustion Efficiency %		85.5
Losses %		14.5
Exc. Air		1
Sensor Temp °F		80

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		5/31/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2864			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2522 RPM's
Date			3/12/2008	3/12/2008
Mileage			66,413	66,413
Air Temp °F			64	64
Gas Temp °F			311	343
HC ppm			3	0
O2 %			0.03	0
CO ppm			475	50
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.8	10.9
Combustion Efficiency %			85.3	84.6
Losses %			14.7	15.4
Exc. Air			1	1
Sensor Temp °F			68	68
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2534 RPM's
Date			6/27/2008	6/27/2008
Mileage			66,875	66,875
Air Temp °F			97	99
Gas Temp °F			295	351
HC ppm			110	5
O2 %			0.07	0
CO ppm			729	44
NO ppm			0	3
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		5/31/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2864			
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2522 RPM's
NOx ppm			0	3
CO2 %			10.8	10.8
Combustion Efficiency %			86.3	85.1
Losses %			13.7	14.9
Exc. Air			1	1
Sensor Temp °F			106	106
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2478 RPM's
Date			9/26/2008	9/26/2008
Mileage			67,627	67,627
Air Temp °F			99	99
Gas Temp °F			222	343
HC ppm			20	0
O2 %			0.15	0
CO ppm			17	70
NO ppm			5	4
NO2 ppm			0	0
NOx ppm			5	4
CO2 %			10.8	10.8
Combustion Efficiency %			87.8	85.3
Losses %			12.2	14.7
Exc. Air			1	1
Sensor Temp °F			104	104

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		7/19/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2861			
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2632 RPM's
Date	7/10/2007	7/10/2007	7/18/2007	7/18/07
Mileage	8,545	8,545	8,545	8,545
Air Temp °F	86	87	84	88
Gas Temp °F	259	364	295	429
HC ppm	2	1	82	0
O2 %	0.13	0.01	0.1	0.01
CO ppm	70	199	103	87
NO ppm	0	0	0	0
NO2 ppm	0	0	0	0
NOx ppm	0	0	0	0
CO2 %	11.8	11.7	10.9	10.8
Combustion Efficiency %	86.8	84.6	86.0	83.4
Losses %	13.2	15.4	14.0	16.6
Exc. Air	1.00	1.00	1.00	1.00
Sensor Temp °F	91	92	86	90
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2504 RPM's
Date			10/24/2007	10/24/2007
Mileage			9,372	9,372
Air Temp °F			75	74
Gas Temp °F			419	469
HC ppm			235	16
O2 %			0.07	0
CO ppm			380	60
NO ppm			0	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		7/19/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2861			
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2632 RPM's
NOx ppm			0	0
CO2 %			10.7	10.8
Efficiency %			83.3	82.3
Losses %			16.7	17.7
Exc. Air			1.00	1.00
Sensor Temp °F			79	79
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2477 RPM's
Date			12/12/2007	12/12/2007
Mileage			9,863	9,863
Air Temp °F			66	66
Gas Temp °F			403	449
HC ppm			234	12
O2 %			0.06	0
CO ppm			354	17
NO ppm			0	0
NO2 ppm			0	0
NOx ppm			0	0
CO2 %			10.7	10.8
Combustion Efficiency %			83.5	82.5
Losses %			16.5	17.5
Exc. Air			1	1
Sensor Temp °F			68	68

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		7/19/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2861			
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2632 RPM's
Date			3/6/2008	3/6/2008
Mileage			10,594	10,594
Air Temp °F			75	74
Gas Temp °F			283	314
HC ppm			1	2
O2 %			0.08	0.01
CO ppm			141	94
NO ppm			1	1
NO2 ppm			0	0
NOx ppm			1	1
CO2 %			10.6	10.6
Combustion Efficiency %			86	85.4
Losses %			14	14.6
Exc. Air			1	1
Sensor Temp °F			78	78
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2476 RPM's
Date			7/29/2008	7/29/2008
Mileage			13,090	13,090
Air Temp °F			88	81
Gas Temp °F			226	370
HC ppm			46	29
O2 %			0.2	0
CO ppm			76	24
NO ppm			3	3
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		7/19/2007		
Vehicle Model:		Ford F-150 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2861			
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2632 RPM's
NOx ppm			3	3
CO2 %			10.7	10.8
Combustion Efficiency %			87.4	84.4
Losses %			12.6	15.6
Exc. Air			1	1
Sensor Temp °F			100	98
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2507 RPM's
Date			9/26/2008	9/26/2008
Mileage			13,608	13,608
Air Temp °F			97	97
Gas Temp °F			325	321
HC ppm			7	8
O2 %			0.01	0
CO ppm			318	256
NO ppm			4	3
NO2 ppm			0	0
NOx ppm			4	3
CO2 %			10.7	10.9
Combustion Efficiency %			85.6	85.7
Losses %			14.4	14.3
Exc. Air			1	1
Sensor Temp °F			106	106

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:			9/30/2008	
Fuel Type:			CNG/H2	
Deployment Start:			8/23/2007	
Vehicle Model:			Ford F-250 CNG	
Location of Operation:			Las Vegas, NV	
Vehicle #		2780		
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2497 RPM's
Date	8/7/2007	8/7/2007	8/21/2007	8/21/2007
Mileage	52,111	52,111	n/a	n/a
Air Temp °F	76	76	81	79
Gas Temp °F	347	397	422	477
HC ppm	0	0	5	0
O2 %	0.48	0.06	0.03	0
CO ppm	66	62	33	73
NO ppm	0	0	1	0
NO2 ppm	0	0	0	0
NOx ppm	0	0	1	0
CO2 %	11.5	11.8	10.7	10.9
Combustion Efficiency %	84.7	83.8	83.4	82.3
Losses %	15.3	16.2	16.6	17.7
Exc. Air	1.02	1.00	1.00	1.00
Sensor Temp °F	82	82	84	83
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2512 RPM's
Date			10/29/2007	10/29/2007
Mileage			53,671	53,671
Air Temp °F			74	74
Gas Temp °F			409	466
HC ppm			92	0
O2 %			0.48	0
CO ppm			0	60
NO ppm			21	0
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:			9/30/2008	
Fuel Type:			CNG/H2	
Deployment Start:			8/23/2007	
Vehicle Model:			Ford F-250 CNG	
Location of Operation:			Las Vegas, NV	
Vehicle #		2780		
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2497 RPM's
NOx ppm			21	0
CO2 %			10.5	10.8
Combustion Efficiency %			83.3	82.4
Losses %			16.7	17.6
Exc. Air			1.03	1.00
Sensor Temp °F			80	80
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2514 RPM's
Date			12/12/2007	12/12/2007
Mileage			54,495	54,495
Air Temp °F			76	74
Gas Temp °F			382	455
HC ppm			66	0
O2 %			0.44	0
CO ppm			0	66
NO ppm			22	0
NO2 ppm			0	0
NOx ppm			22	0
CO2 %			10.6	10.9
Combustion Efficiency %			83.9	82.6
Losses %			16.1	17.4
Exc. Air			1.04	1
Sensor Temp °F			77	77

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:			9/30/2008	
Fuel Type:			CNG/H2	
Deployment Start:			8/23/2007	
Vehicle Model:			Ford F-250 CNG	
Location of Operation:			Las Vegas, NV	
Vehicle #		2780		
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2497 RPM's
Date			3/12/2008	3/12/2008
Mileage			56,579	56,579
Air Temp °F			66	66
Gas Temp °F			372	426
HC ppm			110	0
O2 %			0.47	0
CO ppm			0	1
NO ppm			20	1
NO2 ppm			0	0
NOx ppm			20	1
CO2 %			10.5	10.9
Combustion Efficiency %			83.9	83
Losses %			16.1	17
Exc. Air			1.03	1
Sensor Temp °F			72	71
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2493 RPM's
Date			6/26/2008	6/26/2008
Mileage			58,962	58,962
Air Temp °F			81	80
Gas Temp °F			371	391
HC ppm			78	0
O2 %			0.28	0
CO ppm			47	0
NO ppm			0	2
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:			9/30/2008	
Fuel Type:			CNG/H2	
Deployment Start:			8/23/2007	
Vehicle Model:			Ford F-250 CNG	
Location of Operation:			Las Vegas, NV	
Vehicle #		2780		
	Pre Conversion		Post Conversion	
	@ Idle	2514 RPM's	@ Idle	2497 RPM's
NOx ppm			0	2
CO2 %			10.2	10.5
Combustion Efficiency %			84.4	84
Losses %			15.6	16
Exc. Air			1	1
Sensor Temp °F			82	81
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2493 RPM's
Date			9/26/2008	9/26/2008
Mileage			60,782	60,782
Air Temp °F			88	86
Gas Temp °F			371	388
HC ppm			59	6
O2 %			0.2	0.03
CO ppm			0	0
NO ppm			15	3
NO2 ppm			0	0
NOx ppm			15	3
CO2 %			11.1	11.2
Combustion Efficiency %			84.5	84.1
Losses %			15.5	15.9
Exc. Air			1	1
Sensor Temp °F			83	82

Emissions Comparison: Rev 2 [2007-4-20]				
<i>Data since inception of the program, all vehicles</i>				
Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		10/16/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2784			
	Pre Conversion		Post Conversion	
	@ Idle	2504 RPM's	@ Idle	2509 RPM's
Date	8/22/2007	8/22/2007	10/10/2007	10/10/2007
Mileage	65,997	65,997	65,997	65,997
Air Temp °F	75	74	76	76
Gas Temp °F	292	341	296	348
HC ppm	38	0	79	0
O2 %	0.16	0.01	0.32	0
CO ppm	49	61	0	24
NO ppm	1	1	23	1
NO2 ppm	0	0	1	0
NOx ppm	1	1	24	1
CO2 %	11.6	11.8	10.7	10.9
Combustion Efficiency %	85.9	84.9	85.8	84.8
Losses %	14.1	15.1	14.2	15.2
Exc. Air	1.00	1.00	1.00	1.00
Sensor Temp °F	80	79	82	81
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2499 RPM's
Date			12/12/2007	12/12/2007
Mileage			66,897	66,897
Air Temp °F			69	68
Gas Temp °F			280	351
HC ppm			66	37
O2 %			3.69	4.94
CO ppm			0	0
NO ppm			26	67
NO2 ppm			2	5

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		10/16/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2784			
	Pre Conversion		Post Conversion	
	@ Idle	2504 RPM's	@ Idle	2509 RPM's
NOx ppm			28	72
CO2 %			8.9	8.2
Combustion Efficiency %			85.2	83.1
Losses %			14.8	16.9
Exc. Air			1.23	1.3
Sensor Temp °F			76	76
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2505 RPM's
Date			3/27/2008	3/27/2008
Mileage			68,922	68,922
Air Temp °F			97	97
Gas Temp °F			236	271
HC ppm			10	0
O2 %			0.1	0
CO ppm			30	46
NO ppm			40	14
NO2 ppm			0	0
NOx ppm			40	14
CO2 %			10.8	10.8
Combustion Efficiency %			87.4	86.7
Losses %			12.6	13.3
Exc. Air			1.01	1
Sensor Temp °F			100	100

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		10/16/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2784			
	Pre Conversion		Post Conversion	
	@ Idle	2504 RPM's	@ Idle	2509 RPM's
Date			7/29/2008	7/29/2008
Mileage			71,388	71,388
Air Temp °F			85	83
Gas Temp °F			293	348
HC ppm			71	12
O2 %			0.26	0
CO ppm			0	no reading
NO ppm			3	4
NO2 ppm			0	0
NOx ppm			3	4
CO2 %			11.1	11.2
Combustion Efficiency %			86	84.9
Losses %			14	15.1
Exc. Air			1	1
Sensor Temp °F			100	99
	Pre Conversion		Post Conversion	
	@ Idle	xxxx RPM's	@ Idle	2483 RPM's
Date			9/26/08	9/26/08
Mileage			72,838	72,838
Air Temp °F			92	94
Gas Temp °F			280	301
HC ppm			5	1
O2 %			0.06	0
CO ppm			11	42
NO ppm			7	8
NO2 ppm			0	0

Emissions Comparison: Rev 2 [2007-4-20]

Data since inception of the program, all vehicles

Report Date:		9/30/2008		
Fuel Type:		CNG/H2		
Deployment Start:		10/16/2007		
Vehicle Model:		Ford F-250 CNG		
Location of Operation:		Las Vegas, NV		
Vehicle #	2784			
	Pre Conversion		Post Conversion	
	@ Idle	2504 RPM's	@ Idle	2509 RPM's
NOx ppm			7	8
CO2 %			10.7	10.8
Combustion Efficiency %			86.4	86
Losses %			13.6	14
Exc. Air			1	1
Sensor Temp °F			104	104