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CONVERSION OF PETROL ENGINE TO LPG SYSTEM (Dual Fuel System)

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ABSTRACT

Pollution from automobiles has been great concern all over the world

Also the increasing demand of energy has soared up the prices of controlling it.

Researchers are being carried out throughout the developed and developing

Countries to find alternative source of energy which is cheaper, available and less polluting.

Petrol engines are one of the large sources of environment pollutants. In

Different parts of the world petrol has been replaced in the internal combustion

Engines (such as cars), with, Hydrogen, LPG and etc.

LPG as a fuel for automobiles doesn't seem to reduce the performance of the engine but has greater values in respect to environmental effects, financial saving and to the availability in this part of the world.

Introduction

The rate of consumption of liquid fuel in automotive vehicles is growing fast and it is surprisingly true that the burning of these fossil fuel is one of the major causes of air pollution resulting to global warming due to green house effect As the dependency on these limited resources are on the increase, economists and environmentalist are greatly concerned to find an alternative.

Practical alternative for liquid fuel such as petrol and diesel has been already studied and implement in certain part of the world, LPG (liquid petroleum gas) could be a substitute for the petrol.

LPG delivers roughly the same power, acceleration and cruising speed characteristics as gasoline. It dose yield somewhat reduced driving range, however, because it contain only about 70-75% of the energy content of gasoline.

Its high octane rating (around 105) means, though that an LPG engine's power output and fuel efficiency can be increased beyond what is possible with gasoline.

The total conversion of gasoline or petrol engine to another type of fuel could not be possible for all automobile users but with little alteration and minimum cost direct use of LPG for a petrol engine would be affordable most of the automotive vehicle owners.

This project emphasis on the alteration of petrol engine to uses LPG as a single fuel and as dual fuel system.

The project looks into the simplicity of dual fuel system and the cost effectiveness and the availability of LPG. In regard to this, LPG is available in most of the unban of a country where other types of alternative fuel would be hardly accessible.

I — PETROL ENGINE

PETROL ENGINE

a) Types of Petrol Engines :-

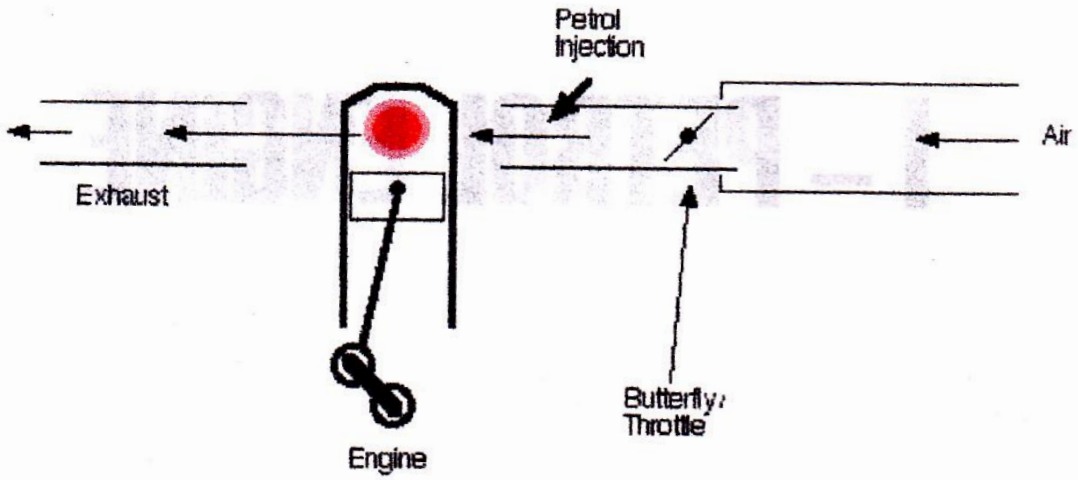
Petrol is the most widely used fuel for automotive engine. It is a hydrocarbon (HC) made up mostly of hydrogen (H) and carbon (C).

There are two types of petrol engines:-

1- Fuel-injection.
2- Carbureted.

The different in how they measure or meter the fuel to produce the desires air-fuel ratio.

Figure 1: Generalized working principle of petrol engine



Source: How LPG system works, http://www.dotslashslash.com/

The carburetor petrol engine uses a carburetor as a mixing device that mixes fuel (petrol) and air to form the air-fuel mixture.

The fuel injection type uses fuel-injection valves or fuel injectors. Thy spray or “inject” fuel into the air to produce the combustible mixture.

Both types include fuel tank, fuel level indicator, fuel lines, fuel pump, fuel filter, air cleaner, throttle body and intake manifold.

Except how the fuel is metered, both basically operate the same way. The fuel tank holds a supply of fuel.thw pump delivers fuel fro, the tank through the filter and lines to the carburetor or fuel injectors. The air cleaner filters the air entering the engine.

The throttle body regulates how much of the cleaned air enters the intake manifold. The intake manifold then caries the air (or air-fuel mixture) to the engine cylinders.

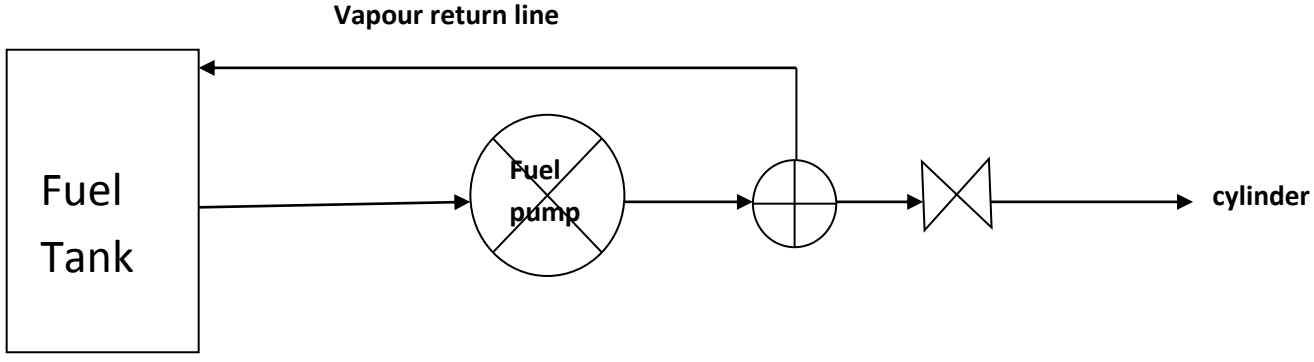
b) CARBRETOR SYSTEM:-

The carburetor is mixing device that supplies the engine with a combustible air-fuel mixture. The basic parts of the carburetor are air horn, venture, the float bowl and the throttle body

The century is a restricted space through which the air entering the engine must pass. The air movement produces a partial vacuum in the venture called venture vacuum.

The resulting pressure differential causes fuel to discharge from the nozzle into the intake air. This produces the air-fuel mixture for the engine.

Figure 2: major components of carburetor system and fuel circuit



c) FUEL INJECTION SYSTEM:-

The fuel –injection system supplies the engine with a combustible air-fuel mixture. It varies the richness of the mixture to suit different operating.

There are two types of fuel injection system

1. Port fuel injections (PFI) which has an injection valve or fuel injectors in each intake port.
2. Throttle-body fuel injection (TBI) in which one or two fuel injectors are located above the throttle valves.

With either systems, the electric fuel pump supplies the fuel injectors with fuel under pressure. As soon as the injector opens, fuel sprays out. An electric solenoid in the injector opens and closes the valve.

Air is about 20 percent oxygen (O) and 80 percent nitrogen (N). With "perfect combustion",
The petrol burns completely. All the hydrogen in the petrol unites with oxygen in the air. This forms hydrogen oxide (H_2O), or water vapour. All the carbon in the petrol unites with oxygen in the air to form carbon dioxide (CO_2). Both of which are harmless.

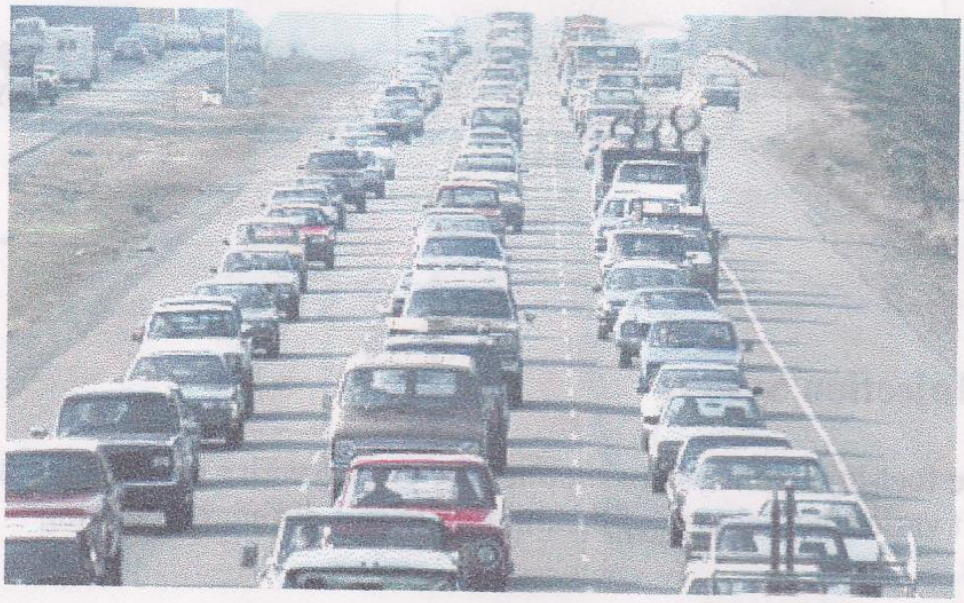
However, incomplete combustion occurs in the automotive engine. Some hydrocarbon (HC) vapour dose not burn or burns incompletely.

It leaves the cylinder as part of the exhaust gas along with the carbon monoxide (CO) and nitrogen oxides (NO_X). the engine exhaust gas always contains some HC, CO, and NO_X.
The chemical equation below shows what happens during combustion:

$$HC + N + O_2 = CO_2 + NO_X + HC$$

Carbon monoxide (CO), hydrocarbon (HC) and nitrogen oxides (NO_X) are pollutants.
The pollute the air we breath.

Figure 3: Conventional fuels contribute to greater air pollution



Source: LPG a healthier world, http://www.eco-drive.co.uk//

II – LIQUEFIED PETROLIUM GAS (LPG)

”as a taxi driver, fuel cost is a major consideration. I can’t understand why everyone isn’t runnung on gas”

LIQUEFIED PETROLIUM GAS (LPG)

a) What is LPG?

Liquid petroleum Gas (LPG) is essentially propane .The same fuel that is used for central heating when mains gas is not available fork-lift trucks and for other commercial and agricultural propane or Commercial Butane and under a variety of other labels. The current naturally and also is a by-product of the oil refinement process

The LPG used in vehicles is the same as that used id gas barbecues and camper appliances. LPG is also used in many homes use LPG for heating, cooking, hot water and other energy needs.

Table 1: products of Complete Combustion

Carbon dioxide (cubic ft/ meters)	30 per c. ft/mtr of gas
Water (Ib./kg)	1.6 per Ib/kg of gas
Water Vapour (cubic ft/meters)	4.0 per c.ft/mtr of gas
Nitrogen (cubic ft/meters)	18.5 per c.ft/mtr of gas
Nitrogen (Ib/kg)	12.0 per Ib/kg of gas
Ultimate carbon dioxide percentage by volume.	13.9

b) LPG As Engine Fuel.

LPG can and are being used as engine fuel in many automotive vehicles.

There are number of reasons why LPG is used as engine fuel. It offers a performance comparable to petrol, in top-end speed, acceleration, and refill times. The big difference when comparing fuels us the large reduction in emissions.

LPG delivers roughly the same power, acceleration, and cruising speed

Characteristics as gasoline. It does yield a somewhat reduced driving range, because it contains only about 70-75%o of the energy content of gasoline. Its high octane rating (around 105)means though, that an LPG engine ‘s power output and fuel efficiency can be increased beyond what would be possible with a gasoline engine without causing destructive “knocking” Such fine-tuning can help compensate for the fuel’s lower energy density.

As an automotive fuel, gas is as safe , if not safe than petrol. It is stored under a relatively low pressure (around 150 psi),in a 6mm steel pressure vessel. These tanks are constructed to take a major impact without penetration. Id struck as high speed, they will absorb the blow, and alter shape while maintaining structural integrity. The use of LPG as an alternative fuel has many economic, social and environmental advantages. The fuel is cleaner than petrol or Diesel.

The octane rating for LPG is very high compared to other fuel (LPG 95110 octane
Regular-grade petrol has 92 octane and premium-grade petrol has 95octane Reduced vibration in LPG car engines means longer engine life .As LPG is a gas in the engine, it does not wash away oil from the cylinder walls. Internal engine deposits are less for all new or least healthy, petrol engines, so engine life is substantially increased due to reduced wear and tear on your engine.
This also means that you do not have to replace lubricating oils as frequently as on conventional engines. Crash and fire tests show that LPG tanks are safer than petrol. If you spill LPG, it evaporates rather than soaking into and polluting the ground.

C) LPG Engine Emissions (Issue of Environment and pollution)

LPG is a world-wise, environmentally friendly, fuel and is comparatively clean both from the standpoint of carbon emissions and low hydrocarbons(70%of those of petrol) , but equally importantly contains no PM10 toxic

Pollution /poison (smuts) most often ignored when comparisons are made with diesel engine (it is the black stuff that you see coming from even the newest diesel vehicle tail pipes).

Many propane vehicles are converted gasoline vehicles. LPG engines produce 75% less Carbon Monoxide than petrol and have 87% less Ozone forming potential.

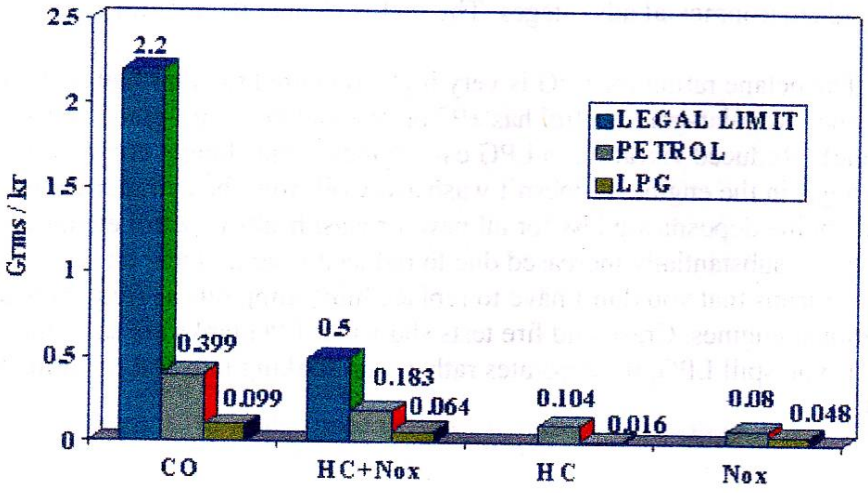
The following table below gives a comparison of ;LPG emission with petrol and diesel.

TABLE 2: COMPARISON OF LPG WITH PETROL AND DIESEL.

Emissions	***Petrol up to***	***Diesel up to***
Carbon Monoxide	63% less	-
Hydrocarbons	40%less	70%
Oxides of Nitrogen	82%less	99%
Carbon Dioxide	13%less	-

Particulates	50%less	98% less

Figure 4: Comparison of emissions with Petrol and LPG



Source: http://www.whitespotlpg.co.uk/lpg_detail.htm

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table 3 : exhaust gas analysis for a concerted petrol engine to dual fuel system (LPG and petrol.

Data:30/3/2009 Mileage: 156803	Time: 10:27:48 Make: toyota corolla	Reg no. AEZ012 MOSLE:EE90-AEKDS
Fuel Type	CO Level	HC Level
Unleaded gasoline	5.02%	207ppm
LPG	4.28%	805pmm
Diagnosis limits	4.50%	1200ppm

The results obtained from the exhaust gas analysis as shown in the table below shows a high percentage of unburned Hydrocarbon (HC) compared to petrol. This may be due to the fact that the idle fuel adjustment being high. It should be rectified and exhaust gas analysis should be repeated. The high percentage of CO in petrol, over the limits and relative high percentage of CO from LPG is an indication for the above mentioned reason.

d) LPG conversion Cost Analysis

One of the most important reason using LPG as fuel is that it is lot cheaper and it is most likely to remain that way for some considerable time as the environmental pressures. It saves about 50% on fuel costs. The outlay of the conversion cost can be easily recouped in around 5-6 months, covering an average yearly business mileage.

The relatively inexpensive an expensive conversion kit (in figure) cost about Taka 6000/- Compared to the cost savings by running on LPG this amount can be recovered within months after conversion.

In India the cost of conversion in case of imported kits varies from Rs 7000 to Rs 11000 .locally made kits are available at as low as Rs 5000.

Table-4: Cost saving by a Taxi running on LPG

Single Business User	
Company:	Bop Band-Station Taxi's

E- MAIL:	Bob @ rband. Demon.co. uk	
Vehicle (s) running gas:	Company Vehicle (taxi)	
Savings*:*	Annual Fuel bill BEFORE gas:	180 per week
	Annual Fuel bill AFTER gas	120 per week
	Total Saving:	60 per week

Source: http://www.whitespotlpg . co. uk /lpg_detail. htm

A quote from customer**:"As taxi driver, fuel cost is a major consideration. I can't understand why everyone isn't running on gas"**

e) storage and safety

LPG is easy to store as a liquid at+_ 6 bar. (relatively low pressure and relatively very safe). It is stored under a relatively low pressure(around 150psi),

In a 6mm steel pressure vessel. These tanks are constructed to take a major impact without penetration. If struck at high speed , they will absorb the blow, and alter shape, while maintaining structural integrity. This ,makes low cost tank options available, and allows good levels of fuel storage capacity

Propane is an odorless, ,nonpoisonous gas that gas the lowest flammability range of all alternative fuels. High concentrations of propane

can displace oxygen in the air, though, causing the potential for asphyxiation. This problem is mitigated by the presence of ethy1 mercaptan, which is an odorant that is added to liquefied gas becomes very cold upon escaping from a high pressure tank, and may therefore cause frostbite, should it contact unprotected skin. As with gasoline, LPG can form explosive mixtures with air. Since the gas is slightly heavier than air, it may form continuous stream that stretches a considerable distance from a leak or open container, which may lead to a flashback explosion upon contacting a source of ignition.

f) Safe Handling of LPG

the two liquefied petroleum gases which are generally available in the UK are Commercial Butane and commercial propane as defined in BS4250

The combustion of LPG produces carbon dioxide (CO_2) and water vapor, but sufficient air must be available. Inadequate appliance flueing and/ or ventilation, or poor air-gas mixing(for example; doe due to lack of servicing) can result in the production of toxic carbon monoxide.

Everyone concerned with the storage and handling of LPG should be familiar with the following characteristics and potential hazards:

a) LPG is stored as a liquid under pressure. It is almost colorless and its weight is approximately half that of an equivalent volume of water
b) LPG vapor is denser than air: butane is about twice as heavy as air and propane about one and a half times as heavy as air. Consequently the vapor may flow along the ground and into drains, sinking to the lowest level of the surroundings and be ignited at a considerable distance from the source of leakage. In still air vapors will disperse slowly .

c) LPG can form a flammable mixture when mixed with air. The flammable range at ambient temperature and pressure extends between approximately 2% of the vapors in air at its lower limit and approximately 10% of the vapors in air at its upper limit. Within this range there is a risk of ignition . outside this range any mixture is either too weak or too rich to propagate flame. However, over-rich mixtures can become hazardous when diluted with air and will also burn at the interface with air. At pressures greater than atmospheric, the upper limit of flammability is increased but this increase with pressure is not linear.

d) Escape of even small quantities of the liquefied gas can give rise to large volumes of vapor/ air mixture and thus cause considerable hazard. A suitably calibrated explosimeter maybe used for testing the concentration of LPG in air. A NAKED FLAME SHOULD NEVER BE USED TO SEARCH FOR A LEAK

e) At very high concentrations in air, LPG vapor is anesthetic and subsequently an asphyxiate by diluting or decreasing the available oxygen.

f) Commercial LPG is normally odorized before distribution by the addition of an odorant, such as ethy1 mercaptan or dimethy1 supplied, to enable detection by smell of the gas at concentrations down to one-fifth of the lower limit of flammability(i.e. approximately 0,4% of the gas in air).
However , in certain cases where the odorant may be detrimental to a process (for example in aerosol applications) the LPG is not odorized.

g) Escape of LPG may be noticeable other than by smell. When the liquid evaporates, the cooling effect on the surrounding air causes condendation and even freezing of water vapor in the air. This effect may show itself as frost at the point of escape and thus make it easier to detect an escape of LPG. Because the refractive index of LPG differs from air, leaks can sometimes be seen as a ‘shimmering’ .

h) Owing to its rapid vaporization and consequent lowering of temperature, LPG, particularly liquid , can cause severe frost burns if brought into contact with the skin. Personal protective equipment(e.g. hand and eye protection) should be worn if this hazard is likely to occur.

A container which has held LPG and is 'empty' may still contain LPG in vapor form and is thus potentially dangerous. In this state the internal pressure is approximately atmospheric. If a valve is leaking or is left open, air can diffuse into the container forming a flammable mixture and creating a risk of explosion: alternatively, LPG can diffuse to the atmosphere .

Note : these properties are general characteristics of LPG, and items such as(h)
Should not occur in normal cylinder usage.

g) Availability of LPG

compared to other engine fuels LPG can reach almost any remote rural areas. LPG cylinders are used for cooking , heating and so on. These cylinders can and are used as fuel tanks in converted LPG vehicles.(see figure 4)

special tanks like those which can be filled from filling stations similar to petrol filling stating stations would find difficulty in re

filling if a good refilling infrastructure has not been set up. A chaos like what is found in Dhaka city for refueling CNG would arise.

III_OTHER TYPES OF ENGINE FUELS

III. OTHER TYPES OF ENGINE FUELS

a) liquefied Natural Gas, LNG

LNG is 90-100% pure methane that has been cooled to -259 F at

Atmospheric pressure. LNG weighs less than half as much as the same volume

Of water. Water (8 ib./gal); LNG(3.5 ib./gal). One (1) ft3 of LNG is

Approximately 618 ft3 of natural gas. Doesn't leave any contamination in the soil Or water if spilled.

Gas is liquefied by cooling it to -160 Celsius (-260F) at atmospheric

Pressure. Why bother? Because LNG occupies 1/600th the volume of natural gas

At atmospheric temperature and pressure. The high energy density of LNG makes

It useful for energy storage in double-walled, vacuum-insulated tanks.

LNG account for about 4% of natural gas consumption worldwide, and

Is produced in dozens of large-scale liquefaction plants. These are operated by Distribution utilities for seasonal storage and by companies that ship natural gas By tanker across oceans.

Because LNG is a relatively new fuel for trucking, many existing

Liquefaction plants aren't designed to serve the need of trucking and aren't

Located in places convenient for truck refueling. As LNG becomes more widely

Used for vehicles, production facilities will change to accommodate this

Economic activity.

In addition, the prospect of LNG as a fuel for vehicles has spurred

Development of new small-scale liquefaction technology by companies like

Westport's strategically cry fuel system inc. of Monroe, Washington. Cry fuel

Technology is designed to produce LNG from landfill (garbage dump)gas or

From pipeline gas in areas where large-scale liquefaction is not available.

b) Hydrogen

Hydrogen sound like the perfect fuel until you try to make it or store it.

In theory a non-polluting source, in the practice it has to come from somewhere and

Guess what-commercially available hydrogen is usually made from petroleum-

Derived methane. In the laboratory it can be made by breaking water molecules

Into its component hydrogen and oxygen, but it that takes huge amounts of

Energy, far more than you recover when you burn the oxygen and hydrogen later

For power. Even with a perfect storage medium and 100% efficient fuel cell, you

Might as well simply store the energy you'd use for wrestling with hydrogen

Atoms and use it directly to do the work you originally intended. One pound of

Hydrogen contains 36KWH. Its volume depends on the storage medium.

Hydrogen fuel cell technology is relatively new and companies cite

Refueling infrastructure and hydrogen generation and storage concerns as the

major hindering factors. It is very costly.

c) Methanol

Methanol (and ETHANOL) is pretty powerful stuff; at 23KWH a gallon similar

Enough to gasoline; 16 gallons of methanol has the same energy as 10 gallons of

Gasoline. it can also be produced from fermentation of organic matter, and

Apparently in Brazil lots of commercial fuel alcohol is , making it a renewable

Energy source there. In the U.S. most methanol production is from petroleum and

lumber-industry by-products. Its attractive as a motor fuel because its fits in

Existing fuel-dispensing systems and equipment, but not a very clean.

d) compressed natural Gas (CNG)

Advantages

Compressed natural gas is like LPG in many ways. It is very easy on the

Engine, giving longer service life and lower maintenance costs. CNG is cheap

Alternative fuel when you compare equal amounts of fuel energy.

The high octane rating of natural fast allow the CNG-powered Honda

Civic GX to use a very high compression ratio and produce more power than

Stock gasoline versions. In addition because natural gas is lighter than air and has

Very narrow flammability limits, if a leak develops it is very likely than the fuel

Will dissipate harmlessly into the air without causing a danger of ignition or

Explosion.

Natural gas has over the course of the 1990's proven to be the most

Effective fuel for reducing emissions in an internal combustion engine. The 1993

Doge full-size CNG vans were the first vehicles to meet the California low

Emission vehicle (LEV) standards the 1994 Chrysler/dodge CNG minivans

Were the first to meet the ultra-low emission vehicle (ULEV) standards; the

1997 ford CNG pickups and vans were the first to meet the super ultra-low

Emission vehicle (SULEV) standards and the 1998 CNG Honda civic GX was

The cleanest internal combustion engine vehicle ever tested by the EPA.

Disadvantages

The tanks are quite bulky and heavy about three times more so than LPG

Tank. Range is significantly less than for an equivalent gasoline gasoline vehicle, unless

You really go overboard adding extra fuel tanks! And again mostly because of

The heavy-duty tanks, there is currently a large price premium for a CNG vehicle

Compared to a gasoline version ($3000-5000). The fuel and maintenance cots

Can be enough cheaper. Finally the refilling infrastructure is still growing

as one would see long line of queues at CNG filling stations in Dhaka.

IV- LPG CONVERSION

IV. LPG CONVERSION

a) Required Components

LPG Tank

Tanks are available in two configurations – Cylinder and Ring Tanks. Each configuration is available in many different sizes and dimensions so that it can be fitted to each vehicle in the most convenient place. A ring tank for example can often be installed in the spare wheel well of a vehicle so that it does not encroach on boot space.

For larger vehicles, it is possible to give more than one tank installed to give a greater range. For example, many Range Rovers are well suited to having two smaller tanks mounted underneath the vehicle, and one in the boot space to increase the carrying capacity of LPG.

Figure 5: Different kinds of LPG tanks

Commercially available LPG cylinders

"Torpedo" and "Donut" tanks.

It is note worthy that LPG exists in its liquid form inside the tank and that 20% of a tanks capacity is unused to allow for gas expansion, hence a 60 litre cylinder tank for example will hold 48

liters of usable LPG. Safety is an integral part of tank design and is catered for by the…

. LPG shut off solenoids

(Ultimate system safety is ensured by defaulting to the system being shut down as installed default, with the LPG solenoids shut unless all three are supplied with voltage. Only available with ignition on, with engine running and with input –both electrical and engine vacuum – required).

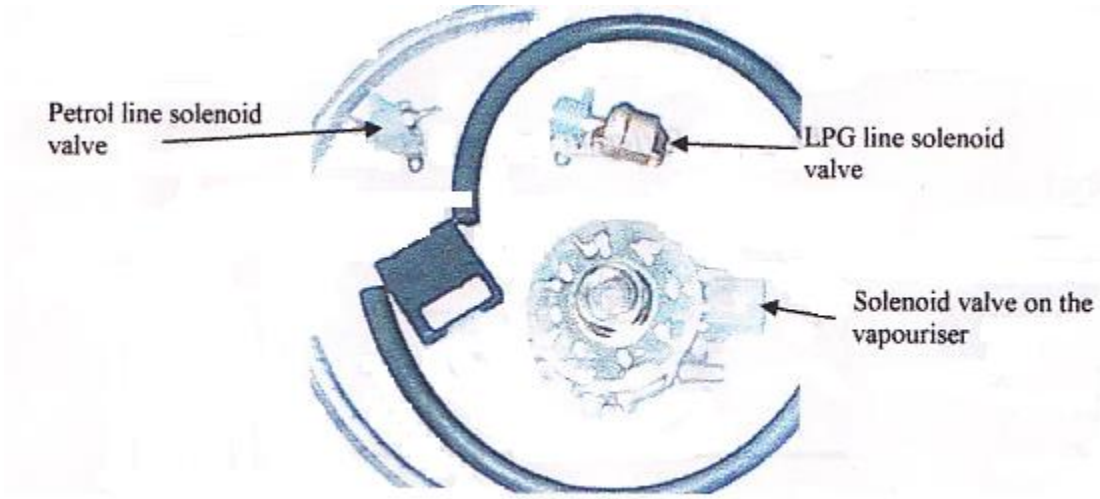
Tank solenoid: Electronic and default is closed, Allows for refueling with LPG through the filler socket with automatic closure at 80% of total tank capacity by means of a mechanical device operated with a float.

LPG Filter Solenoid: Electronic and default is closed, Ifrequired allows simple disconnection of LPG pipe from tank to filter in the engine bay and is only open when engine is running and switched fuel mode is LPG .

LPG Filter Solenoid: Electronic and default is closed. If required allows simple disconnection of LPG pipe from tank to filter in the engine bay and is only open when the engine is running and switched fuel mode is LPG

Vaporiser Solenoid: Electronic and default is closed, If required allows simple disconnection of LPG pipe from filter to vaporizer in the engine bay and is only open when the engine is running and switched fuel mode is LPG.

Figure 6: solenoid valves



.Regulator/vaporizer

Regulator is to vaporize the liquid gas and regulate the amount of LPG that goes to the engine. (The regulator working principal is not dissimilar to the basic functions of a Divers Breathing Mask (demand valve) in operational terms).

When the engine is operating on gas LPG oasis sown the fuel line,

Through the Solenoid Valve and into the Regulator. This is an electronic control device which reduces the LPG passes down the fuel line through the Solenoid Valve and into the Regulator. This is an electronic control device which reduces the LPG pressure and vaporizes it, thus allowing a regular flow of gas whenever the engine requires it.

Figure 7: Regulator / Vaporizer

Source: ECOGAS System Ltd. Unit6 waterloo Industrial Estate Bedford-on Avon Warwickshire B50 4JH ,http://www. ecogas. Co. uk.com; LPG vehicles, http://www. Lpg-vehicles. Co.uk/

Vaporization of the LPG from the liquid to gas phase takes place by a drop in pressure and by absorption of heat from the regulator, which is heated by liquid from the engines own cooling circuit. A separate LPG pipe provides the
Flow of gas necessary for engine idling and this can be adjusted to alter the idle speed when operating on gas. The regulator also includes an electronic starting device with a built- in safety system that trips and shuts off the gas solenoid valves if the engine is switched off or even stalled.

The idle mixture adjustment screw is located on the vapouriser.

.Mixer

The mixer is mounted in the intake manifold, where it meters the flow of gas according to the requirement of the engine

Figure 8: Different designs of mixers

Source: ECOGAS System LTD. Unit 6Waterloo Industrial Estate Bidford-on Avon Warwickshire
B50 4JH, gttp://www.ecogas.cou.com

Each mixer is designed for a specific vehicle and works in conjunction with the Regulator and the LCS Computer to optimize both gas and petrol operation.

. Switch and LPG Gauge

The switch is discreetly mounted somewhere conveniently on the dashboard, and allows simple switching between LPG and petrol operation without any need to cut the engine or stop the vehicle.

Figure 9: Switch and LPG Guage

Source: ECOGAS System Ltd. Unit6Wateloo Industrial Estate Bidford-on Avon Warwickshire
B50 4JH, http://www.wcogas.co.uk .com/

A row of four green LEDs and one red (indicating reserve) on the switch indicate the amount of LPG in the tank (s)

. Other Fittings, nuts and bolts

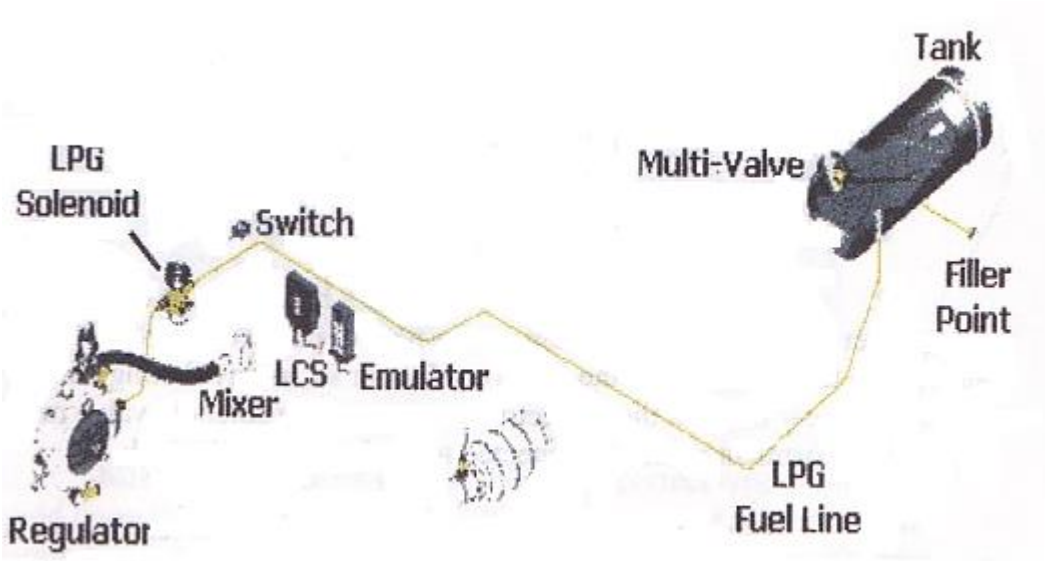
Brackets, stainless steel tank straps (where appropriate), tubing, LPG

Supply, filling lines and gas-type tubing, filer, instructions and adapter's code.

b) Conversion to LPG (Dual Fuel System)

Conversions differ from vehicle depending on the type (e.g. carburetor, injection, with CAT, turbo etc.) and various other factors. Generally however. The simplest form of conversion which could be carried out in a small garage is discussed here.

Figure 10: A typical converted LPG system



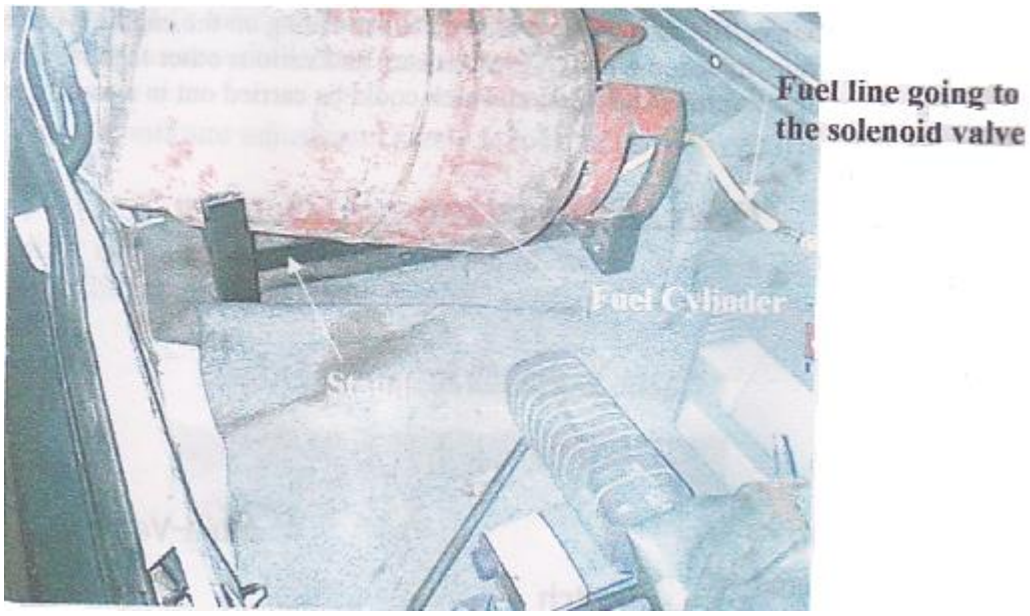
Source: ECOGAS System Ltd. Unit6 waterloo Industrial Estate Bid ford-on Avon Warwickshire

B50 4HJ, http://www.ecogas.co.uk .com/

1. Mounting the tank will be the hardest part; gasoline tanks are made-to-fit the car and LPG tank don't come in such convenient should be placed on a stand which would restrict the movement of the cylinder from jerks. From the cylinder a connection should be

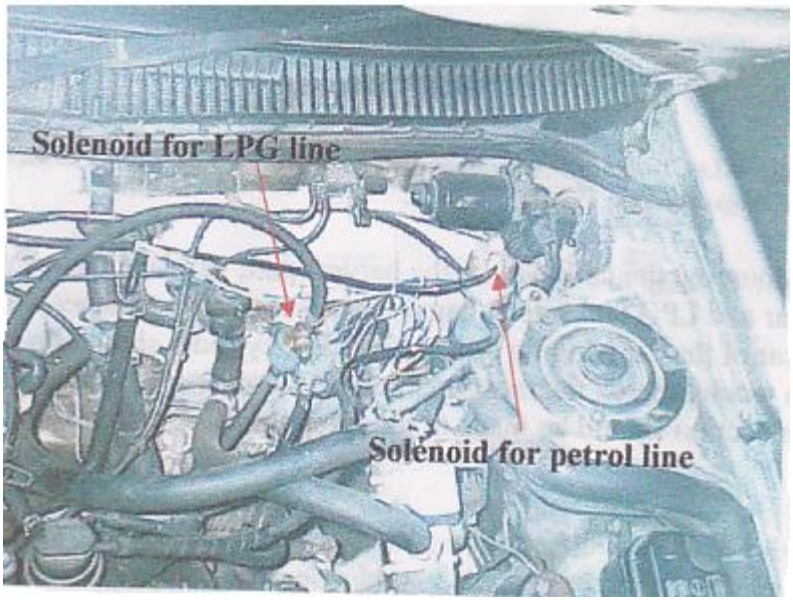
Made to the solenoid valve by reinforced flexible hose.

Figure 11: showing position of LPG cylinder



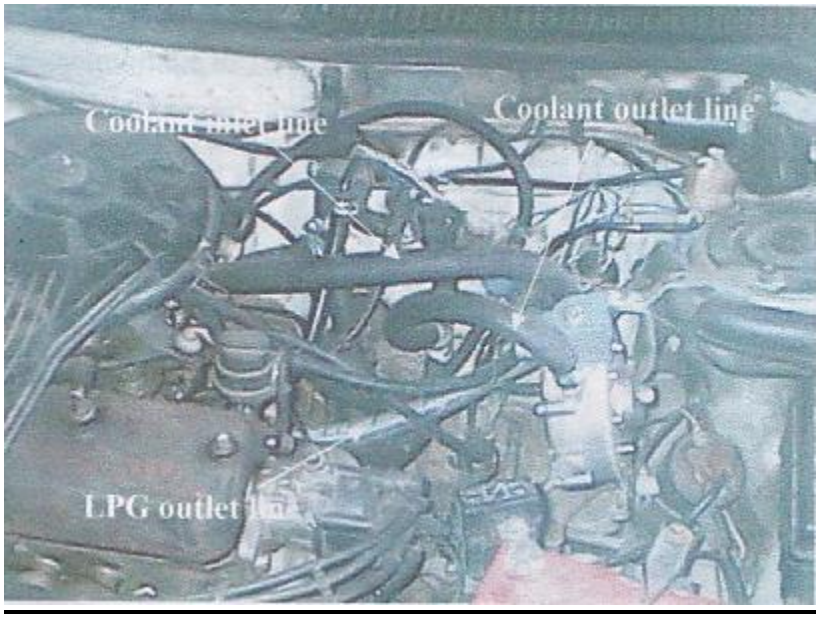
2. Running the LPG hose requires a bit of care. Make sure that it doesn't get exposed, while running over a rock or curb could crush it, and should attach it to the underside of the car every foot or so, as any flexing will eventually wear through the protective covering. The solenoid valve in the engine compartment must be connected to the hose from the tack.
3. Mount the regulator as low as possible, (less sensitive to coolant level) and close to the carburetor, with a one foot section of hose between the filter and regulator, and an 18 inch piece of vapor hose to the carburetor. (For most installations you can simply connect the filter/ shutoff and regulator/converter together as a unit with short pipe nipple instead of hose

Figure 12: solenoid connection to the fuel lines

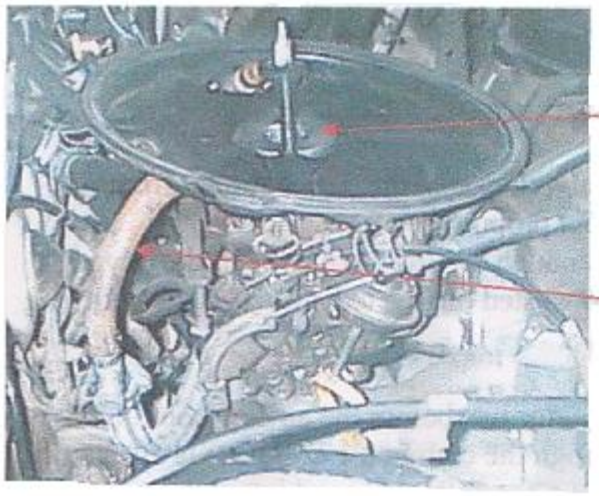


4. The water connections aren't fussy; as long as get decent water flow, and keep the radiator full.

Figure 13: Connections to the regulator



5. Mixer installation is simple. Place the correct type of mixer which would fit on the carburetor properly. It's far shorter and more compact than a gasoline carburetor, so there will probably be on interference with other components



6. The switch should be fixed on the dash board or any convenient place inside the car. Electrical connection must be made to the switch from the petrol line solenoid and the LPG fuel line solenoid.

Note: Maximum performance, simplicity and economy will be achieved with the single fuel setup but will cone an higher price than the conversion explained above.

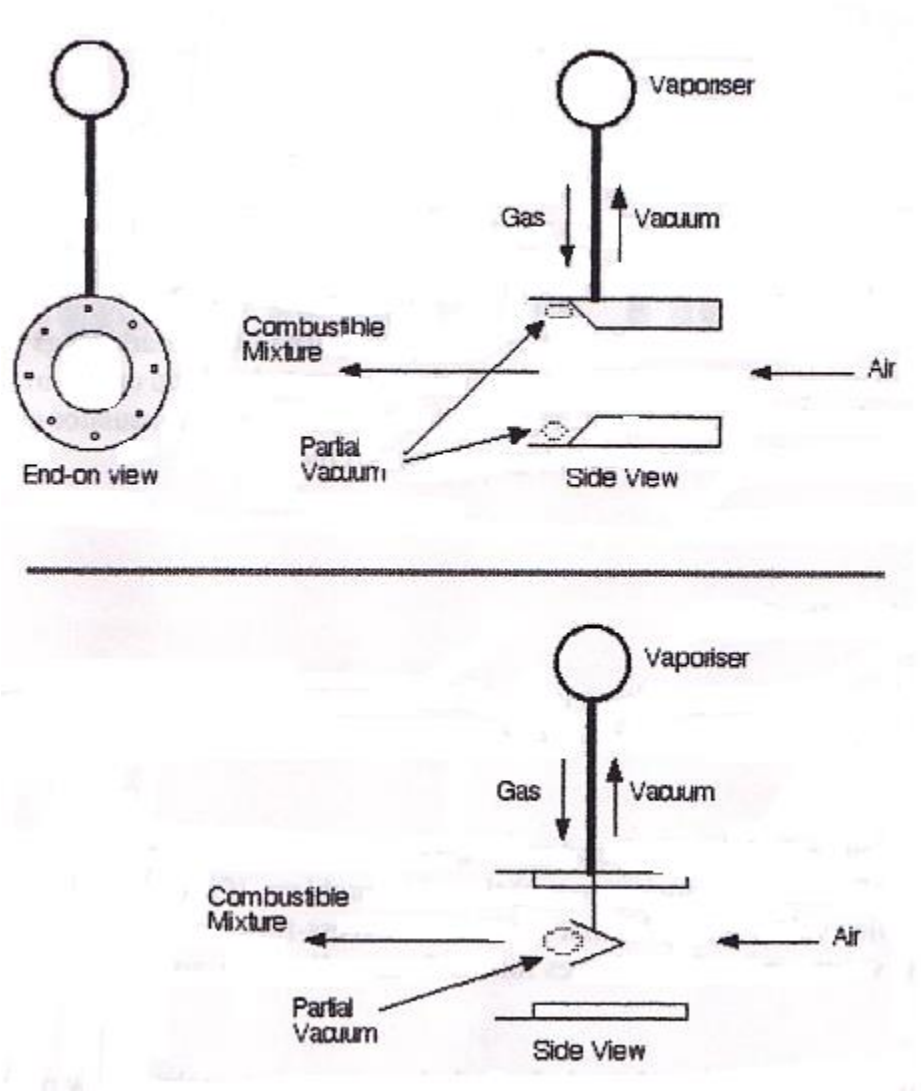
c)How LPG System Works

LPG systems do two things: Firstly, they stop the petrol system from working. Secondly, they inject the correct proportion of gas given the instantaneous airflow, such that there's enough LPG to burn with all the oxygen in the air, without any left unborn to go wasted out the exhaust. That's the idea anyway.

The mixer fitted above the carburetor jest before the airflow control valve mixes the LPG with the air flowing through the carburetor. A mixer is essentially a tube which the LPG with the air flows through. It has a carefully designed internal profile though, such that the air initially flows through a medium diameter hole, which then expands to the maximum internal diameter of the tube as the airflow continues. Since air has momentum, this creates a partial vacuum at the expansion point. This vacuum is proportional to the airflow rate, and it ids this that LPG systems use to meter the meter the amount of gas joining the airflow.

Just at this expansion point there are some small holes in the inside of the mixer. These pick up the partial vacuum and send this back along a pipe to a "vaporizer". The vaporizer hex a large diaphragm in it which response to the amount of vacuum in the mixer. As this vacuum (i.e. airflow rate) increases, the diaphragm is pulled on (since the other side of it is referenced to normal atmospheric pressure), and this opens a progressive valve which is controlling how much LPG is allowed in , and so more LPG is expanded to gas. This gas goes back down the same tube, into the mixer

joins the airflow, and goes off into the engine to be burnt in the same way as petrol.



Source: How LPG system works, http://www.dotslashslash.com

Note that the lower part of the above diagram shows a second kind of mixer, which uses a suspended cone pointing into the airflow as means of creating

d) Starting It UP!

First, use plumbers' bubble-leak detector or soap solution to check for leaks.

1. Open the LPG liquid valve, and look, listen and smell for leaks. A squirt of soap at all connectors helps. If there is any leak, try tightening a bit; if a little is good a lot is not better; it'll just wreck things. Check for leaks up to the filter/shutoff.
2. Star the car—no fancy preliminaries. The regulator/converter will purge itself of air, and it should start within 5-10 seconds. The throttle must be opened a small amount. The idle speed and mixture has to be adjusted.

3. At this point, check for leaks after the filter/shutoff

4. Tune up the car normally. No special settings are required, and for emissions/legal purposes, none desired. Set the ignition timing dead stock. If the car was previously in tune, all you should need to do is set the idle mixture and speed on the new carburetor.

5. After a thousand miles or so, check the spark plugs. Spark plugs will last considerably longer, as there are no fuel additives to build up on the insulator during combustion. Check for the right heat-range plug—if the insulator color is too white, or if it looks burnt, get plugs one range colder.

e) Typical Problems

There are some problems unique to LPG fuel systems, and because the components are mechanical devices, they can fail. Some tips on troubleshooting and repair are;

In general, if frost is found on LPG components (liquid service valve, filter/shutoff, and regulator/converter) there is a problem. If it happens to the liquid service valve, it may be that the internal excess-flow safety valve snapped. Close the valve, wait a few minutes for the frost to dissipate, and reopen the valve.

If the converter/ regulator is frosted, there is engine-coolant flow problem. Assuming it's installed properly, it probably means low coolant level m a loose water pump fan belt, bad water pump, or other mechanical failure. Normally the converter/ regulator run about as hot as the radiator.

V – POTENTIAL OF LPG ENGINES IN THE FUTURE

V . POTENTIAL OF LPG ENGINES IN THE FUTURE

There's no doubt about it, if we were all zipping around in gas-powered cars the world be a cleaner, greener place. This is not as implausible as it might first sound. Gas petroleum (LPG or liquefied petroleum gas) is a reality. And has been for many years. It's half the cost of conventional petrol or diesel, the emissions are less harmful and just about any normal car can be converted to run on gas. So far the roll-out has been rather sluggish but parts of the motoring world are starting to sit up and take notice. So, given the benefits of LPG, also commonly known as "auto gas", will it eventually see off old fuels like petrol and diesel?

LPG is very common in certain developed countries. All the taxis in TOKYO run on auto gas. In Italy more than a million vehicles accept gas; there are almost half-a-million in Australia and 360,000 in the Netherlands.

Given below is a case study of LPG converted vehicles.

Care and vans

Thales

"With group fuel costs of several million Pounds per annum, exploring ways of reducing Costs is a continuous exercise. Having already Cut fuel costs by over 50%, saving thousands of Pounds a year on those vehicles converted to LPG, the decision to increase our bi-fuel fleet is An obvious one. " .

Nigel Rowden, Fleet, Thales Group

Chauffeur Link

” we can buy Calor Auto gas at less than half The pica of petrol, and on average it takes just Three months to recover the cost of conversion.

Over the remainder of the Manager life of the Vehicles, we save thousands of pounds in fuel Cost.”

Keith davis, managing director, chauffeur

Link .

Budget Rent A Car

”the first ever gas-powered cars available for Hire are not only cleaner, but have the added Advantage of being more cost efficient for Business and leisure travelers due to their Lower refueling costs. ”

Roddy Graham, Sales & Marketing

Directory, Budet Rent a Car

Bell glass

”from years of experience running our vehicles On Calor Autogas, we are fully aware of the Benefits: substantial cost savings, especially on the cost of the fuel, and reliability.

Our cans have proven themselves to be more than capable of conversing extensive mileage and with less normal wear and tear.”

Paul Martin, Director, Bell Glass

Buses

Chester council

“Running Calor Autogas buses on one of Chester’s busiest park and ride routes has certainly helped to draw attention to the advantage of Calor Autogas as an alternative fuel, as well as contributing to a reduction in harmful emissions along a key route into the city. ”

David Lewry, Policy & Projects Officer,

Chester County Council .

Guide Fridat Tour Buses

”we have converted nearly 30 of our buses running on daily scheduled services in Stratford upon Avon. Edinburgh, Dublin, Lincoln, and York. Quieter than those running on diesel and the fuel are much cheaper.”

Davis Limpet, Engineering Director, Guide

Friday.

Mowers

The threat of new emissions legislation And congestion taxes is becoming ever More real and will have significant Effects on Local Authorities and businesses operating in city and town centers.

And with fuel prices fluctuating daily, operating costs are difficult to manage and control.

If you're responsible for keeping parks and gardens in order, LPG powered Ground care machinery can help you cut Emissions and cut your operating costs.

Forklift

High profits, Low emissions. It's no wonder sales of LPG powered forklift trucks are rising.

Ideal indoors and out, clean, green, Calor LPG powered FLTs stop for nothing.

They work hard, 24/7. They take slopes and uneven surfaces in their stride. They operate effectively when temperatures are as low as 20_0C. And refueling takes minutes, not hours.

Operation benefit hugely from the smooth operation of LPG powered FLTs. And everyone benefits from the low emission. Lead-free and soot free, Calor LPG has a very High octane rating. Carbon monoxide emissions Are virtually zero when trucks are fitted with a 3 way catalyst. A move which also cuts fuel consumption by around 20%.

But eliminating emissions isn't the only way Calor LPG will help you clean up.

LPG trucks can save time and space, resulting in lifetime costs which van be

Lower than electric and diesel powered versions.

With almost no extra infrastructure required for LPG, future of LPG in Developing counties has a greater potential and as the governmental of the world face higher and higher pollution taxes and environmental pressures LPG Driven vehicles are expected to be on the rise in the future.

CONCLUSION

Most types of vehicles that run on petrol can run on LPG, which means that they are duel fuel vehicles, and can run on either petrol or gas; this can give you greater range all at a flick of a switch!

Propane vehicles emit about one-third fewer reactive organic gases than gasoline –fueled vehicles. Nitrogen oxide and carbon monoxide emissions are also 20%and60% less, respectively. Unlike gasoline fueled vehicles, there are on evaporative emission while LPG may vehicles are running or parked , because LPG fuel system are tightly sealed . Small amounts of LPG may escape into the atmosphere during refueling, but these vapors are 50% less reactive than gasoline vapors, so they have less of a tendency to generate smog forming ozone. LPG, s extremely low sulfur content means that the fuel does not contribute significantly to acid rain.

Fleet owners find that propane costs are typically 5% to 30% less than those of gasoline. The cost of constructing an LPG fueling station is also similar to that of a comparably sized gasoline dispensing system.

In light of the above mentioned points and what is discussed in this theirs, conversion gasoline or petrol engine to LPG or dual fuel system would be least expensive, less polluting, very safe and a wise decision.

Appendix:1 Typical properties of LPG

Property	Commercial Butane	Commercial Propane
Relative density of liquid at 15 ƒC	0,57 to 0,58	0,50 to 0,51
Imperial gallons/ton 15 ƒC	385 to 393	439 to 448
Liter /tonne at 15 ƒC	1 723 to 1 760	1 965 to 2 019
Relative density of gas compared with air at 15 ƒC and 1013,25 mber	1,90 to 2,10	1,40 to 1,55
Volume of gas (litters) per kg of liquid at 60 ƒF and 30 in Hg	6,5 to 6,9	8,5 to 1,55
Boiling point at atmospheric pressure ƒC approx .	-2	-45
Vapour pressure for products at their maximum specified Vapour pressure (gauge): Temp. ƒC -40 -18 0 15 38 45	 Bar - * 0.9 1,93 4,83 5,86	 Bar 0,5 2,3 4,5 6,9 14,5 17,6
Latent heat of vaporization (kJ/kg) at 15 ƒC	372,2	358,2
Latent heat of vaporization(Btu/Ib) at 60 ƒF	160	154
Specific heat of liquid at 15 ƒc(KJ/kgƒC)	2,386	2,512
Sculpture content per cent weight	Negligible to 0.02	Negligible 0.02
Limits of flammability (percentage by volume of gas in a gas- air mixture to	Upper 9,0 Lower 1.8	Upper 10,0 Lower 2,2

from a combustible mixture)		
Calorific values: Cross : (MJ/m^3)dry (Btu/ft^3)dry (MJ/kg) (Btu/Ib) Nett: (MJ/m^3)dry (Btu/ft^3)dry (MJ/kg) (Btu/Ib)	 121,8 3 270 49.3 21 200 112,9 3 030 45,8 19 700	 93.1 2 500 50,0 21 500 86,1 2 310 46,3 19 900
Air required for combustion (m^3 to burn 1 m^3 of gas)	30	24
*Minimum Commercial Butane vapour pressure at n 18 *f* is minus 5224 mbar g.		

Source: http://www.whitespotlpg.co.uk/Whatis.htm

References:

Automotive Mechanics; William H. crones and Donald L. Angling ; tenth Edition; ISBN0-07-112499-X

RPI Engineering International Ltd, http://www.rpiv8,com/

Running a car on LPG,by Tim Hewett year 2000, http://www.dotslashalsh.com/

Do-It-Yourself Automotive LPG Conversion; by Tom Jennings; World Power System ,San CA; fourth adition , Nov98; www.wps.com

North West Gas Ltd, http://www.auto-gasconversions.co.uk/

LPG a healthier World, http://www.eco-drive.co.uk/

Indian Express Newspapers (Bombay) Ltd, http://www.expressindia.com/

ECOGAS System Ltd. Unit 6 Waterloo Industries Estate Bedford-on-Avon Warwickshire B50 4JH, http://www.ecogas.co.uk.com/

LPG vehicle, http://www.1pg-vehicles.co.uk/

LPG Mower, http://www.1pg-mower.co.uk/

LPG Forklift, http://www.1pg-forklift.co.uk/