

Burning gas in a diesel engine

Aftermarket conversions allow diesel trucks to burn a proportion of gaseous fuel - usually CNG or LPG, but sometimes LNG - alongside regular derv. The gas is usually cheaper, has lower carbon content and may produce less particulate matter. By Toby Clark

Operators who want to reduce their carbon footprint (and perhaps also their operating costs) don't have to buy dedicated gas-powered trucks to replace their diesels.

The way the system works is this: the engine starts up conventionally, on 100% diesel fuel; then, as it reaches working temperature and demand, the gas is introduced (at much lower pressure than diesel injection) along with the intake air, up to typically 50% gas/50% derv - this is known as 50% substitution rate. (This rate is nowhere near as for example the latest purpose-built gas CI engines from Volvo - see <https://is.gd/ijolul> - but those are more expensive, and the technology cannot be retrofitted.)

The motivation for operators to adopt dual-fuel systems is almost always cost. Mercury Fuel Systems' Quicksilver AFI is said to replace up to 25-35% of diesel, replacing it with secondary fuel, usually LPG. The company says: "Feedback from existing clients suggests that, depending on individual circumstances, return on investment can be achieved in 10-18 months, with savings continuing for the duration of the vehicle's life."

But for others it is an environmental imperative: Bruce Simpson, technical director of conversion firm Alternattech,

says that Waitrose's conversion of a large number of trucks to dual fuel was intended primarily to achieve green credentials. "If it was cost neutral, they were happy," he adds.

One longstanding dual-fuel supplier is Prins Autogassystemen of the Netherlands. Its mainstream truck product is called Dieselblend: it's a low-pressure system which introduces the gas (LPG, CNG or LNG) along with the



air via the inlet manifold, so there are no changes to the engine internals. It communicates with the vehicle's ECU via CAN-Bus and uses engine parameters (speed, load, throttle position, temperature) to determine how much gas to inject. The system is said to be suitable for diesel engines from Euro III on, and conversion does





THE SPARK-IGNITION OPTION

A full conversion from diesel to 'mono-fuel' spark-ignition natural gas operation is possible, but very involved. For example, Excion of Korea enumerates the steps required:

- Modify diesel cylinder head to install spark plugs
 - Reduce compression ratio from 17.5 to 9.3:1
 - Fit crank position, air pressure and temperature sensors
 - Fit new intake manifold, throttle body and high-pressure fuel injectors
 - Install three-way catalyst and oxygen sensor
- ...and this is before installing the gas tank, filling system, pressure regulator and shut-off valve.

A purpose-built spark-ignition engine makes more sense, but with its relatively low compression ratio, it is less efficient than a diesel, and engine braking is less effective. However, Jacobs Vehicle Systems (of Jake Brake fame) has developed an HPD (high power density) engine brake promising up to 1.5 times the available braking performance of a conventional compression release engine brake.

not affect the emissions classification of the engine – if it was Euro IV originally, it stays Euro IV – but dedicated diagnostic software allows tweaks to the system.

FUEL SPEED AHEAD

Southampton-based Alternattech's conversions use Prins components for each fuel option. Simpson reports: "CNG is the most popular at the moment. LPG is also popular, but LNG not so much due to the higher cost of the conversion." Alternattech has recently converted 20-plus vehicles for flour miller and distributor Heygates.

He continues: "LPG is easier to distribute, and many sites have an LPG tank for forklifts. CNG is more expensive, but you get a better return, and it's cleaner." A typical CNG conversion might cost £15,000-£18,000, and could deliver between 25% and 28% in fuel cost savings, reports the technical director, compared to 10-12% on an £8,000 LPG set-up (a fuel savings calculator is on <https://is.gd/fusava>). LPG conversions are cheaper and easier to fit than CNG or LNG, explains Simpson, because the tanks are smaller

and simpler – they are at ambient temperature and relatively low pressure.

Space constraints can still pose problems, however. "The majority of the tractors in the UK are 6x2," he adds, "and once you put blowers and hydraulics in, it can get very tight." 4x2 tractors are easier to convert, particularly if they are not running at maximum weight (pictured: top, a DAF XF converted by Ecomotive Solutions in Spain; left, Tribune Group's Alchemist retrofit tanks).

Whatever the fuel, conversions impose a weight penalty; for an LPG set-up it's around about 150kg, but for a typical CNG system (which uses high-pressure gas cylinders) it can be 900kg. This can be reduced to around 600kg by using carbon fibre tanks rather than steel, although they are more expensive.

The system works best at constant load and speed, so motorway running is ideal. "If you're in and around town all day, it won't work," says Simpson. Another good steady-state application is PTO. In this application, says Simpson, the substitution rate can go up to 60-65%, and there are benefits for local air quality and noise, as gas

runs more quietly and smoothly.

Maintenance involves an annual service to change three filters in the system, a job that is said to take about an hour.

CATALYST DEGRADATION?

While Simpson claims that burning gas reduces the need for catalyst regeneration, that view is not shared by all. There is evidence that the excess water produced by burning methane reduces the effectiveness of oxidation catalysts. Brian McMurray of LambdaX is working with Queen's University Belfast on new catalyst technology that could solve this problem.

However, McMurray is dubious about the long-term prospects for dual-fuel trucks, suggesting that even high-pressure gas injection systems might be better suited to constant-speed applications such as marine engines.

He also warns that 'methane slip' – gaseous fuel escaping from the system unburnt – can reduce efficiency and spoil the truck's green credentials. Any converter should be asked for evidence that this has been accounted for. **TE**