

# Money-saving engines

LPG may seem like old hat, but dual-fuel diesel offerings are being given the high-tech treatment and pioneering operators like what they're seeing. Brian Tinham reports

**M**ulti-fuel engines have never enjoyed anything like mainstream status and there are several good reasons for that – not least their sheer cost. To date, if you want, say, a CNG/LNG (compressed or liquefied natural gas) and diesel-fuelled engine on a truck, you're looking at a retrofit price in the region of £20,000 to 25,000 (Transport Engineer, April 2010, page 19).

Why such a premium? Well, there's the cost of the additional fuel-handling hardware and software, its integration with the host engine, testing and commissioning. And there's also the cost of the additional CNG or LNG tanks and the work involved in re-siting auxiliaries to make space.

Gas engines, too, have had their ups and downs. Not surprising when a CNG variant of a spark ignition (petrol) engine on a 44 tonne tractor unit adds much the same on-cost, even when ordered direct from the manufacturer (Transport Engineer, May 2010, page 26). In this case, the argument goes that such engines have to be designed, tested, proven and optimised from the ground up, at a cost that can't be quickly recouped by manufacturers on small production runs. Add to that the issues around reduced power in operation, due to the lower energy density of straight CNG, and the limitations are clear.

So, relatively few brave souls have given the options much of a go. Indeed, most that have fall into one of two camps: those who are prepared to live with savings achieved only over the long-term (several years); and those convinced they can harness these engines' promises of reduced noise and emissions to benefit their operations in other ways – for example, by gaining access to built-up areas after dark. Beyond these, it's only operators large enough or wealthy enough to trial emerging technologies in their search for better options, or those needing to demonstrate their green

credentials, that have been in the running.

Of course, the coalition government claims a green agenda and, 'in the national interest', a desire to achieve diversity of energy and to reduce the UK's consumption of fossil fuels. So, who knows? We may yet see the resurrection of RPCs (reduced pollution certificates) for trucks and vans offering emissions below Euro 5, on the run-up to Euro 6. We may also see reductions in duty on fuels deemed to be 'green'. And we may even see a resolution to create a biomethane infrastructure, piping biogas from existing landfill sites and future biomass plants – together making CBG/LBG (bio-derived compressed or liquefied methane) more viable, along similar lines to Transport Secretary Philip Hammond's proposed national recharging network for hybrids. But don't bank on it.

In the meantime, what about LPG (liquefied petroleum gas – primarily propane) in the multi-fuel mix with diesel? Clearly, LPG doesn't have the green appeal of CBG/LBG, because it's a bi-product of petroleum refining – but it's no less green than CNG/LNG, which itself is processed from fossil fuels. At the very least, powering trucks using LPG and diesel would enable transport to extend the life of our finite fossil fuels. Further, because LPG is less carbon intensive, particulates and CO<sub>2</sub> emissions are reduced, while studies have also shown NOx emissions down 5–6%, compared with diesel alone.

## Better way forward

Transport engineers with a few years under their belts will recall that LPG-diesel enrichment has endured something of a chequered past. LPG has been less than kind to some diesel engines – causing everything from premature failure to all-out fires. However, most of the problems appear to have been associated with relatively crude, continuous and high LPG substitution rates. Engineering experience, research, development and modern digital ECU technology can change all that.

That's the approach taken by G-volution, which has patented a retrofit Optimiser that sits on top of a standard diesel engine ECU and manages LPG substitution (Transport Engineer, August 2009, page 10). G-volution managing director Simon Pickess stresses that his company's technology is by no means limited to LPG and diesel. Indeed, he hints that it is not only capable of other dual-fuel arrangements, but also "controlling two or more supplementary fuels".

However, for the time being, pragmatism dictates LPG-diesel – so far, only on MAN D20 and D26 engines (360–440hp), although he says G-volution is also now working on DAF 12.9-litre MX (Paccar) diesel engines and has plans for Volvo/Renault next. Pickess makes the point that LPG has been tried and tested in the automotive sector, so there is a



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**John Maiden, managing director, Maiden’s of Telford**

reasonable distribution infrastructure across the UK and Europe. Just as important, for the moment it’s less than half the price of diesel, so it’s potentially a very big winner for hauliers.

Crucially, he also reveals that his company’s engine conversion costs a modest £9,500 (that’s for the optimiser, fuel lines and tank, as well as commissioning and support) – less than half the price of a CNG-diesel equivalent. Why? “It’s partly because ours is a ‘ghost system’, so there’s no remapping of the ECU or other work with the engine

itself. And it’s because we’re substituting LPG for diesel at 30–40%, so nothing like the high rates used in CNG/LNG-diesel applications.

“But it’s also because the components are so much cheaper. CNG and LNG tanks, for example, are very high pressure items and, in the case of LNG, there’s a very significant cooling requirement, too. So the cost of those tanks is around £5,000, compared with £500 for an LPG tank.” And, given that typical consumption for a haulier might be 100 litres of LPG for every 350 litres of diesel, they don’t





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have to be that big. “Also, there’s a world-wide LPG automotive industry out there, so you can buy most equipment off the shelf.”

How does it work? Pickess puts it thus: “We intercept the signals for the diesel injection pulses, between the vehicle’s own ECU and the injectors, and we shorten them. So that reduces the amount of diesel and, since the Optimiser knows how much it’s reducing the diesel by, it replaces the lost kW by the right amount of secondary fuel. We have very accurate power mapping, so we don’t over- or under-power the engine. Also, the Optimiser continuously adjusts the fuel ratio in real time, according to engine operating conditions – taking account of drive-cycle, load and driver behaviour – rather than assuming best-case conditions.”

He also adds that there are “a couple of versions” of the software map that suit different vehicle types, operations and duty cycles – making the point that a 44-tonne tractor unit has a different LPG substitution requirement to a 32-tonne 8x4 rigid tipper. And he explains that the Optimiser also has a ‘dummy injector’ that sends signals back to the engine ECU, so that ancillary systems that affect the brakes, stability, etc, aren’t compromised. “In fact, the vehicle doesn’t recognise the Optimiser is even on board,” says Pickess.

As for the running costs, he asserts that hauliers can expect a 10–15% overall fuel cost saving, based on that 30–40% LPG for diesel substitution when the engine is in steady state and taking into account the fact that LPG’s lower energy density means higher rates of gas consumption than diesel. “Engines start on diesel and stay on diesel throughout full-torque

acceleration [to avoid historical problems with higher revving requirements]. Then, for a typical 44-tonner, the system allows maximum substitution in the 30–150kW band, where most haulage vehicles spend the majority of their time on motorways, dual carriageway and A roads. That’s independent of load, although the higher the load, the more fuel a truck uses, so the greater the savings. Payback for an average operator burning £40,000 of diesel a year could be 12 to 18 months.”

### **Maiden voyage**

John Maiden, managing director of haulier Maiden’s of Telford, broadly confirms the savings. He has been running three MAN TGA 26/440s with G-volution’s LPG-diesel conversion since this time last year. Indeed, so pleased is he with the results, that he has now ordered a fourth. “We started working with this technology, because we reckoned that, with our operation, we could write off the £9,500 conversion cost in about 21 months on some of the contracts and then we’d be saving money. In fact, we now anticipate getting payback in 18 months and the next truck could take just 16 months, because, although LPG has gone up slightly, it’s nothing compared to deriv. When we started, LPG was 39p per litre, now it’s 45p. But diesel has gone up from 89p to £1.02 over the last 12 months.”

Maiden’s experience reveals an overall saving of around 8% on fuel – that average figure coming straight from the MAN telematics fitted on his trucks. “These units are doing 3,500 miles each per week, because they’re double manned. Some are on dedicated haulage; others on ad-hoc general

## Getting LPG enrichment right

Five years is a long time for engine development and that's certainly the case with LPG-diesel. It's no longer about pouring in as much gas as possible and using the engine knock sensor to trim the diesel, as in the pioneering days. That wrecked engines and turned transport managers rapidly off any ideas claiming to save a quick buck.

Now, embryonic technologies from a few determined firms are slowly, but surely, proving their place in the world – to such an extent that Stephen Fricker, managing director of Exeter-based fuel specialist Gas Power UK, believes that LPG-enriched diesel will hit the big time for trucks and vans in the next two to three years.

He should know: Fricker has been working on LPG-diesel and other combinations for years and, as a board member of UK LPG (formerly, the LPG Association) provides expert guidance. He has also carried out his own significant R&D and perfected several installations using different companies' technologies on a range of vehicles.

In 2005, for example, it was Fricker who did the LPG/diesel conversion work for Stafford's (now defunct) truck trials. "At that time, we were looking for the perfect mix of fuels, starting with zero LPG and taking it up to 30%," he explains. "We had five trucks running the same route. They worked well and one is still at Millbrook."

The following year, Fricker did the installation for a successful trial with Vitacress on a Scania 260 4x2 rigid, using early GSPK fuel substitution technology. Then, in 2007, he worked with an Ecomex

[Combustibles Ecologicos Mexicanos] system on a 10-tonner with a Cummins engine, for a multi-drop operator in the Midlands.

More recently, Gas Power UK did conversions on two trial vehicles – a TD5 Land Rover and a Mercedes-Benz Sprinter (Euro 3) van – using Diesel Gas Australia equipment. And then, in 2008, Dairy Crest in Totness got the treatment, using Green Power Bifuel's (now G-volution) multi-fuel technology on a Volvo tractor. "In terms of fuel, average annual savings they got were 22%, compared against running on diesel. But the Dairy Crest site was sold and the system was stripped off before the vehicle was taken over by Wincanton."

Fricker says the recession put paid to further R&D at his firm, but he insists that LPG-diesel is coming. "Take-up of this technology isn't even in its infancy yet and you still have to get the tuning right. People forget that, if you're running with any two fuels, then you have three perfect tune marks to optimise – one for best mpg, then best mpg and best torque, and finally best torque on its own. Modern software mapping is getting over the other problems and, when hauliers get wise to this, it's going to be a real money spinner."

Watch this space for developments. Fricker: "For operators, my advice would be: go to the UK LPG website for guidance; look at the figures from the John O'Groats challenge; and then make sure that whoever you use to do your installation follows UK PLG Code of Practice 11. That will be mandatory for trucks by September 2011."

haulage. On dedicated haulage, the gross weight is always under 40 tonnes, but that isn't important. What we've looked for is high volume, high total mileage operations, because, the more you do, the greater the overall cost savings and the faster you write off the conversion cost and start improving margin. If you're doing, say, 80,000–100,000 miles per year, you'll still get the savings, but it might take you two and a half years to get to payback."

Those kinds of savings aren't, however, going to be realised for multi-drop operations or those involving stop-start on urban roads, where the engine won't be cruising, so LPG substitution will remain low.

"The real winners are trucks that sit on motorways for hours at a time, fully laden," says Maiden. "I'd recommend a conversion for this kind of operation. The life of a truck today is about seven years, so, even if you take two and a half years to write off the initial cost, the savings after that will be very worthwhile. Our only issue at the moment is that we don't keep LPG on-site. We'll probably go for LPG on-site sooner rather than later, but, for now, there's a service station just three miles down the road and the LPG tank is good for 600 to 700 miles. If we do need to refuel elsewhere, Keyfuel identifies all the LPG sites on our routes."


Maiden also alludes to an approximately 200kg increase in the unladen weight of his vehicles, due to the equipment and weight of a full tank of gas. That might affect some hauliers wanting to run right at the maximum legal total vehicle weight, but G-volution's Pickess says there's usually a way around any weight gain, if that really matters. "For example, on

tractor units working with tipping trailers we can remove the diesel fuel and hydraulic fluid tanks, and install a combination unit with reduced capacity on the diesel side, so that adding the gas tank keeps the combined weight down."

### High-pressure future

As for the future, Pickess believes that, with the millions still being spent by the big OEMs on highly efficient, clean diesel technology on the run up to Euro 6, these engines are likely to remain firmly in the driving seat for the foreseeable future. And, by the same token, with their budgets committed, that also means LPG/diesel will remain a retrofit option.

"Our value, in this sense, is that we make it possible for operators to use less expensive fuel. But in the next, say, two to four years, we'll introduce replacements for LPG – maybe biomethane, but maybe also ethanol, because it has energy and emissions benefits and can also be produced outside the food chain, so it's sustainable."

With hints at further patents on the way for multi-fuelling retrofits, it looks like G-volution is one to watch. In the meantime, if you feel like going ahead, watch whom you trust with your vehicles' conversion. There are several organisations out there purporting to offer conversions to LPG-diesel: best to check some of their references before you go ahead. 

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