

# Gas guzzlers?

Natural gas engines have been around for a while, but we might just be on the verge of a resurgence – if only the sums can add up. Brian Tingham explains

**W**hile dual-fuel natural gas (methane) and diesel trucks could be heading for greater uptake, as fleet managers see increased potential for both fuel savings and sustainable green operations from improved technology (Transport Engineer, April 2010, page 16), straightforward spark-ignition gas engines could also be set for some resurgence.

Surprised? Transport engineers that have kept their ears to the ground are likely to believe that the arguments for gas engines all but died around five years ago, when the Energy Savings Trust's PowerShift grant, originally set at £19,000 a vehicle for gas truck purchasers, was reduced to £13,000 before finally being axed. There followed the closure of Foden in Cheshire, under Paccar, marking the then end of gas-diesel tractor unit production in the UK.

And then, to add insult to near fatal injury, in 2008 standard diesel trucks, even without exhaust after-treatment, emerged, meeting EEV (enhanced environmentally-friendly vehicle) specifications – the EU standard originally drafted to recognise gas-engines' ultra-clean credentials. As a result, the high cost of conversion costs became not only prohibitive, but apparently also pointless; gas-fuelled trucks' residuals fell away and the rest should have been history.

## Growth in gas

Except that they haven't died: indeed some van, truck and notably also bus manufacturers with gas engine businesses to their names are currently claiming growing sales – even, in some cases, in somewhat unexpected circles. Cummins is one,

## Cost of conversion

Manufacturers and environmentally aware operators are understandably concerned about the slow take-up of CNG engines, in whatever form, and green technologies in general. Everyone accepts that every business needs to see some kind of payback from buying into alternative fuels and engines, even more so in tough economic times. As Iveco's Martin Flach puts it: "If government wants to drive down carbon emissions, it has got to do more than just support electric city cars. On the commercial vehicles side, above 3.5 tonnes gvw, electric traction can only be part of the picture and it certainly won't feature above 7 tonnes for the foreseeable future."

The point: current green technologies are manifold, including biomethane, DME (dimethyl ether), biogas-biodiesel, hybrids, etc. But for as long as there remain significant economic penalties for their adoption, operators can be forgiven for considering them niche players. For example, the cost of a Hardstaff dual-fuel system ranges from £13,000 for a single gas cylinder CNG installation on a Euro 3 vehicle, up to £25,000 for a three-cylinder CNG system on a Euro 5 truck. Enough said.

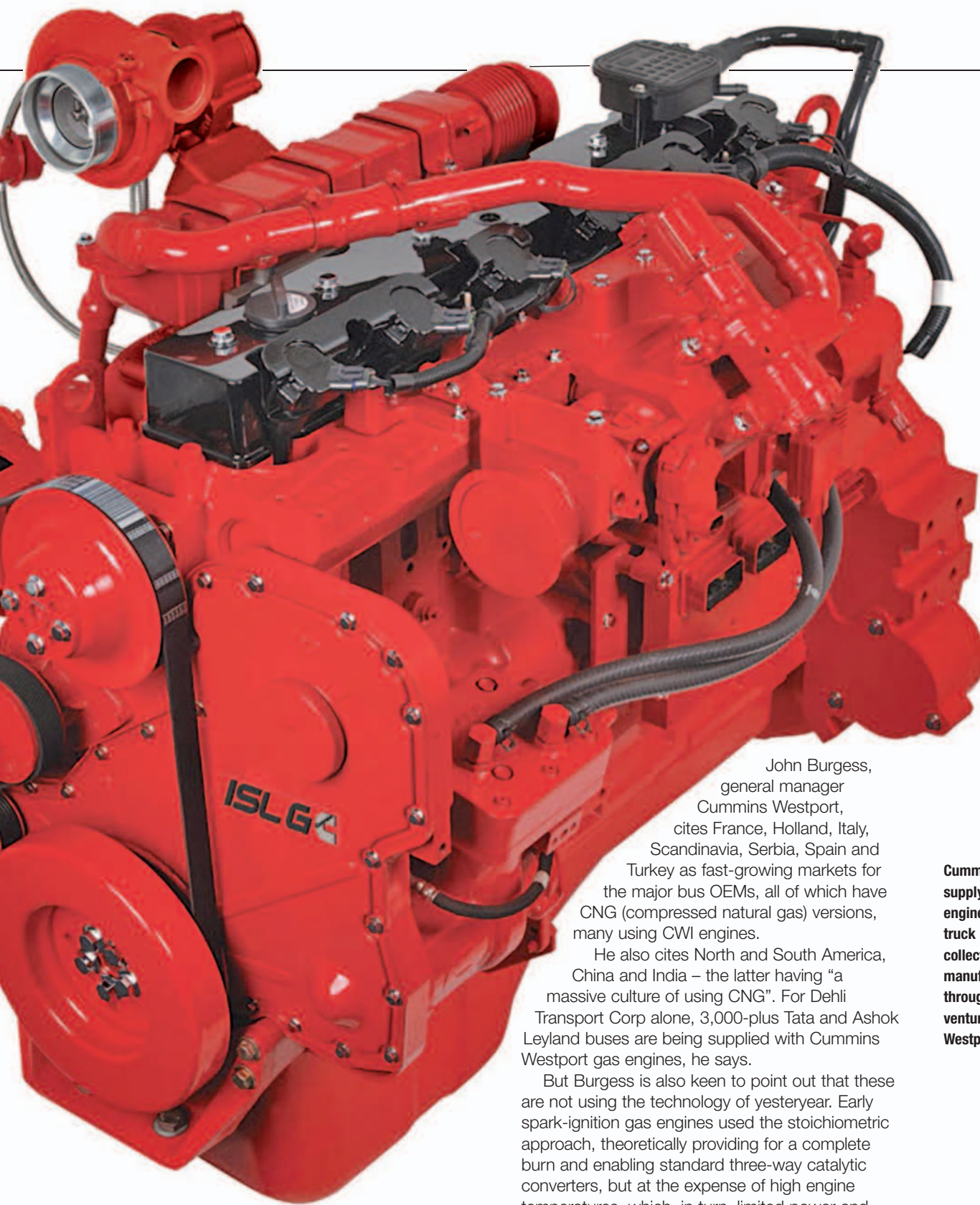
"Government has the ability to facilitate public bodies to become early adopters. There are some opportunities with Low Carbon Vehicle Partnerships [now with a further £30 million DfT funding for green buses, following last month's budget], but they're scratching the surface," insists Flach. "We would like to see another RPC [reduced

pollution certificate] for clean, green engine technologies. But it needn't involve a huge amount of money. For example, gas-fuelled vehicles could be allowed to drive along bus lanes to save time. And how about gas or electric vehicles delivering goods at night in central London? Changes in local authority regulations could change the operating parameters of clean vehicles, so that operators could three-shift them and then maybe afford the additional capital spend."

Cummins Westport's John Burgess, who manages the company's gas engine sales in Europe, adds his weight to the argument, making the point that, for this technology, relying on the lower cost of CNG and CBG (compressed biogas) is simply not enough. "The UK does promote new technology adoption among bus operators, through the BSOG [Bus Service Operators Grant], for low carbon vehicles that save at least 30% greenhouse gases, compared with straight diesel. Hybrids can achieve that, but it's difficult to claim 30% from gas, unless it's biomethane, when the well-to-wheel carbon emissions savings are 80 to 90%."

It's clear that the authorities in the UK have only focused on hybrid and fuel cell technologies, in terms of subsidies and also the fuel infrastructure. Until UK government follows the experience in countries such as Turkey, France, Scandinavia, North America and India, potent carbon emissions-saving technologies are destined to remain niche solutions.





through its Westport joint venture (CWI, now eight years old), which, according to the company, is delivering engines to bus, truck and refuse collection vehicle manufacturers, in particular, all over the world. Iveco is another, stating that, although the UK has hitherto been slow on the uptake, sales of methane-powered vehicles are now growing – and not just its vans and rigids, but also large tractor units.

John Burgess, general manager Cummins Westport, cites France, Holland, Italy, Scandinavia, Serbia, Spain and Turkey as fast-growing markets for the major bus OEMs, all of which have CNG (compressed natural gas) versions, many using CWI engines.

He also cites North and South America, China and India – the latter having “a massive culture of using CNG”. For Dehli Transport Corp alone, 3,000-plus Tata and Ashok Leyland buses are being supplied with Cummins Westport gas engines, he says.

But Burgess is also keen to point out that these are not using the technology of yesteryear. Early spark-ignition gas engines used the stoichiometric approach, theoretically providing for a complete burn and enabling standard three-way catalytic converters, but at the expense of high engine temperatures, which, in turn, limited power and torque. That’s why second generation gas engines turned to lean burn technology, with excess oxygen leading to greater power output, better cylinder temperature control and hence NOx management, but with two-way catalysts providing for EEV certification.

“Three years ago, we went back to stoichiometric combustion, but with cooled EGR [exhaust gas recirculation], using a waste-gated turbo, to get the best of both worlds – an exhaust

**Cummins is supplying gas engines to bus, truck and refuse collection vehicle manufacturers through its joint venture with Westport**





**Iveco is selling gas-powered vehicles in the UK. It is hoped that the CNG Stralis will put out up to 330bhp by the end of the year**

that is free of oxygen, so that we could use the simple passive three-way catalyst again, and cooled combustion. By doing so, engine designers get better torque and power that's more diesel-like in its behaviour," explains Burgess.

Cummins Westport's 8.9l ISLG is its latest platform, providing from 250 to 320hp and 895 to 1,356Nm of torque, and Burgess insists it will meet Euro 6, once details such as the catalyst brick and engine calibration have been adapted. "ISLG gas engines are being installed on city buses, refuse collection vehicles and some back-to-base delivery operations across Europe, as well as on buses and haulage trucks in North America," he claims. "On the bus side, we're talking about eight-, nine-, 12- and 15-metre city buses. For example, we're now providing 180 engines to Solaris on 12 and 15 metre Urbino buses for Scandinavia. And that follows 190 12-metre BMC buses for Kayseri in Turkey."

Meanwhile, on the European truck side, Cummins partners with PVI in Paris, putting CWI BGas+, CGas+ and ISLG natural gas engines into 12 to 26 tonne gvw refuse and distribution trucks. Those are built on Renault chassis and supplied through the Renault network.

Clearly, interest is growing and that observation is confirmed by Iveco UK product director Martin Flach, who indicates that, while methane-powered vehicles have been in serious production at Iveco since the mid 1990s, some of the old reservations over gas use are now evaporating. "Ten to 15 years ago, the UK gas mains had a lot of moisture, so some operators did have problems with early CNG-fuelled Eurotech trucks, for example. But now we have a better understanding and, where operators

run from the natural gas supply, we can make sure that adequate driers are part of their systems at the filling station level," he explains.

"We're now actively selling gas vehicles in the UK, and we've got some pretty serious interest and orders for Dailys and also our first Stralis CNG," he continues. "We have CNG-tested the Daily, Eurocargo and Stralis up to 300bhp, and our intention is to take the CNG Stralis up to 330bhp this year. That will work well on tractor units pulling semi-trailers on relatively short runs, say from a warehouse into a shop in an urban area. The classic example is M&S in Oxford Street, where there is little or no warehouse space on site, so the logistics is about trunking in goods all day from its White City warehouse three or four miles away. For that type of operation, you don't need the 480bhp of a diesel engine or a dual-fuel gas-diesel: 330bhp is enough."

So we're not just talking about the lighter end of commercials – typically urban operations, where the advantages of straight gas combustion (clean, quiet and non-polluting) are well known – but also sneaking into a segment normally reserved for mainstream heavyweight diesel or dual-fuel gas-diesel tractive units.

### Tesco's experience

That certainly ties in with experience at Tesco, which has been running trials recently with both CNG and dual-fuel trucks. Matthew Smith, Tesco's development engineering manager, sets the scene: "On the gas truck, spark-ignition engine side, we trialed one vehicle [a Mercedes-Benz Econic] in 2007 at one specification and we've just completed trials on a second. The first was a 6x2 26 tonne rigid, instead of our standard 18 tonners, because we were concerned about the impact of the heavier construction on our payload. But we've since worked with Mercedes-Benz around, for example, carbon fibre tanks and the latest trial was with a standard 4x2 18 tonner."

Smith's view so far: "Spark-ignition CNG has pros and cons. The trucks do run at lower noise levels, which makes them good for urban distribution, but they are a lot more expensive. Our data will show the full detail over the next few weeks." He's right: even though Econic gas engine trucks are now in series production, there is a



premium of around £25,000 – resulting, according to Nick Blake, sales engineering manager for Mercedes-Benz, from the costs of ground-up design and low volume manufacture. Interesting, too, that Smith doesn't mention the lower emissions recorded in refuse collection-type Econic operations.

As for dual-fuel, Tesco's trials have been at the heavier end, using Mercedes-Benz Axor 4x2 tractor units, plated at 44 tonnes and running from its Harlow depot. Its first trial was in 2005, with Clean Air Power on a Euro 3 engine, but Tesco then transitioned from Euro 3 straight to Euro 5 and, in the last few weeks, has been trialling another 4x2 Axor dual-fuel at Euro 5, with the conversion now done by Hardstaff – one of the rival gas-diesel equipment specialists. Smith's only comment to date: "It's too early to say what the strengths and weaknesses of dual-fuel are going to be, although other trials do show benefits for trunking in store distribution mode."

#### What about infrastructure?

Looking at the gas itself, though, Smith comments that two key issues for would-be converts are availability and price of CNG, whether as a fossil fuel derivative or biogas – unless, of course, you generate the methane yourself. For the time being, he says, Tesco is keeping a close eye on both gas-diesel and gas spark-ignition technologies – and looking at the proposition of potentially investing in its own biogas infrastructure. Imagine the fossil fuel, finance and greenhouse gas savings, not to mention the green credentials to be gained from Tesco running its distribution vehicles largely on its own waste-generated gas in a closed energy loop arrangement.

So which gas engine, if any, should you choose? It's all about the nature of your operation (the kinds of vehicles you run, the distances and their stop-start frequency), the up-front on-costs of the additional gas tanks and the engine conversion, and your projections for the price, availability and infrastructure for natural gas, whether from fossil fuel or biomass processes (see panel above).

Iveco's Flach says simply: "We've gone down the spark-ignition engine route for the simple reason that the main opportunity for gas trucks and vans is in distribution [because of the still limited gas filling station infrastructure], where the dual-fuel diesel conversion alternative is less appropriate." Why? "Because combustion temperatures at low speeds and low engine loads are such that dual-fuel engines can't do much with gas. They need a hot burn, so they work well on 44-tonners trunking down motorways, but less well in an urban environment. On spark-ignition engines, it doesn't matter what the

## Fossil fuel or biomethane?

Methane is methane, whatever the source. But whereas gas from the mains is clearly a fossil fuel, and an ultimately limited resource that adds to the carbon loading of the planet during combustion, the story for biomethane extracted, for example, from landfill sites is potentially limitless and, importantly, also carbon neutral.

"Whether its CNG or BNG, the vehicle tailpipe emissions are the same, but the change is the well-to-wheel analysis," explains Martin Flach, Iveco UK product director. "That carbon has already been fixed, and the reality is that methane gas available from bio-sources could easily fulfil the requirements of the automotive and transport markets, if the infrastructure was in place," he adds.

Currently, Guildford, Surrey-based Gasrec is one of the few biomethane producers that has invested in the requisite clean-up kit for supplying to vehicles. "There are thousands of landfill sites around the country, many of which could be equipped with this technology. That's a long-term solution, but, over and above that, the industry could also use anaerobic digestion plants that take biodegradable material and ferment it to produce biomethane very quickly. Nobody much is doing it at present, but some local authorities are looking at how they might get going."

The sooner they do so, the better.

engine is doing and the vehicles can carry a petrol reserve tank."

What about the reduced torque of spark engines, compared with common rail diesel? Flach concedes that point, agreeing that, in general, gas spark-ignition engines offer around two thirds to three quarters the torque of their diesel rivals. "A Tector 6l diesel engine delivers up to 300hp and 1,000Nm of torque, and that falls to around 200hp and 700Nm in the gas spark-ignition version," he says. And the new Daily 3.0 litre Natural Power offers 136hp and 350Nm torque, compared to the diesel's 146 to 176bhp and 350 to 400Nm. "But gas spark-ignition is a relatively cheap and easy environmentally friendly solution."

Also, remember, dual-fuel's environmental performance varies, depending on what you're doing; you only get hindsight of how much diesel and how much gas you've been burning. Compare that with modern stoichiometric gas engines, with cooled EGR and three-way catalytic converters, all of which should meet Euro 6 particulates and NOx requirements, with little or no development. Makes you wonder about the future for electrics and electric hybrids, doesn't it? **TE**

Warburtons has trialled gas-powered Mercedes tractor units

