Euro 6
the inside story

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INTRODUCTION
The Euro 6 exhaust emissions legislation that begins to apply to newly type-approved trucks and buses from the beginning of next year has been described as the toughest technology challenge facing the commercial vehicle industry since emissions legislation began in the early 1990s. You are certainly going to be seeing and hearing a lot more about Euro 6 engines and vehicles over the coming months. What this publication, produced in association with Cummins, sets out to do is give you an early insight into some key aspects of this technology challenge. We have been talking to engine development engineers, vehicle manufacturers, oil companies and vehicle operators. We hope you enjoy reading the results of our research and find it useful.

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What are the key technical and engineering challenges presented to engine manufacturers by Euro 6 legislation (European Union regulation 595/2009, to be precise) coming into force for newly type-approved trucks and buses on 1 January 2013 and one year later for all new registrations? And how exactly are these challenges being tackled? It would be hard to find any organisation better placed than Cummins to provide expert answers to such questions.

The assertion might surprise some seasoned British truck operators, especially those for whom the Cummins name is associated most with fond memories of 10- and 14-litre in-line six power units beloved by independent truck-makers of the past with famous names such as Foden, ERF and Seddon Atkinson. These operators perhaps could be forgiven for assuming that the demise of marques like these amid global consolidation of the truck manufacturing industry has meant hard times for all proprietary diesel engine suppliers, including Cummins. But how wrong any such assumption would be.

Right now, nobody is building more diesel engines over three litres swept volume than Cummins. In a table listing manufacturers by annual engine output, it ranks well ahead of Mercedes, Caterpillar and Isuzu, in that order. The latest annual financial results from the Columbus, Indiana-based group, published last month, show record turnover and profit. In 2011 alone more than one million Cummins engines were built worldwide, 67,000 of them in the UK, at manufacturing plants in Daventry and Darlington. Last year’s global turnover is US$18 billion (£11.4 billion), up 36 per cent on 2010, with gross profit up 54 per cent to US$2.56 billion (£1.6 billion).

“Cummins had its best year ever in 2011, despite economic uncertainty in a number of regions,” says Tom Linebarger, a month after taking over from Tim Solso as the company’s chairman and chief executive. “We continue to benefit from our leading position in a number of end markets and geographies. Revenue in the United States grew 53 per cent and international revenue grew 27 per cent year-over-year. In fact, we experienced record full-year revenues in North America, Brazil, China, India and a number of other important markets.”

Turnover is expected to grow again, by about 10 per cent, this year. “Our 2011 results and our forecast for 2012 reaffirms our confidence in reaching our goal of achieving $30 billion in sales and 18 per cent EBIT (earnings before interest and taxes) in 2015,” says Linebarger.

To find out what Euro 6 legislation means to Cummins we went to its Darlington, County Durham plant, home of European variants of the ISB and ISL truck and bus engine ranges, spanning power outputs from 140 to 400hp, and of an impressive technical centre responsible for the group’s five-year Euro-6 development project.

Answers to our Euro 6 questions come from Shelley Knust, midrange (3.9- to nine-litre) technical operations technical director;
Jonathan Atkinson, product development chief engineer, and Neil Pattison, on highway engine business director for Cummins’ EMEA & CIS (Europe Middle East and Africa & the Commonwealth of Independent States, including Russia). Knust has a background in electrical and electronic engineering, gained mainly in her native US at the Cummins base in Columbus, Indiana. She came to the UK last October.

Atkinson’s background is in mechanical engineering and design. His responsibilities at Darlington include the performance development engineering team as well as vehicle and engine test operations. As director of the on-highway engine business, Pattison brings commercial and financial disciplines to the party.

This team of three neatly epitomises one of the main themes to emerge from our interview: that Euro 6 demands unprecedented integration of various aspects of vehicle and engine engineering. “As emissions regulations have evolved, the components needed to meet these regulations have become much more complex,” explains Knust. “The single biggest engineering challenge we have had is bringing the system together in an optimal manner. So systems engineering has been a focus for Cummins for several years. Our objective is to always get the engine package correct in terms of power and torque with the expected levels of durability, reliability, emissions, fuel economy, noise and driveability for the market in which the vehicle operates. The challenge is integrating all of the engine technologies to provide the best possible balance and add value to our customers. We have more experience in integrating these technologies than anyone in the business. Cummins is the only engine company to own all technologies from air-handling to exhaust after-treatment. This allows us to better integrate turbochargers, fuel systems, combustion technology, electronic controls, engine filtration and exhaust after-treatment, delivering the best level of fuel economy for each stage of emissions regulations. Managing this technology recipe using the latest components has seen our Euro-4 and Euro-5 products deliver excellent results and puts us in a good position for Euro 6.”

It is already clear from the Euro 6 truck and bus engines that have been unveiled already by the likes of Scania, Mercedes and MAN (page 8) that turbocharger development plays a pivotal role in cutting emissions at the same time as maintaining or improving fuel economy. Cummins is unique among diesel engine manufacturers in having a wholly-owned turbocharger development and manufacturing subsidiary, the former Holset company (now called Cummins Turbo Technologies) based at

Shelley Knust: “Systems engineering has been a focus for Cummins for several years.”

Jonathan Atkinson: “We know exactly where we need to be in the marketplace. We’re confident we’re there.”
Huddersfield, West Yorkshire. How crucial is its work on turbocharger technology to the Cummins Euro 6 project? “That’s a very difficult question to answer without revealing too much too soon about our Euro 6 product architecture,” replies Atkinson. “But in any advanced combustion development programme these days air-handling is absolutely critical. Having that capability in-house and being able to heavily influence the design and development of these components to match up with our engine programme is fantastic. Engineers from Huddersfield also have a base here (in Darlington). We sit alongside each other. It’s a very beneficial relationship to have as a development engineer.”

But how far can the diesel engine combustion process be taken, even with advanced turbocharging and charge-air cooling? The fundamental design of direct-injection compression-ignition engines has been around a long time, and despite all the refinements by Cummins and others, and even spurred on by ever-tightening exhaust emission limits, the best basic thermal efficiency has never gone beyond about 47 per cent. Atkinson accepts the point, but soon makes it plain that Cummins certainly does not take the view that diesel engine development could soon be reaching the end of the road. “It’s all to do with the amount of data that’s available to us now, the capability to acquire data at high speed, and the computing capability to analyse that data,” he explains. “This has been one of the major changes, I would say, over the past ten years. We’ve gone from people sat at test cells and manually tuning parameters to very advanced electronic systems which require the engineers to create three-dimensional control surfaces. Data manipulation tools become necessary because you cannot easily visualise all the hardware and software interactions. This processing power delivers our advanced combustion solutions. In essence, we’re still trying to make the fuel burn as cleanly and efficiently as possible but now we have many more tools at our disposal that help us optimise the system.”

Neil Pattison chips in here to underline the commercial considerations for every engine and vehicle manufacturer. “You still need to make the product affordable,” he says. “You could add all the technology in the world and get a very, very capable product, but it would cost too much. It’s a bit like Formula One cars. They are the pinnacle of technology but you don’t see many people driving around in them.”

Pattison and his colleagues evidently have been paying close attention to the concerns of truck and bus operators who fear that the introduction of Euro 6 will add greatly to their operating costs without really delivering worthwhile environmental gains. Some even worry about what might come after Euro 6. “What’s important today is that we manage fuel economy, and minimise the amount of diesel our engines use,” says Knust. “We also think about the greenhouse gas legislation that is the next stage and we are working on improving fuel economy to levels that we’ve never had before. It’s about responsibly utilising the scarce resources we have until we can come up with breakthrough technologies to lessen dependence on fossil fuels. We expect the regulators in the EU to review the effectiveness of Euro 6 in controlling real-world emissions and that their decision on the next stage of emissions standards will be based on the success of this. There are several provisions in the legislation specifically aimed at controlling in-use emissions of heavy-duty vehicles for their useful life, so the regulators are confident that Euro 6 will be effective. We expect that the focus will now shift to greenhouse gas reduction, and indeed the European Commission has already started work on a new method of assessing the greenhouse gas emissions of heavy-duty vehicles. Cummins’ view is that, as well as the vehicle, any greenhouse gas (ghg) legislation should have some focus on the engine as the main producer of ghg emissions in the vehicle.”

Pattison stresses the point that Cummins is not simply a diesel engine manufacturer. “In fact we are quite a diverse power supplier,” he says. “I don’t think we can say we’re not concerned about running out of diesel, but all the indications are that this will be some way into the future and that there’s a lot of technological development to come.”

Turning to the nitty-gritty of Euro 6 legislation, we wonder whether Cummins engineers agree with those who see it as merely another natural progression in the series of gradually tightening European
exhaust emission limits which began with Euro 1 in 1993, or do they agree with those who see Euro 6 as a more significant step-change. “It takes us to near-zero emissions, so from that standpoint it’s a step-change,” says Knust. “However it does build on technology and past experience, so it’s not entirely new but a lot more challenging.”

In two specific areas the Euro 6 legislation is certainly ground-breaking. One is the introduction of a particulate matter particle count limit as well as the familiar grams per kilowatt hour limit on particle mass. The other is that this is the first emissions legislation to adopt “world harmonised” test cycles. The name turns out to be something of a misnomer because it is far from global yet, with the US and Japan continuing to use their own test cycles.

What does all this mean in practical engineering terms? Knust tackles the particle count question first. “It means we are measuring particles in the size range 23 nanometres to around 2.5 micrometres,” she says. “It’s really challenging to get to that level.” A nanometre is one billionth of a metre. Still having trouble picturing it? Wikipedia is helpful here, telling us that the diameter of a helium atom is about 20 nanometres. Equipment to reliably measure particles roughly the size of helium atoms in truck and bus exhaust systems is not the sort of kit you can pick up from your local Halfords.

“Euro 6 puts European legislation on heavy truck emissions at the leading edge,” says Atkinson. “That’s reflected by the advances in measurement equipment that are taking place alongside our engine programmes. The measurement technology has to be transplanted from the laboratory environment and made robust for engineering development.”

For long-haul truck operators in particular, but increasingly for bus and coach operators as well, the most important Euro 6 question of all is a straightforward one: what is going to happen to fuel economy? It is not so long ago that respected observers such as Ricardo engineers were suggesting that a fuel economy penalty as high as eight per cent would be unavoidable. More recently Scania has promised that the fuel economy of its Euro 6 engines will be unchanged from those at Euro 5, and Mercedes has gone further by promising a fuel economy gain of three to four per cent for truck operators moving from a Euro 5 Actros to a new Actros at Euro 6. But exactly how much of this gain will come purely from the improved aerodynamic efficiency of the truck and how much from the engine remains unclear. So we press Knust and Atkinson to give truck and bus operators some idea of where the forthcoming Euro 6 Cummins engines will stand on fuel economy. “What we can say as an independent manufacturer of engines is that we provide solutions for a wide range of applications,” says Knust. “It is our aim to minimise fuel consumption to the lowest possible levels at Euro 6. It goes back to selection of the right technology and understanding duty-cycles, how the engine is going to be used and in particular how hot it is going to run. Fuel economy is closely correlated with that.”

Atkinson stresses again what a crucial role system engineering will have in determining on-the-road fuel economy at Euro 6. “Architecture selection is what drives the capability to deliver fuel economy,” he says. “We’re optimising around a range of duty-cycles that we know operators are going to see. We know exactly where we need to be in the marketplace. We’re confident we’re there.”

But nobody is more acutely aware than Atkinson that with Euro 6 engines there will be more scope than ever before for the final installation to affect engine performance significantly. Small wonder the Euro 6 watchword at Darlington is teamwork.

Neil Pattison: “You need to make the product affordable.”

March 2012 the inside story Euro 6
All truck and bus manufacturers are preparing for Euro 6, of course. But certainly not all in the same way. David Wilcox and Tim Blakemore report on what has been revealed so far.

Europe’s big truck- and bus-makers are split. The underlying cause of the schism is European Union regulation 595/2009, better known as Euro-6 exhaust emission legislation for trucks and buses. To be strictly accurate, Roman numerals (Euro VI) should be used to distinguish this regulation from a parallel one with Arabic numerals (Euro 6) for lighter commercial vehicles, but let’s not complicate matters unduly. The essential point is that truck and bus manufacturers are sharply divided over how and when to introduce engines meeting Euro-6 limits, which come into force for newly type-approved vehicles on 31 December 2012 (twelve months later for all newly registered vehicles).

In one camp are Daimler and Scania. Their first Euro-6 engines, the Mercedes 12.8-litre OM471 and Scania 12.7-litre DC13, were both unveiled early in 2011 (Commercial Vehicle Engineer April 2011).

The Euro-6 approach to date of other truck-makers is perhaps best described as lukewarm. In the UK, MAN and Renault Trucks, for instance, have nothing to say on the subject apart from hardly-surprising affirmations that their engines will be available in time for the legislative deadline.

“In the absence of incentives to buy Euro-6 vehicles early we see no demand for them,” explained Les Bishop, truck product manager at MAN Truck & Bus UK, last year. “So we prefer to focus on vehicles with a lower cost of operation, and that means Euro-5.” In February this year MAN Truck & Bus UK chief executive underlined the point, even though the first MAN Euro 6 engine (a horizontal, 10.5-litre D2066 LH in a Lion’s City bus) had been put on show at the Busworld show in Kortrijk, Belgium last October. “We see zero demand (from truck operators in the UK) for Euro 6 engines at present,” says Evans. “We’ll have them available ahead of the deadline but we are going to concentrate over the next 18 months on Euro 5.”

The story is much the same at the Warwick base of the Volvo Trucks sales and marketing operation in the UK. “We want to be sure that customers have a reason to buy them before we launch Euro-6 engines,” says a Volvo Trucks spokesperson, seemingly unconcerned about arch-rival Scania stealing a march. The first Euro-6 engines from Volvo are expected to be unveiled soon, certainly before the big IAA Hanover show in September and perhaps even in April at a revitalised Amsterdam show.
Daf Trucks, the UK’s top-selling truck-maker, similarly is in no rush. “We will be as late as anyone with Euro-6,” cheerfully admits UK marketing director Tony Pain. “We don’t feel the pressure to launch it early. In fact, the pressure is in the reverse direction, to use Euro-5 as long as possible so that we help mitigate the effects of the recession by not adding unnecessary costs.”

Home alone with SCR

News broke in May last year that Iveco has decided against a combination of EGR (exhaust gas recirculation) and SCR (selective catalytic reduction) for its Euro 6 engine range. Instead, a root-and-branch revision of Tector and Cursor engine ranges involves SCR exhaust after-treatment alone to cut emissions of oxides of nitrogen (NOx). Precisely when these engines will become available remains unclear. Like many of its rivals, Iveco would seem to be planning to use the 2012 Hanover commercial vehicle show as a Euro-6 springboard.

Tector engines have been falling behind rivals in cubic capacity terms. Cummins four- and six-cylinder ISBe engines went from 3.9 to 4.5 litres and 5.9 to 6.7 litres respectively when Euro-4 limits came into force in 2005. Iveco’s Tector versions of the same basic engines (designed and manufactured under the now-defunct European Engine Alliance joint-venture agreement between Cummins and Iveco) kept their original displacements.

Now a longer stroke for four- and six-cylinder Tector engines at Euro-6 is set to sweep away that disparity. The new Tector engines have the same swept volumes as the Cummins ISBe range, as used by Daf (badged as a Paccar FR engine) in its top-selling LF and CF 7.5-to-18-tonners in the UK.

Technology consensus

When it comes to the technology employed to cut particulates (PM) and oxides of nitrogen (NOx) emissions to Euro-6 levels, there is now far less disparity among manufacturers than once there was, if Scania and Daimler are anything to go by.

These two were poles apart at Euro-4 and -5, championing exhaust gas recirculation (EGR) and selective catalytic reduction (SCR) respectively. Now both are singing from the same Euro-6 hymn-sheet, entailing two-stage NOX reduction (EGR first, followed by SCR exhaust after-treatment) with particulates removed by a DPF (diesel particulate filter).

Daf Trucks seems bound to follow suit, taking its lead from parent group Paccar and the way it is meeting Environmental Protection Agency (EPA) 2010 emission legislation, the US equivalent to Euro-6. The parallels were underlined at the Birmingham Commercial Vehicle Show in April where a US-specification 12.9-litre Paccar MX engine (fitted in Kenworth and Peterbilt trucks) was on show on the Daf stand.

Volvo Trucks likewise is going down the EGR + SCR + DPF route, having proved it in the US. And its Volvo group sister company Renault Trucks doubtless will share the same technology. One crucial factor for any EGR + SCR + DPF engine is apportionment of NOX reduction between the EGR and SCR stages. The means by which the DPF is kept unblocked is another important consideration.
Engineers are looking for the lowest cost of operation, balancing capital costs, engine fuel consumption, AdBlue usage and on-road fuel penalty (caused by both a rise in exhaust back-pressure and by doses of fuel needed to burn off trapped particulates).

Separately, EGR, SCR and DPF systems are thoroughly proven. But integrating them into a single system capable of meeting Euro-6 requirements is not quite as straightforward as it may seem. The legislation not only sets more stringent emission limits than those applying at present (Euro 5) but also demands a step-change in the precision of emission-control equipment. On top of all this is the durability requirement (700,000km or seven years, whichever comes first) written into the legislation, not to mention intense commercial pressure to ensure there is no fuel economy penalty. The humble exhaust pipe and silencer is about to become a costly box full of catalysts and sensors. Pragmatic fleet engineers may already be wondering whether some sort of protective guard for these boxes would be prudent.

**Some like it hot**

Scania, Daimler and Iveco are all taking the “one-box” approach, with all exhaust after-treatment equipment and the silencer enclosed in a single insulated box. Scania points out that its Euro-6 box, with a total volume of about 0.25 cubic metres, is no bigger than its current, Euro-5, silencer. So space for big fuel tanks or a chassis-mounted hydraulic “wet kit” is unaffected. Scania’s and Daimler’s Euro-6 “one-boxes” are supplied by Swenox, a Swedish sister company of Eminox in the Gainsborough, Lincolnshire-based Hexadex group. Iveco’s comes from Eberspächer of Germany. It is worth noting that last November Eberspächer took control of Swenox by acquiring 76 per cent of its issued share capital. The remaining 24 per cent stays in Hexadex hands.

Packaging exhaust after-treatment kit tightly into an insulated box not only avoids wasting precious chassis space but also helps keep the kit warm. This is more critical than ever at Euro-6 because the test cycle includes a new cold-start element, and average engine speed and load during this test are lower than in earlier test-cycles, so exhausts run cooler. But the NOX-conversion efficiency of SCR catalysts remains sensitive to temperature. AdBlue injection cannot start until exhaust temperature reaches 200 degrees Celsius. And every second spent waiting for AdBlue injection worsens NOX emissions. “Thermal management” is a key phrase in the Euro-6 engineering vocabulary.

This helps explain why a variable throttle-valve has been added to Scania’s air intake, downstream of its variable-geometry turbocharger and charge-cooler and just upstream of the inlet manifold. When the vehicle is coasting this valve restricts ambient air flowing through the engine and cooling the exhaust. The Swenox exhaust after-treatment boxes used by Scania and Daimler include several temperature sensors at various points, gathering data to control AdBlue injection.

**Many an ammonia slip**

The Euro-6 NOX target is tiny, with penalties for overshooting as well as for falling short. This legislation introduces a limit on ammonia (NH₃) of 10 parts per million (ppm). The aim is to prevent an excess of ammonia in the exhaust caused by over-active NOX reduction, not least because ammonia is a toxic gas which can damage lungs when inhaled in high concentrations. In Scania Euro-6 engines 50 per cent of in-cylinder NOX is removed by EGR, leaving the SCR system in the exhaust to deal with 95 per cent of the remaining NOX. At NOX-conversion rates of 80 per cent or less there is little risk of excess ammonia (“ammonia slip” in the technical jargon) but at 95 cent it is all too easy for the 10ppm ammonia limit to be breached. This is why both the Scania and Daimler Euro-6 engines (and probably all their rivals) have ammonia-slip catalysts at the end of their after-treatment systems, to ensure any residual ammonia is removed. These ammonia catalysts also need to be kept warm. They start to work only when their temperature reaches around 200 degrees Celsius.

The need to hit a small NOX target with great precision means Euro-6 SCR systems have to be more sophisticated than those of Euro-4 and -5 engines. Like Daimler, Scania uses a pair of SCR catalysts, plumbed in parallel, rather than a single catalyst. Most AdBlue injectors hitherto have been powered by the vehicle’s compressed air, but now Daimler and Scania have adopted electrically-actuated “airless” systems. These are said to be more precise with better-defined spray patterns and smaller drops which are readily converted from AdBlue into ammonia for the catalysts. AdBlue injection rate is managed in a closed-loop control system by a pair of costly NOX sensors.

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NH₃ is measured in parts per million (ppm)
Particulate count is individual particles, measured on the World Harmonised Stationary Cycle (WHSC)
All other values are g/kWhr, measured on the European Stationary Cycle (ESC).
Iveco’s SCR-only system demands exceptionally precise AdBlue control to keep it working in a narrow corridor, between 95 and 100 per cent NOx-conversion. Iveco engineers say that CFD (computational fluid dynamics) modelling of AdBlue injection and exhaust gas movement has been used to ensure there is enough swirl to encourage the fluid and gas to mix and be distributed over the catalyst.

A Euro-6 vehicle using an EGR + SCR + DPF combination can be expected to use less AdBlue than an SCR-only Euro-5 equivalent. This is because EGR prevents some NOx from forming, leaving less for the SCR system to tackle. AdBlue consumption on Scania Euro-6 engines is expected to be three or four per cent of fuel consumption, compared with five or six per cent on its Euro-5 SCR engines. The clear implication for Iveco’s SCR-only Euro-6 engines is that they will consume more AdBlue than at Euro-5. But it remains to be seen how successful Iveco engineers will be at optimising SCR efficiency to minimise increases in AdBlue bills for vehicle operators. Iveco’s UK product director Martin Flach reckons AdBlue consumption at Euro 6 is likely to be seven or eight per cent of fuel consumption, compared with five or six per cent at Euro 5.

With half their NOx emissions taken out by an SCR system, Scania engines need less vigorous exhaust gas recirculation at Euro-6 than at Euro-5: up to 25 per cent compared with up to 30 per cent. And the ever-present trade-off between NOx and particulates means that a little more NOx developed in the cylinders allows combustion to be tuned a shade cleaner, cutting particulates and improving fuel economy. This small improvement in mpg is enough to counterbalance the fuel consumption penalty of a DPF in the exhaust system, it is claimed. This helps explain why Scania engineers are adamant that a Euro 6 Actros tractor will deliver between three and four per cent better fuel economy than a directly comparable Euro 5 Actros.

The news on weight is not so good. Scania’s Euro-6 engines are up to 200kg heavier than their Euro-5 SCR equivalents. Much of the extra weight is in the silencer box, up from 70kg to 125kg. More weight is added by the AdBlue tank (50- or 75-litre capacity) and its contents.

All engines need a wall-flow DPF to comply with the Euro-6 particulate limits, including not only mass but particle count as well. Daimler employs two DPFs plumbed in parallel. Scania prefers a single large DPF. In both cases an active filter regeneration system is needed for when exhaust temperature stays low, to burn off trapped particulates before too many accumulate and raise back-pressure. Pressure sensors before and after the DPF detect any gradual increase in back-pressure and trigger regeneration accordingly. On Mercedes engines this is achieved by means of an independent fuel-injector in the exhaust manifold. A slug of fuel is vapourised and burnt in the exhaust, producing the necessary temperature spike in the DPF. The frequency of this (and hence the amount of fuel used) depends on vehicle duty cycle, but once a week is probably typical, according to Georg Weiberg, Daimler’s head of truck engineering.

Scania’s “continuous” regeneration employs the same “HC (hydrocarbon) dosing” principle as Daimler’s, but instead of an independent injector in the exhaust manifold, the XPI fuel injection system provides a post-injection of fuel in the cylinder. This fuel burns as it is swept through the exhaust. And if that fails to do the trick, a warning message comes up on the instrument display, telling the driver to press a button to activate forced regeneration. This takes about 25 minutes and involves raising engine-speed with the vehicle stationary.

“Forced filter regeneration will not be necessary under normal circumstances,” says Iveco. This would seem to be a result of egr having been rejected, thus minimising particulates in combustion at the expense of high engine-out NOx. So particulate emissions should be low and there will be plenty of NOx entering the DPF, which is upstream of the SCR system. This NOx includes the nitrogen dioxide (NO2) that helps particulates trapped in the DPF burn at a low temperature, keeping the DPF clean and clear.

None of these regeneration systems eliminates the need to remove the DPF occasionally to clean out ash residue from burnt engine oil. With an oil meeting Scania’s recently-introduced low-ash oil specification LDF-3, DPF cleaning intervals are reckoned to be around 240,000km on long-haul work. But that interval is cut in half on urban work. It is a 30-minute operation to take out the DPF cartridge from the silencer box (mounted on the chassis on a swing-out bracket) and install a service-exchange DPF, according to Scania. The original is sent back to a Scania dealer for cleaning.

**Price of progress**

The capital cost of all this extra sophistication in the exhaust pipe is considerable. Vehicle manufacturers stress the need to recoup research-and-development costs. Of Scania’s 2,800 development engineers, 600 are focused on engine technology. This is put forward as part justification for a proposed €12,000 (£10,550) price premium for a Euro-6 12.7-litre DC13 engine compared with a Euro-5 €5,300 and £7,050) more than a Euro-5 equivalent. Perhaps Daimler’s global economies of scale account for this rather lower premium, allowing the €6,000 to cost be spread across more engines. Euro-6 premiums from other truck-makers are expected to fall somewhere between these two extremes. But precise engine on-costs probably will be hard to identify anyway because there is sure to be a crop of new models and facelifts to accompany Euro-6 engines, sugaring a bitter price pill.

Appeals to European legislators to offer financial incentives for early uptake of Euro-6 engines are being made loudly by Daimler, among others. But European tax-payers are unlikely to be sympathetic. So costly are Euro-6 engines that any incentive would have to be substantial to stand any chance of being effective. Yet the cuts in NOx and particulate emissions are small by comparison with previous tiers of European emission limits.

The law of diminishing returns has set in. More than half the 11 million heavy trucks and buses in service in Europe date back to Euro-2 or earlier, according to Scania. It could be argued that financial incentives for fitting these vehicles with DPF, or taking some of the oldest off the road entirely, would deliver far bigger environmental bangs for our bucks. 

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*March 2012 the inside story Euro 6*
If there is one certainty about all Euro 6 truck and bus engines, it is that their capital costs will be higher, substantially higher, than those of the engines they will replace. Any fleet manager working on long-term fleet replacement budgets right now would be well-advised to factor in this inescapable fact. But what about running costs? On the crucial aspect of fuel economy, the jury is still out, though there are encouraging signs that any penalty will turn out to be much less than once had been feared. Indeed Mercedes is even promising truck operators that its new Euro 6 Actros will deliver on-road fuel consumption cuts of up to three or four per cent compared with Euro 5 models.

Engine oils account for only a tiny fraction of truck and bus operating costs, but there is still concern about possible adverse Euro 6 effects on whole-life engine oil costs.

Our research reveals both good and bad news. The bad news is that the engine oils recommended at Euro 6 are generally the variety costing most per litre. The good news for operators running mainly Euro 5 vehicles at present is that no radical engine oil policy change is likely to be needed when Euro 6 engines appear on the scene.

We asked Shelley Knust, technical director of midrange technical operations at the Cummins engine plant in Darlington, to explain the oil recommendations for the soon-to-be-unveiled Euro 6 Cummins engine range.

“To maximise the service life of the DPF (diesel particulate filter), Cummins will recommend oils meeting API CJ-4 (equivalent to ACEA E9),” says Knust. “These new oils have a maximum ash content of one per cent and are often referred to as low-ash or low SAPS (sulphated ash, phosphorus and sulphur). They have been developed to maximise the life of the DPF (and other exhaust after-treatment devices). They may also be used in older engines, providing ULSD (ultra-low sulphur diesel) fuel is used (otherwise the oil drain interval may be reduced). Low-ash oils have lower amounts of trace elements in the oil additive pack, including calcium, zinc and phosphorus which, when burned, form ash. If the ash content of the oil is too high, the DPF will get clogged by ash deposits (reducing engine performance) before reaching the DPF service interval. Low-ash oils enable the DPF to require less frequent cleaning.
“Exhaust gas recirculation increases the amount of exhaust soot in the combustion chamber, and subsequently into the oil. However, CJ-4/E9 oils have increased dispersants to minimise this effect so the oil service interval is not impacted. The key point here is that these oils can also be used in older engines (depending on whether they’re using ULSO). So we are going to recommend new oil at Euro 6 but it’s backward compatible.”

Probably the biggest surprise so far among the Euro 6 declarations from vehicle and engine manufacturers over the past twelve months comes from Iveco. It will be meeting Euro 6 oxides of nitrogen (NOx) limits by using selective catalytic reduction (SCR) alone, not in combination with EGR. We asked Iveco’s UK product director, Martin Flach, what the implications of this are for engine oils. “It’s business as usual,” he says cheerfully. “There’s no fundamental need to look at the oils we use for Euro 5 as they are fully up to the job of Euro 6.” Iveco already recommends fully synthetic oils from Petronas, the Malaysian oil and gas company with which it and other Fiat group divisions work closely. Flach seems quietly pleased that the SCR-only option adopted by Iveco for its Euro 6 engines means that he will not have to concern himself with the increased soot generated in crankcases by exhaust gas recirculation systems.

**What does low-saps mean?**

One basic rule of thumb for any transport engineer or fleet manager thinking about engine oil options is that a DPF in the exhaust system (and that means all Euro 6 trucks and buses, so far as we can tell) demands a low-SAPS oil: E9 or E6. A plain English explanation of these terms might be helpful at this stage.

The term “low-SAPS” (sulphated ash, phosphorus and sulphur) first entered the engine-oil vocabulary of truck and bus fleet engineers about eight years ago, following introduction of the E6 specification for heavy-duty diesel engine oil (“sequence” in the lubricants industry jargon) by ACEA (Association des Constructeurs Européens d’Automobiles), the European vehicle manufacturers association. The E6 addition to ACEA sequences was written around low-SAPS requirements. For truck and bus diesel engines, the sulphated ash part of low-SAPS has most significance, originating largely in anti-wear and detergency additives. When oil gets past the piston rings and is burnt in the combustion process, burnt additives emerge as ash in the exhaust. This is troublesome when a diesel particulate filter (DPF) is fitted in the exhaust because the ash is trapped by the filter and never burns. Accumulated ash clogs wall-flow filters, pushing up exhaust back-pressure until the filters are cleaned. The speed at which a filter clogs depends on engine health – the higher its oil consumption, the more rapid the ash accumulation.

ACEA introduced the E6 specification in response to growing use of diesel particulate filters. The laboratory test limit for sulphated ash in other ACEA sequences for heavy-duty diesel engine oil is two per cent by mass. With an E6 oil the maximum is one per cent. But though the chemistry of E6 oils may be spot-on, their economics are flawed. Stringent requirements on piston-cleanness (high detergency) mean that the base oil has to be at least part-synthetic. A sophisticated additive pack adds more cost, with the result that E6 oils are at at least twice the price of mineral-based oils. Operators of DPF-equipped vehicles are loth to pay such a price for a low-SAPS engine oil when they can instead stick with a mineral-based E7 oil (or its E5 predecessor) and live with the extra ash.

Enter E9, an ACEA sequence published about three years ago. It delivers low-SAPS in a more affordable oil. Why no E8? The explanation lies in the ACEA sequence numbering system. Even numbers such as E4 and E6 are reserved for oils satisfying the high piston cleanliness demanded by big European engine-makers such as Iveco, Daf, Mercedes-Benz and MAN. Odd numbers such as E7, E5 and E9 are for oils majors on control of soot-induced wear, as demanded by US engine manufacturers such as Cummins (which supplies Daf with the ISBe engines badged “Paccar” in the top-selling LF range of trucks). Scania engine oil recommendations are similar, to minimise soot-induced wear in its exhaust gas recirculation (EGR) engines.

Crucially, E7 and E9 sequences can be satisfied by mineral-based oils. In a nutshell, the E9 sequence is a low-SAPS version of E7. Whereas E5/E7 oils are made from “group one” base-oils, E9 oils use “group-two” base-oils. These are still mineral, but as well as containing less sulphur than group-one oils they also need fewer metallic additives, thus cutting sulphated ash at source. Group-two oils are more costly, but still far cheaper than group-three (hydrocracked mineral oils) or group-four polyalphaolefins (PAO), the starting points for E4 and E6 part- and fully-synthetic oils respectively.

E9 oils are similar to those meeting the US API (American Petroleum Institute) CJ-4 specification, introduced in 2006 for engines complying with the US EPA (Environmental Protection Agency) 2007 exhaust emission limits. The link is that these engines also need a DPF to reduce particulate emissions, so they too like low-SAPS oils. Indeed the E9 SAPS limits are lifted directly from CJ-4 rather than copied from E6.

ACEA limits do not necessarily translate into real-world comparisons of oils. Take the sulphur limit, for example. Knowing that sulphur chemically “poisons” a DPF catalyst, reducing its effectiveness, many fleet engineers will spot that the E9 sulphur
limit is higher than that of E6 but infinitely better than E4’s and E7’s. In reality, typical E4 and E7 oils have a sulphur-content of between 0.5 and 1.0 per cent. E6 oils are likely to be in the 0.14 to 0.20 per cent range. E9 oils are between 0.3 and 0.4 per cent. This is quite a spread for something that reduces the life of a DPF catalyst. Research has shown that the influence of an oil’s sulphur is minor compared with that of sulphur in fuel. But the balance shifts as we move to zero-sulphur diesel. And the argument for low-sulphur oil strengthens for DPF-equipped vehicles with engines suffering high oil consumption.

For fleet engineers seeking to extend DPF cleaning intervals, the link between an oil’s sulphated ash and accumulation of ash in the DPF is clear. Nevertheless, ACEA sulphated ash limits again do not tell the whole story. The E4 and E7 sequences have the same 2.0 per cent upper limit on sulphated ash but the extra additives in an E4 oil for higher levels of piston cleanliness will generate ash. So a typical E4 oil has a sulphated ash content around 1.8 per cent, whereas E7 oils generally are nearer 1.3 per cent. Low-SAPS E6 oils are likely to be at around 0.9 per cent and E9 oils have to be close to that to squeeze below ACEA’s 1.0 per cent limit. But Shell’s UK oil products division, first to market four years ago with an “E9-ready” oil, Rimula RT4 L 15W-40, acknowledges that it will lead to more ash in a DPF than the “top-tier” low-SAPS Shell E6 oil.

Shell expects E9 oils to be most popular in DPF-equipped buses, particularly those with Cummins engines that would otherwise use E7 or E5. High oil-consumption in the many elderly buses still in service makes such premium oil deeply unappealing. Moderately-priced E9 oils look promising. Similar reasoning applies to many of the elderly trucks forced to have DPF fitted to comply with London’s low-emission zone (LEZ).

Urban bus operations

Oil companies are increasingly keen to focus on the potential fuel-efficiency gains offered by their top-spec products, and the introduction of Euro 6 engines is sure to accelerate this trend. Generally the economics are more likely to make sense with long-haul truck operations, but sometimes they can apply equally well to urban bus operations.

Four years ago Plymouth Citybus, a Devon bus operation then owned by the local council (now part of the Go Ahead group), switched its entire fleet of around 160 buses to a fully-synthetic (and costly) Shell engine oil, Rimula R6 LM 10W/40. About two thirds of the Plymouth Citybus buses are fitted with Allison automatic gearboxes. At about the same time, a fully synthetic lubricant, Transynd TES295 from Castrol, was adopted for these as well. “With public transport in constant demand, it is essential that the fleet is not pulled off the road unnecessarily,” said Plymouth Citybus engineering director Karl Duncan at the time. “Using this new formulation of Rimula (engine oil) enables our Cummins-engined buses to adopt an average oil-drain period of 40,000km, double our current 20,000km, so we need to take them off the road less often.” The switch to fully-synthetic lubricant in the fleet’s Allison transmissions, coupled with regular oil testing, meant that their routine oil change interval could be extended from 40,000km to 120,000km, or three years.

Four years on, how does engineering director Karl Duncan now look back on the switch to full-synthetic engine and gearbox oils? He has no regrets whatsoever. “It has saved us a fortune,” he says, though adding that the fully-synthetic engine oil now used in his fleet is supplied not by Shell but by Q8 Oils, part of Kuwait Petroleum International Lubricants (UK).

Steve Crawley, commercial vehicle lubricants manager in ExxonMobil’s UK and Ireland division, spends much of his time trying to convince truck operators to see oil as Karl Duncan does, as an investment rather than a cost. “We work closely with OEM (original equipment manufacturers) to develop the correct oils, often from their engine blueprint stage, and it’s a working partnership that benefits us both,” he says. Cheap oils and frequent drain intervals are anathema to Crawley. “Professional fleet engineers understand that oil is not a convenient avenue for cutting costs and corners,” he insists. “We’ve developed a useful spreadsheet for our customers that demonstrates the impact that their choice of oil has on the total cost of ownership. We run trials with customers over an 18-month period and let them see the results for themselves. You do need to be meticulous in ironing out the variables, but a low-friction fully-synthetic product provides figures for all to see.”

Castrol’s point of view

Brian Utton is technical manager at the heavy duty vehicle division of Castrol, the BP group’s Swindon-based lubricants subsidiary. In the April 2011 edition of Commercial Vehicle Engineer he spelled out the economic arguments in favour of costly, full-synthetic engine oils as Castrol sees them. The introduction of Euro 6 engines is bound to focus more and more attention on the points Utton makes.

Plymouth Citybus: switched to fully-synthetic engine and transmission oils four years ago.

In these cash-strapped times, many truck fleet engineers (not least in local authorities) are increasingly faced with conflicting pressures. They are expected to cut running costs on the one hand, but on the other to extend the lives of vehicles that normally would be ripe for replacement. Vehicles once covered by manufacturers’ repair-and-maintenance agreements are now out of contract and not being replaced as planned but asked to soldier on for another year or so. But it remains the fleet engineer’s job to keep them running reliably. With the cost of diesel fuel scaling new peaks with every passing week, it is hardly surprising that the pressure to improve fuel economy is intensifying as well. So what is a fleet engineer to do? My advice in many instances is to make what may well seem like an odd decision: switch to a more expensive engine oil. To be more precise: one that is more expensive in terms of cost per litre. The point is that this particular cost is far less significant than the impact of oil type on cost of oil per kilometre and, ultimately, on the overall cost per kilometre of vehicle operation. So, what is the best buy when it comes to filling the 40-litre sump of a typical long-haul truck? Is it a standard mineral oil at around £2.25 per litre, a synthetic at £2.90, or an all-singing, all-dancing low-viscosity, high-performance oil at maybe £5.90 per litre?

For the sake of argument, let’s consider two representative oils from the Castrol range, both of the low-SAPS (sulphated ash,
phosphorus, sulphur) variety: Enduron low-SAPS 10W-40 and Elixion low-SAPS 5W-30; and compare them with what we’ll call a bog-standard mineral multigrade. As always pointed out in the excellent annual Commercial Vehicle Engineer analysis of truck operating costs, bear in mind that the actual prices you will pay for these oils will vary considerably, not least with size of order. But for the sake of argument again, we’ll stick with the per-litre prices of £2.25, £2.90 and £5.90. The first thing that needs to be established with any engine oil is its suitability for the particular truck in question, taking into account make, model, age and vehicle operation. Truck-makers have their own individual standards on wear-protection of lubricants and their ability to cope with contaminants. These standards should be used in conjunction with oils’ E-numbers to decide suitability. Some people still mistakenly think an £4 oil must be suitable for a Euro-4 engine. Sadly, the truth is far more complex. The E-numbers on engine oils represent classifications (“sequences” in the technical jargon) published by ACEA (Association des Constructeurs Européens d’Automobiles), the Brussels-based association representing European vehicle manufacturers. These sequences are based loosely on Mercedes performance specifications, but tailored to meet various engine requirements. They are used by engine manufacturers and oil companies alike as a measure of compatibility. Beware of some anomalies. The performance of E5 oils, for example, is inferior to that of E4s but superior to E3s, so perhaps really should have been categorised as £3.5. But the crucial thing is to ensure that the engine oil you intend to use meets the requirements specified by the truck manufacturer and is suitable for the truck’s particular operation. This brings us to our first money-saving opportunity. Some vehicle manufacturers approve more than one grade of oil, but the specified oil-change intervals vary with the grades. Take for instance a truck with a standard recommended oil-change interval of 100,000km. This is extended to 150,000km with upgraded oil. Let’s do the maths. The cost of 40 litres of mineral oil changed at 100,000km is £90 (40 x £2.25). So the cost of oil per 10,000km is £9.00. The cost of 40 litres of Enduron low-SAPS 10W-40 would be £116 (40 x £2.90) but its oil-change interval is 150,000km, so the oil cost per 10,000km is £7.73. In other words, oil costs have been cut by 14 per cent. And the savings do not end there, because other oil-change costs ought to be factored in, including labour, waste-oil disposal, filters and gaskets, to mention lost productivity while a truck is off the road. In 300,000km a truck on standard mineral oil would have needed three oil changes whereas on Enduron low-SAPS 10W-40 it would have needed only two. On top of all this, the higher-quality oil will have provided better protection against engine wear, even with the longer oil-change interval. And for a truck with a diesel particulate filter (DPF) the low-SAPS properties of the more expensive oil will have meant less risk of filter clogging and the attendant adverse effects on vehicle performance or perhaps even costly filter replacement.

Now let’s consider Elixion low-SAPS 5W-30. It seems difficult, on the face of it, to make a strong case for this oil. Like Enduron low-SAPS 10W-40, it conforms to £6 and £7 standards yet is much more costly. An oil change on our long-haul truck would cost £236 (40 x £5.90), so the oil cost per 10,000km would be more than doubled, as the oil-change interval would be no greater than with the Enduron oil. But independent field tests have confirmed that switching from a 10W-40 engine oil to a 5W-30 can deliver fuel consumption savings of four per cent. The saving is greatest in winter, at low ambient temperatures, so a year-round average saving of three per cent would be a reasonable assumption.

Let’s factor this into the truck’s combined fuel and oil costs, assuming the truck’s average fuel economy is 8mpg. Over 150,000km (93,205 miles) this truck will consume 52,425 litres (11,650 gallons) of fuel. At an assumed bulk diesel price (excluding VAT) of 109p per litre, that comes to £57,143. A three per cent fuel saving would cut this bill to £55,429. So switching to Elixion low-SAPS 5W-30 would cost an additional £120 but should deliver a fuel saving worth £1,714 over 150,000km. Suddenly the Elixion case seems anything but weak.

It is hard to think of any other investment of such modest size that is capable of delivering a saving like this is a transport operation. Even if the oil did not perform nearly as well as expected and returned only a one per cent fuel saving, well over £500 still would be knocked off our truck’s fuel bill. And it is worth underlining that these savings would be consistent, and not dependent on driver training or behaviour, or on anyone remembering to do something or use special equipment.

Castrol is now so confident in data from field and laboratory tests that we are offering a software-based fuel efficiency calculator to allow operators to work out fuel savings predicted to result from switching to Elixion low-SAPS 5W-30.

As the emphasis on improved fuel efficiency and commensurate cuts in carbon dioxide emissions from trucks and buses intensifies in the post Euro 6 world, the economic arguments in favour of low-friction but costly engine oils are sure to strengthen. Buyers of new vehicles would do well nevertheless to take careful note of the word of caution offered by Nick Blake, Mercedes-Benz UK’s highly-regarded truck sales engineering manager. He advises operators to check carefully on the specification of engine oil in the sumps of newly-built vehicles. “A high-quality fully-synthetic or low-friction oil is not good news for a brand new truck,” he says. “We don’t recommend its use until after the engine is run-in, when it does have a valuable role to play. All operators know that a truck does not reach peak performance on fuel economy until it has a few months work behind it.”

On current, OM501/S02 engines, Mercedes uses Shell Rimula Ultra SAE 5W-30 as a factory-fill. So be warned, using a tip-top thin and slippery oil from new will drag out the running-in process and cost you money. These engines at least need a bit of the rough stuff to properly bed in.

Mercedes-Benz UK truck sales engineering manager Nick Blake: “Low-friction oil is not good news for a brand-new truck.”
FM Conway is a Dartford, Kent-based firm specialising in highway maintenance, civil engineering and construction services in and around London. The Conway fleet of more than 250 trucks includes tippers, mixers, “hot-boxes” (tarmac carrying trucks), white-lining vehicles and low-loaders. This January’s tightening up of London’s LEZ (low-emission zone) rules precipitated the departure of 80 Euro-3 vehicles, leaving the entire fleet now at Euro-4 and -5 levels.

Transport manager Peter Parle is a pragmatist. But he is also naturally averse to letting vehicle replacement policy drift, so even though it will be the thick end of two years before Euro 6 legislation comes fully into force, it is firmly on his radar already. “We run eight-wheelers for around seven years”, says Parle. “They do relatively low mileages with a lot of their time spent attending JCBs and road-planers, so we let them run the distance.” When Conway vehicles not subject to contract hire deals reach the end of their time in the fleet, many end up being exported. “There are more right-hand-drive markets out there that many people might think,” explains Parle. “Although it seems a fair way off, in practical terms we have started tailoring our fleet replacement activity to allow for the arrival of Euro 6.” How worrying are the mooted steep price increases? “The trade media have been predicting increases around €10,000 per chassis with Euro 6,” he says. “So let’s put it this way: I don’t expect to be registering much in the first half of 2014.”

Parle evidently has been paying more attention than most fleet managers to the technical details of Euro-6 limits. “Particulates will be further cut to just 0.01g/kWh, with NOx (oxides of nitrogen) down to 0.46g/kWh,” he notes. “It’s great news for the environment, but I do wonder how much there is left to squeeze out of this lemon.”

He is far less concerned about service and maintenance cost implications. Conway employs 22 fitters in its own workshops, though a fair number of the firm’s vehicles are contract hired, with repair and maintenance included. Parle likes to mix and match between outright purchase and contract hire so he can take full advantage of the keenest prices at any particular time.

He recognises that Euro 6 vehicles will bring fresh maintenance challenges. “Most trucks will have a particulate filter which will need cleaning more regularly, but this will be simply integrated into
workshop schedules,” he says. “Apart from the increased chassis prices, my only other worry is to do with the enormous cut in emissions over Euro 5. I’ve a feeling it will cost us fuel.” Like many truck fleet managers, he remains sceptical about truck-maker promises on fuel economy, at least until he sees figures in his own operation.

Volvo, Daf and Mercedes Euro-5 trucks in the Conway fleet mean it is already no stranger to handling and storage of the AdBlue demanded by SCR (selective catalytic reduction) exhaust after-treatment systems. New Conway depots incorporate underground AdBlue storage tanks. On older sites the liquid is stored in IBC (intermediate bulk containers).

“We manage perfectly well,” says Parle. “It’s largely a space issue.”

A top ten logistics company
Bibby Distribution is a Liverpool-based logistics company owned by Bibby Line Group. Sister companies in the £1 billion-turnover family-owned group include a shipping line, several related maritime businesses, and Costcutter, a Yorkshire-based franchised convenience store organisation. Among Bibby Distribution acquisitions in the past two years are Tay Group of Bedfordshire, Worcestershire-based TM Logistics (Taylors of Martley), and parts of...
MRS Distribution, a collapsed Bathgate-based operator. All this has taken Bibby Distribution fleet strength to around 1,800 vehicles and trailers. The company now operates from 100 sites, has about 2,000 employees and is reckoned to rank among the UK’s ten biggest logistics companies.

Following the retirement of Geoff Mitchell, John Finn was appointed Bibby Distribution fleet and procurement director in April 2011. Finn was previously fleet director at Home Delivery Network (HDNL), the big parcel delivery operator renamed Yodel in March 2010 following its acquisition of the DHL Express parcel operation. Yodel is owned by the Barclay brothers, whose other interests include Telegraph newspapers.

Finn has worked in fleet management and road transport engineering for over 35 years. Before joining HDNL he was DHL’s UK fleet director. His previous posts include engineering operations manager at Joint Retail Logistics (JRL), the 50/50 joint venture set up by Exel and Tibbett & Britten in 1999 to serve Marks & Spencer.

In short then, when it comes to truck fleet management and engineering Finn know his onions.

His policy with the 600-plus tractive units in the Bibby Distribution fleet is to replace them after only 24 months in service. Bibby has no workshops of its own and runs all its trucks under repair-and-maintenance (R&M) contracts with manufacturers and dealers. Finn’s Euro-6 plans are sure to give truck-makers pause for thought. Capital costs and fuel consumption are his two top concerns. “We will be deferring any Euro-6 purchases for as long as possible,” he says. “We will be buying forward Euro-5 fleet from the third quarter of 2013. After the Euro-6 deadline passes in December, I don’t expect to buy another tractor for 18 months.”

This is hardly music to the ears of truck salesmen in a market recovering from a long, deep slump. But Finn sums up the position accurately and succinctly. “Of course we’ve been here before,” he says. “The supply and demand cycle is regularly interrupted by the vagaries of economic ups and downs, and legislation on emissions have given us additional peaks and troughs. This will be no different, but the unusually high chassis price hike with Euro 6 will exacerbate the position.”

A youthful fleet of trucks is soon to become even more valuable than normal, Finn points out. “With the added cost of Euro-6 chassis and the inevitable buy forward of late Euro-5 models, our used stock’s value will increase as demand lifts in front of the deadline,” he notes, recalling the “ridiculous” lead times for new trucks (60 weeks or more) of a few years ago, and predicting that we could easily be in a similar situation in late 2013.

About 90 per cent of Bibby tractors at present are MANs, supplied in a deal with unusually flexible terms. “We buy tractors on a two-year deal and, in theory, they could go back after just one month with no penalty,” explains Finn. “Of course, we’ve never done it, but if we’d needed to during the recession, the facility was there. As we approach the end of 2013, I can dispose of good-quality, late-model stock which MAN will be pleased to take as availability of new stock will be under pressure with prices moving upwards.” Bibby trucks are painted plain white with a simple vinyl livery to help keep costs down when they are sold on.

But this flexible acquisition plan was not the only MAN attraction. “We liked the simplicity of not needing AdBlue as well as the get-out option in the deal,” says Finn. “We know AdBlue is on the way as everyone seems to be going for it at Euro 6, whether they need the additional bite of EGR or not. It’s not an issue for us. We took 20 MAN 460s with SCR before Christmas to assess them and they are easily supplied from IBC (intermediate bulk containers).”

It is clear that the unquantified scale of Euro-6 truck price increases just around the corner remains Finn’s primary concern. “It’s difficult to get a firm statement about the on-cost for Euro 6 from the truck manufacturers,” he says. “It feels like a game of poker sometimes. We need to know what these costs are, and so do our customers.” At present he is basing budget forecasts on the estimate that a Euro-6 rig, comprising three-axle tractive unit and new curtain-sided tri-axle semi-trailer (meeting the specification for longer trailers at present on trial in the UK), will cost about £16,000 more than a comparable, current Euro-5 outfit (with 13.6-metre semi-trailer).

“That needs recovering,” he says. “We’re not afraid of investing. We put 400 new trailers on the road last year. It’s the pricing mystery we don’t need.”

Bibby Distribution: around 90 per cent of its tractive units are MANs.
A concise explanation of some of the abbreviations, acronyms and technical jargon most commonly associated with Euro 6 engines and commercial vehicles.

ACEA - Association des Constructeurs Européens d’Automobiles, the Brussels-based European vehicle manufacturers association which publishes engine oil specification “sequences” including E4, E6 and E9.

AdBlue – the trade name coined and registered by VDA (Verband der Automobilindustrie), the German motor industry association, for the liquid made up of urea and water and used in SCR (selective catalytic reduction) exhaust after-treatment systems to break down NOx emissions from diesel engines.

cetane number - a measure of diesel fuel’s ignition quality.

common rail – a highly-efficient fuel injection system used in many modern diesel engines. Fuel is fed into a pressurised reservoir, or ‘rail’ which feeds injectors with fuel at a high pressure which is independent of engine speed.

CO₂ – carbon dioxide is a by-product of combustion, the amount emitted being in direct proportion to fuel used. It is one of the “greenhouse gases” on which climate change is blamed.

CO – carbon monoxide is one of the emission by-products from internal combustion engines and is a result of incomplete combustion of fuel. It is a colourless, odourless but toxic gas which blocks the ability of lungs to obtain oxygen. Compression-ignition (diesel) engines emit far less CO than spark-ignition (petrol) engines.

DEF – Diesel Exhaust Fluid is the name used in North America for the SCR urea solution called AdBlue in Europe.

doc – diesel oxidation catalyst promotes oxidation process in diesel exhaust after-treatment system. The filter has a catalytic coating in its honeycomb structure to oxidise soot particles.

DOT - US Department of Transportation.

DPF – diesel particulate filter physically traps particulates to stop them being emitted from the tailpipe. In an ‘active regeneration’ DPF, hot exhaust gases are used to burn off the particulates captured in the filter.


EGR – exhaust gas recirculation is the process whereby a percentage (typically 25-35 per cent) of a diesel engine’s exhaust gases are redirected back into the combustion cylinder to help cut oxides of nitrogen emissions.

EPA – Environmental Protection Agency. US government agency responsible for legislation and enforcement of rules on diesel engine emissions.

exhaust after-treatment – equipment to remove emissions from a diesel engine’s exhaust downstream of combustion chambers. In Euro 6 engines, most manufacturers are likely to use a combination of SCR and EGR, together with a particulate filter.

HC – hydrocarbons are unburnt fuel found in the exhaust stream after the combustion process. They are present at very low levels in diesels. They contribute to ambient ozone formation and are associated with volatile organic compounds (VOC).

g/kWh – grams/kilowatt/hour is the unit of measurement for the constituents of a diesel engine’s exhaust as currently used in Euro 1- Euro 6 emission legislation.

NOx – oxides of nitrogen. The collective term for gaseous emissions composed of nitrogen and oxygen NO and NO₂. They are formed during high temperature combustion and contribute to ambient ozone formation and regional haze, causing health concerns.

OBD – on-board diagnostics, the part of an engine’s electronic control system monitoring emission control. When OBD detects excessive emissions it alerts the driver and logs the event. In extreme cases it can even automatically limit engine power and torque.

PM – particulate matter is a complex mixture including nitrates, sulphates and solid carbon (soot) by-products of combustion. Low combustion temperature and incomplete combustion increases PM emissions. It contributes to ambient PM formation causing health concerns.

SCR – selective catalytic reduction is an exhaust after-treatment involving liquid urea (AdBlue in Europe) being injected into the hot stream of exhaust gases where it breaks down into ammonia. The ammonia is used by the catalytic convertor to convert NOx into harmless nitrogen gas (N₂) and water vapour (H₂O).

ULS D – ultra-low sulphur diesel is diesel fuel with a sulphur content less than 15 parts per million (ppm) by volume. This is essential in modern diesel engines to ensure the exhaust after-treatment works properly.

VGT – variable-geometry turbocharger is one in which turbine vane position is continuously adjusted (mechanically or electronically) to optimise airflow into the combustion chamber. One effect is to eliminate the “turbo lag” of conventional turbocharged engines.

XPI – Extra High Pressure Injection, diesel fuel-injection system developed jointly by Cummins and Scania. Very high fuel injection pressure contributes to optimum combustion and fuel-burn rates.

ZEV - zero emission vehicle, probably powered by electricity, fuel cells or hydrogen, and certified as meeting emissions standards specified by the California Air Resources Board (CARB).
Perfectly Adapted

Greener engines, perfectly adapted to meet your needs.

Over 90 years of engineering expertise is invested in Cummins' Euro 6 engine programme. Our products have proven to deliver both operational and environmental benefits in bus and truck use up to Euro 5. The new Euro 6 engines will be tailored by our engineers to meet your specific needs and optimised for the lowest possible fuel consumption and CO₂ emissions. Backed by the widest experience in engine technologies, Cummins is the natural choice for Euro 6. Visit www.cumminseuro6.com for more information.