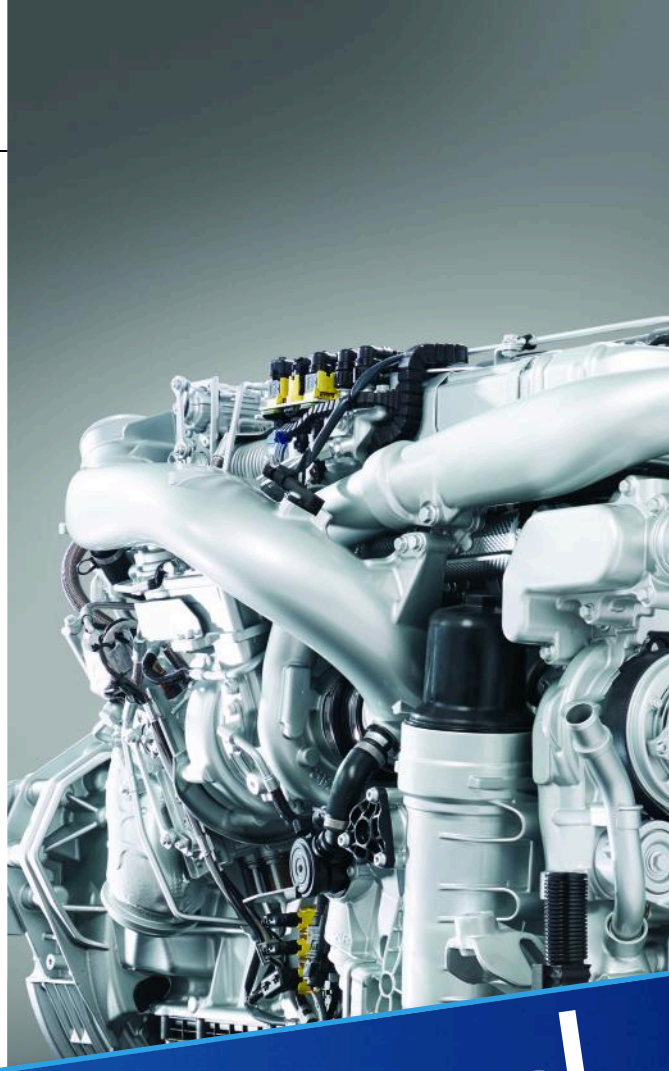
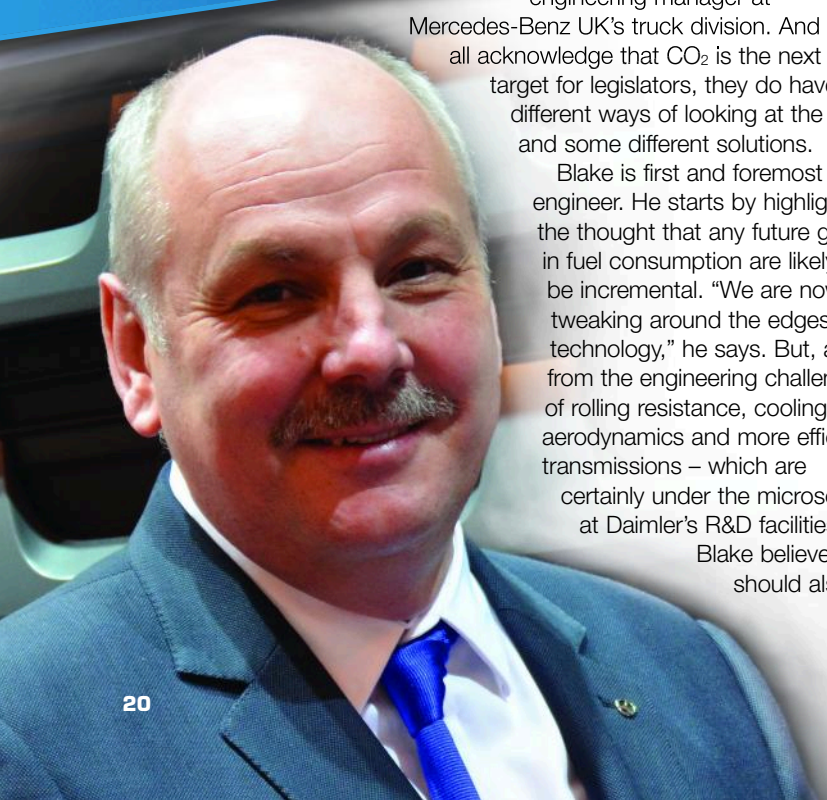
To infinity and

The heavy commercial vehicle industry has been concentrating on Euro 6 for so long, you'd be forgiven for thinking it was the end of a process. It isn't. Ian Norwell speaks to three senior engineers about what's next



The long-since familiar graphic that illustrates the dramatic reductions in exhaust emissions – especially particulates and oxides of Nitrogen (NOx) – achieved on the journey from Euro 1 to Euro 6, is undeniably impressive. It's been a 20-year trail. But while particulates, NOx, hydrocarbons, carbon monoxide and ammonia have taken a pummelling, one gaseous emission has kept itself out of the limelight. We're talking about carbon dioxide and it's surprising, because CO_2 is probably the best-known villain of the greenhouse gas gang. And it correlates directly with fuel consumption and costs.

So I travelled to Eindhoven, Munich and Birmingham to explore what's likely to happen next, speaking to Ron Borsboom, chief engineer at DAF Trucks, Stefan Knecht, senior vice-president of engineering at MAN, and Nick Blake, sales engineering manager at Mercedes-Benz UK's truck division. And while all acknowledge that CO_2 is the next target for legislators, they do have different ways of looking at the issue and some different solutions.



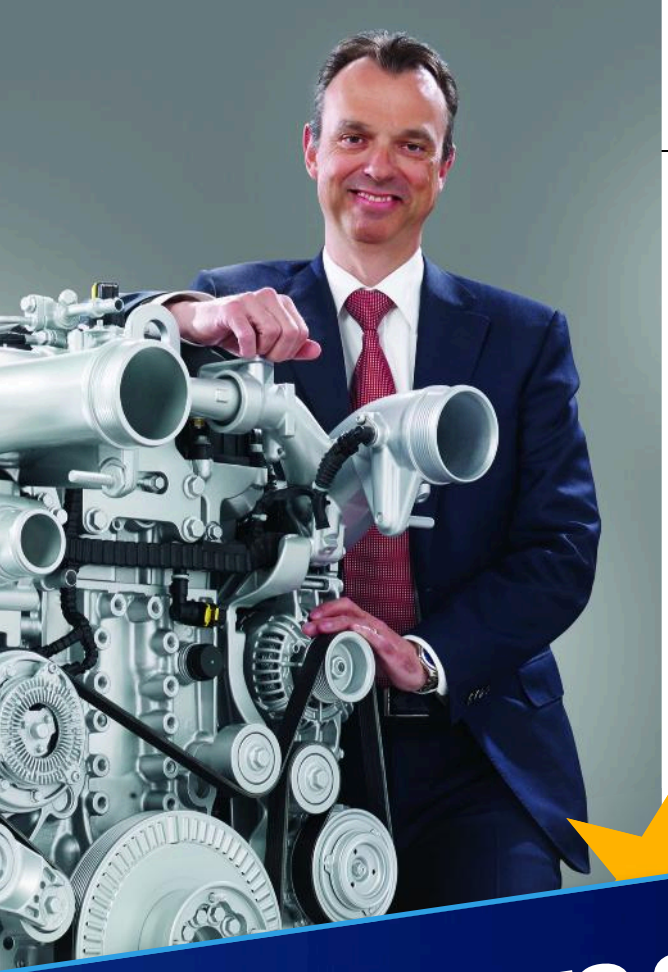
Blake is first and foremost an engineer. He starts by highlighting the thought that any future gains in fuel consumption are likely to be incremental. "We are now tweaking around the edges of technology," he says. But, aside from the engineering challenges of rolling resistance, cooling, aerodynamics and more efficient transmissions – which are certainly under the microscope at Daimler's R&D facilities – Blake believes we should also be dusting off our chemistry textbooks.

"The chemical formula for diesel fuel is $C_{12}H_{26}$ and the numbers speak for themselves. Most hydrocarbon fuels have a 2:1 ratio [of hydrogen to carbon] and, unless we move to a low-carbon fuel stock, our opportunities for significant improvements are limited," he asserts.

Lower carbon fuels

We are currently burning 200 tonnes of diesel fuel per second in Europe and its fossil-based nature makes CO_2 emissions a direct result. In energy terms, diesel gives you a bigger bang per volume (never mind buck) than, say, methane (CH_4) or LPG (liquefied petroleum gas – primarily propane (C_3H_8) and butane (C_4H_{10})), but both carry less carbon. So, yes, there are infrastructure and technical challenges, but Blake points out that there are big wins to be had by changing the fuel game.

A low-carbon fuel, such as biomethane, in a diesel engine has the potential to cut CO_2 by 60%. "Such a fuel should not be wasted in power stations, where there are alternatives, but dedicated to road transport," insists Blake.



beyond

DAF's starting point, however, is slightly different. Ron Borsboom believes that hunting down every location where energy is lost will yield the best gains. "The sweet spot of operation is the holy grail we are pursuing," he indicates. And even with his new Euro 6 MX-13 engine and a new XF tractor at his side, he walks with a frown. "The entire drivetrain, from piston crown to the tyre and road interface, needs constant examination," he says. He points to the rear axle. "We have reduced the oil capacity of our XF rear axle by 30% and saved energy previously lost in churning. High-quality oils have allowed us to do this – and it's not over." But DAF's researchers are also looking at three more areas for either cutting or recycling waste energy. They believe that brakes, exhaust heat recovery and smart mobility will be key to many efficiencies over the next 30 years.

Energy recovery

Regenerative retardation, and the recovery and conversion of waste heat to re-usable energy, possibly via steam, are all on the table. Meanwhile, smart mobility will kick off the drivers' and route-planners' contribution. "The billions of euros we spend can easily be squandered by these guys. We've got to be in it together," says Borsboom.

Then again, while all three engineers agree that areodynamics have a lot more to offer, Borsboom cautions that it's too easy to think the industry can cover every angle with a smooth surface. "There are big cooling issues to be overcome and the cost/benefit needs careful examination," he warns. One damage repair bill can negate even a long period of microscopic wins, he adds.

Turning to materials of construction, MAN's Knecht believes these, too, will bring big benefits. We've seen the recent move to CGI (compacted graphite iron) blocks and heads, and Knecht expects more soon. "Weight reductions, with materials such as high-strength steels, are helping," he says, adding that "the game is far from over for steel". However, Knecht sees new materials opening the door for even further down-sizing and down-speeding of engines. The additional strength and ever-higher injection pressures they allow will also help to 'narrow-band' new engines and back them into a corner where they are most efficient.

"[The sweet spot] is currently between 900 and 1,100 rpm, but we are putting the squeeze on it," states Knecht. That said, steel remains interesting, not least because of some of the others' drawbacks. Aluminium, for example, has a dual personality: it works well in certain roles, but is expensive to make and even worse to repair. Plastics and thermo plastic materials, such as SMC (sheet moulding compound) and new tech versions (SMC-lite), are also in the frame, but cost of production and recyclability issues mean that vigilance is required.

Then, on the transmissions front, Knecht agrees that ratio switching without torque breaks is the future. Dual-clutch systems will come, but the cost and weight penalties have to be worth it. Some of these systems are being developed to withstand outputs of 600bhp and 3,000Nm-plus. That could leave DAF playing a canny waiting game, as it is not a member of the brutal horsepower club.

As for a verdict, no one should be in any doubt that the search for a more efficient truck is on-going. The commercial imperative alone is sufficient to push these engineers and their companies to greater heights. TE

Clockwise from top left: DAF's Ron Borsboom, MAN's Stefan Knecht and Nick Blake, of Mercedes-Benz