Diesel's not dead (yet)

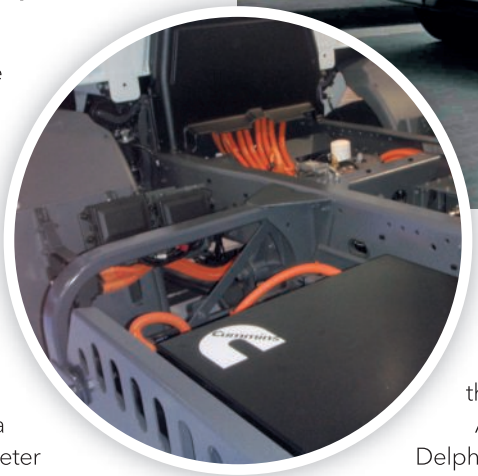
The IAA Show in September 2018 was remarkable for the foregrounding of non-diesel trucks. But, in the background, it appears that there is still more to be squeezed from the diesel engine. By Richard Simpson

Last month marked the point at which the clock starts ticking for Europe's truck manufacturers in terms of reducing fuel consumption in response to the EU's demand that vehicle carbon emissions must fall by 20% by 2025 and 35% by 2035. Furthermore, 5% of all new trucks registered will have to be low or zero emissions by 2025, and 20% by 2030.

Last autumn's IAA Show in Hanover, Germany provided some useful insights into how this was going to be achieved. Electric power for distribution trucks was highlighted by DAF, Mercedes, MAN and Volvo Group, while IVECO took the unprecedented step of clearing its stand of diesel vehicles altogether and promoting gas as the fuel of the future.

Stepping away from the bright lights of the manufacturers' stands, representatives from tier one and two suppliers almost universally state that diesel isn't dead yet. However, they add that meeting ambitious carbon reduction targets would require a multifaceted approach involving increasing combustion efficiency, reducing parasitic losses and recovering energy that might otherwise be wasted as exhaust heat or braking friction.

Starting with the fuel being put into the engine, Delphi said its DFI 21 injector has begun small-scale production for trials with engine manufacturers. DFI 21 forms the heart of the upcoming F3 common-rail system, which is set to replace the F2 injection that took DAF and Volvo to Euro VI. It features a pin of only 1mm diameter precision-ground to just a few microns of variability, allowing for an astonishing 10 injection events per combustion cycle at pressures of up to 3,000bar (pictured, p13). This degree of precision lowers peak combustion pressures, enabling NOx and soot outputs to be reduced, removing some of the burden from exhaust aftertreatment systems. It's more than mechanical: miniaturised electronics enable true closed-loop control of the combustion process, with any variation in injector performance being compensated for electronically. The F3 system will appear on production engines from 2021.



Delphi also developed the injector currently used on Volvo gas engines. A small combustion charge of diesel precedes a main injection of gas, with both fuels entering the combustion chamber through the same nozzle. And expertise Delphi has developed in electronic controls will enable it to provide key components to manufacturers producing hybrid drivelines; not motors or batteries, but inverters. It cites its Viper high-voltage switch as an example.

REDUCING DRAG

Besides enhanced combustion, engines can also be made more efficient by reducing parasitic drag. Federal-Mogul showed new piston rings and a plain bearing material, both designed to work with the next generation of ultra-low Euro VI lubricants in diesel engines (*www.is.gd/jucuze*), which in turn will reduce internal pumping and churning losses. It is also working on a variety of solutions involving electric systems for diesels, including electric supercharging and hybrid drives (see also pp10-11).

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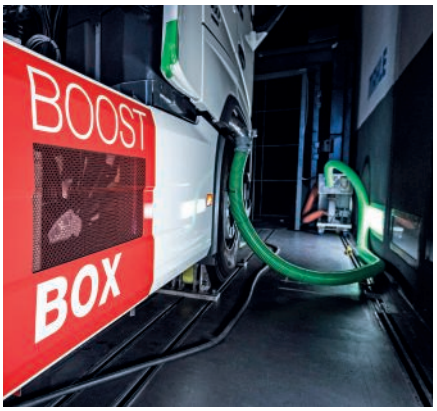

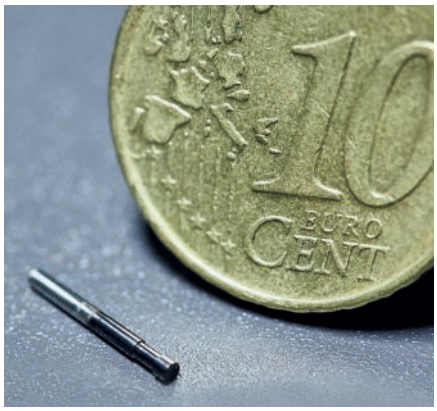

The instant response from an electric supercharger may enable the downsizing of smaller truck engines from six to four cylinders, saving weight and fuel.

Bosch can bring a huge range of expertise to bear in helping decarbonise transport, not least from its experience of developing the 'internet of things' for its domestic appliances. It acknowledges that, even in 2025, most trucks will run on diesel. So a key challenge is to get them to run on less diesel, by fine-tuning fuel injection and exhaust control.

It contends that battery-electric drivelines will never be used on long-haul trucks: the batteries will always be too heavy. Instead, it is developing hydrogen fuel cells, arguing that their range per tonne will be ten times higher.

Cummins, by contrast, is backing a mixture of all-electric and hybrid technology. It supplied the driveline for the battery-electric LF truck shown by DAF, and also displayed its PowerDrive 6000 diesel hybrid in a Kenworth T370 crane truck on its own stand. PowerDrive replaces the conventional transmission with two hybrid and two pure electric drive options, optimising the powertrain for the best fuel economy for the situation with an electric-only range of 80km (50mi). It can also produce external mains power, and the truck's crane can be powered by the diesel engine or electricity.

Mahle is also pursuing a dual-technology strategy that includes diesel. It will continue internal combustion developments until at least 2030. Diesel engine technologies include waste heat recovery from the exhaust to generate electricity, either to power auxiliary systems or to boost the driveline to the tune of 13kW – equating to a 5% fuel saving. The Mahle Boost Box (pictured above) is retrofittable to existing truck designs.

For hybrids, Mahle is developing an oil management module that will cool the battery motor and transmission. It sees fuel cells as having great potential in the post-diesel world, but cautions that the waste heat will be of the same order as that of a diesel engine.

Eaton can install a mild hybrid into existing transmissions via the PTO, with a 48V motor/generator and a cab air-con drive both incorporated. Energy recovered from the truck on overrun could be stored to power the air-con when parked. The 48V electric motor/generator could also replace both the engine starter motor and generator, and power-steering pump. About 22kg could be shaved off total vehicle weight, and there would be no drive belts cluttering the front of the engine.

Regenerative braking systems are an essential for hybrid and electric vehicles, but installing a regenerative brake on to a trailer could turn any existing compatible tractor into a hybrid. Brake giant WABCO's prototype eTrailer showed how this might work. The rear axle incorporates a differential, with a shaft-driven 224bhp induction motor/generator. This provides braking ahead of the trailer's friction brakes, and then returns the harvested energy for traction purposes or to power a system such as a fridge motor.

There is a weight penalty of around 1.4 tonnes on the prototype, but production versions are expected to weigh less than one tonne, which could be compensated for if the EU gives a similar allowance for electric trailers as it does for trucks. Payback could be less than two years for regional distribution of 100,000km (62,000mi)/year. But the OEM warns operators to be careful to fit the correct tyres to the driven axle; chances are that a conventional trailer tyre will not be the best choice.

It's an idea which has been tried before, but WABCO maintains that its expertise in electronic braking means that its system can be used safely without risk of jack-knifing or other hazards on any tractor with WABCO EBS. TE