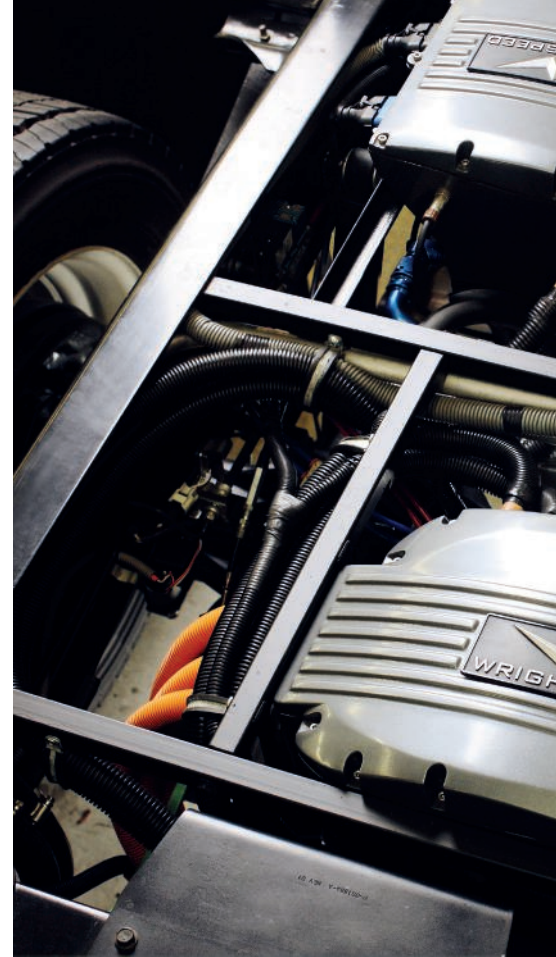


Brighter sparks



Hybrids, range extenders and full-electric vehicles are getting a lot of airtime and attracting significant R&D dollars. But are some developers missing an engineering trick? Brian Tingham reports

Hybrids, range extenders (series hybrids that relinquish diesels as part of the drivetrain), full electrics... The look and feel not only of commercial vehicle powertrains but also of their energy storage and delivery technologies, as well as their associated 'refuelling' infrastructures, is on the move.

And it's no longer just about buses and a few vans and lightweight chassis cabs - the former driven by subsidies, the latter riding on the coat-tails of accelerating take-up in the automotive sector. Mid to heavyweight trucks are also now seeing significant engineering innovation, if not yet much uptake.

Look at Mercedes-Benz's 26-tonne all-electric rigid - a revolutionary truck that has already moved beyond last year's IAA Hanover Show prototype into small series production, and trials with major operators across Europe (see panel).

Look also at US-based Nikola Motor Company's Nikola One full-electric long-haul 6x6 tractor unit, which famously boasts 1,000bhp and 2,700Nm torque delivered via six wheel motors. Still at prototype stage, this leviathan is powered by a 320kW/h lithium-ion battery pack, in turn charged via a hydrogen-electric 800V fuel cell (or, optimally, a 400kW gas turbine-driven

generator - strictly speaking, making it a range-extender hybrid).

Also in North America, Mack is working on a range extender drivetrain - in its case a Wrightspeed Route 1000 hybrid powertrain in place of the conventional MP7 11-litre diesel engine on its LR RCV (refuse collection vehicles) chassis. Drive is all electric, with Wrightspeed's 80kW Fulcrum multi-fuel turbine generator and its 730kW KERS delivering the recharge.

Coming down the weight range, in the UK there is Tevva Motors' 7.5-tonne range-extender truck, based on the Chinese JAC N series chassis. Like the

Nikola One this vehicle also runs under electric power, in this case harnessing a 120kW/1,800Nm electric motor and a reduction gearbox to drive the back axle. However, its 66kWh battery pack is augmented by a 100bhp 1.6-litre Ford engine, which provides charging on the move - so boosting its electric-only 100 mile range to circa 370.

Critical to this innovative little truck's likely acceptance, however, is its PREMS (predictive range-extender management system), which harnesses GPS to determine when to fire-up the diesel and when not. For example, not in urban areas where zero emissions matter.

TIME FOR A CHANGE?

Why the scale of activity now on electric and hybrid commercial vehicles? Partly it's because vehicle manufacturers are alive to growing environmental pressures (regulatory and political) nudging the industry towards cleaner and quieter trucks. Partly - and there is some causality here - high-profile fleets are concerned about their brands' green credentials and the increasingly damaging impact of diesel-driven transport.

Full-electrics and intelligent range extenders, such as Tevva's, ostensibly solve both problems while also enabling night-time deliveries, with their obvious potential to bear down on equally important traffic congestion. And as the charging infrastructure improves, so the feasibility index looks more attractive.

However, technology too is on the move, with both the energy density and price per kWh of battery packs of all flavours looking increasingly favourable. Together, these mean that current payload penalties and the considerable on-costs of hybrids and full electric vehicles alike are set to diminish - and quite rapidly, capitalising on developments in the consumer and automotive markets.

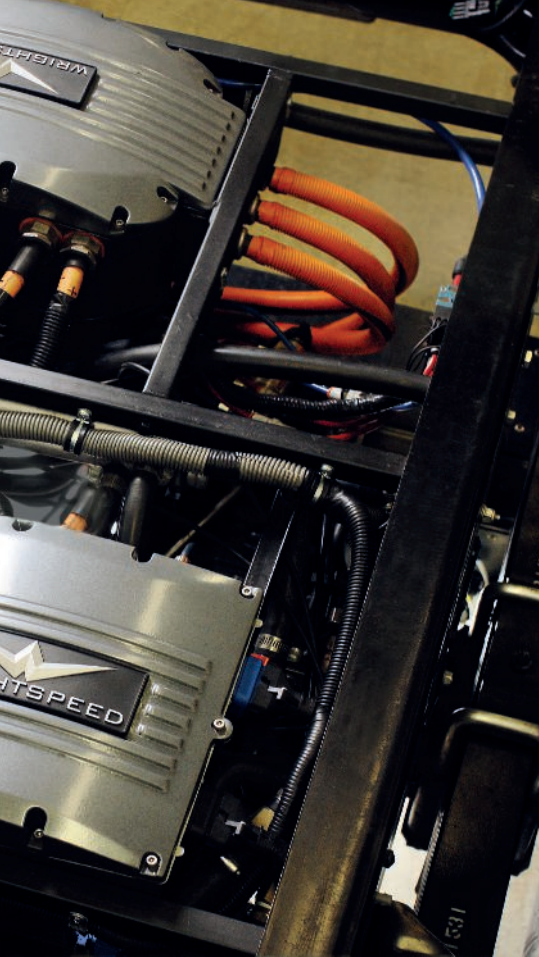
MERCEDES-BENZ ALL-ELECTRIC URBAN E-TRUCK STARTS OPERATOR TRIALS

Following the launch of its all-electric 26-tonne gw Urban eTruck – the first and with a range of 200km – at last year's IAA commercial vehicle show, in Hanover, Mercedes-Benz is now starting customer trials across Europe. Initially, a “low two-figure number” of Mercedes' new zero-emission trucks will go to customers in Germany, with more to follow elsewhere in Europe later this year, according to Stefan Buchner, head of Mercedes-Benz Trucks worldwide.

The vehicles – each initially offering a payload of 18 tonnes – will be deployed in real transport operations, with a goal of optimising the electric truck's concept and systems configuration, he says. “We are currently talking to around 20 potential customers from the waste, food and logistics sectors,” states Buchner. “With this small series, we are now rapidly taking the next step towards a series product. By 2020 we want to be on the market.”

Details released so far are that 18- and 26-tonne gw models will be available, and will be equipped with refrigerated, dry box and platform bodies. They will be handed over to customer-operators for 12 months. Each will come with charging facilities appropriate to the customer's likely demand, and will be supported by Mercedes-Benz Trucks' road testing department.

“2017 will be our year of implementation: step by step we are developing the vehicles and systems to achieve market maturity,” insists Buchner. And he adds that Daimler Trucks' analysis reveals that battery costs will have fallen by a factor of 2.5 between 1997 and 2025, with energy density increasing at the same rate – together changing the landscape for all-electric heavy trucks.



Then Mercedes and Iveco offer all-electric variants of their established Fuso Canter (up to 6 tonnes) and Daily (3.5–5.6 tonnes) light commercials respectively. Although both have been around for a while, it's still early days for full-scale operations as the ROI and payload equations don't yet balance. That may change, particularly in the lower gw ranges, when (not if) the UK concedes a 4.25-tonne car driving licence derogation for alternatively fuelled vehicles.

And there are diesel-electric hybrids, such as the Fuso Canter Eco Hybrid (up to 7.5 tonnes), with its 150bhp diesel engine working in parallel with a 40kW electric motor. Organic food producer Soyfoods is operating one, citing its fuel-saving (up to 23% compared to the straight diesel equivalent) and green credentials as key to its selection.

They all sound promising and the list goes on. But, according to some in the advanced driveline development community, many may be missing potentially important tricks. In particular, although KERS (kinetic energy recovery systems) is used in practically all electrics and hybrids to harness otherwise wasted braking energy, insiders challenge the underlying technologies. Equally – and this criticism applies specifically to

parallel hybrids – why, they say, do so few implement automated disconnect-clutch technology?

KERS first, and one company suggesting there's a better way than the current (primarily flywheel and supercapacitor) options already in use is Lightning Hybrids International. CEO Tim Reeser is a strong advocate of KERS as an enabler not only for reducing emissions and fuel (diesel or otherwise) consumption, but also powertrain and braking wear. However, he believes existing approaches don't have the capacity to expand adoption beyond, for example, buses and RCVs.

Hence his enthusiasm for a hydraulic alternative: “By using composite carbon fibre accumulators for high-pressure storage, our system is one sixth the weight of an equivalent battery pack yet delivers six times the power density. It's virtually an order of magnitude more powerful.” And he suggests that means more opportunities either for downsizing existing engines in new vehicle designs, or retrofitting equipment to existing trucks and buses to slash emissions.

UNIVERSAL BOOST

“Other than first start, our KERS offers massive acceleration support for launches, which are responsible for 80% of a truck's pollution output, as well as a powerful built-in retarder for braking,” insists Reeser. And that's not all. “Our innovation has been in making this technology applicable across the market for every [parallel hybrid] platform, truck type and vehicle size. We've also made it universal for drivers: there is no requirement for specialist training because it is fully automatic.”

Reeser claims several existing applications for Lightning Hybrids' KERS – including in the UK on a DAF 18-tonner operated by TradeTeam on DHL's beverage distribution side. “That's been running for one year,” he says, adding that the vehicle in question came with



an unmodified drivetrain, comprising a Paccar Cummins engine driving through a standard AMT (automated manual transmission).

"We simply replaced the drive shaft with two prop shafts, one for the conventional drive and the other for our system. Then we installed our high-pressure energy storage and reservoir tanks - in this case behind the rear axle. Electronically, the system integrates with the truck's Wabco EBS so that when the driver brakes, it sees the signal and captures energy hydraulically, via a high-pressure pump, until the vehicle stops, when it reverts to the foundation brakes."

On acceleration, he continues, the system sees the ECU throttle demand and releases a control valve to feed hydraulic fluid at up to 450bar through a hydraulic motor to drive the secondary prop shaft, with the switch to acceleration accomplished in milliseconds. "Typically, our system takes the vehicle from 30mph to rest, recovering braking energy, and then back up to about 25mph, when the diesel engine takes over."

Reeser accepts that Lightning Hybrids is new to the UK, but points to its partnership deal with Horiba Mira, which sees the firm's European headquarters now established at the Mira Technology

Park. "Mira is validating our technology for the European market, both from the emissions reduction and vehicle integrity perspectives."

Meanwhile, turning to parallel hybrids for mid- to heavyweight vehicles, Mike Savage, chief engineer at hybrid powertrains developer Drive System Design, wonders about their long-term viability. He points to the sheer cost and complexity of implementing both conventional and electric powertrains.

OVERKILL TECHNOLOGY

"Two major power sources - a full-blown diesel and a sizeable electric machine plus power inverter, energy storage devices, etc - doesn't come cheap. That's why we're seeing increasing numbers of pure EVs, especially on buses. They're pretty simple and buses don't generally need a 600-mile range."

Savage concedes it's a slightly different story with light vans and trucks. However, if an interim solution is diesel-electrics, why, he wonders, have so few implemented a disconnect-clutch to isolate the engine from the electrical

machine so that drive can be full electric. "Look at the Fuso Canter Eco Hybrid. The electric machine augments the diesel engine but it can't drive on electric alone. Having spent all that money on the diesel, the Duonic dual-clutch AMT, the electric machine and battery pack, why not spend a little more on an automated disconnect-clutch?"

For him, until Mercedes, Nikola and the handful of others pursuing heavy-duty full electrics can deliver on their promises, the only viable technologies for near zero-emission regional trucks are range-extenders and diesel-electric hybrids. "The technologies are readily available. Battery technologies are improving in terms of energy density, weight, longevity and charging speed. And prices are coming down.

"Our only criticism is the lack of uptake of disconnect-clutch technology on diesel-electrics. It's not only about the facility to switch the engine off and leave the electric motor driving the gearbox. That's key. But it's also about using the same kit to start the engine - connecting to the flywheel to kick it into life." **TE**

ELECTRIC COMMERCIAL VEHICLE CHARGING GETS £2.2 MILLION BOOST

Charging technology firm Zapinamo has won £2.2 million of funding to partner with WMG (Warwick University's manufacturing centre), Iveco and others on ultra-high-speed charging systems for commercial vehicles. The funding is part of the Low Emissions Freight Trial supported by DfT, OLEV and Innovate UK.

Zapinamo uses on/off grid and renewable sources for electric vehicle charging, and delivers 400kW to charge a vehicle in minutes - ideal for electric CVs with long and/or demanding duty cycles. The trials will be carried out with food delivery specialist Farmdrop, operating in Bermondsey, south London.

Tim Martin, chief executive of Zapinamo, describes it as "a great day" for his business and for the emerging commercial EV industry. "Our technology is a global first and it is fantastic to be trialling it in London with our partners," he says.

For WMG, Richard McMahon, professor of power electronics, adds: "WMG has a key role in the project, drawing on its experience of power electronics-based systems in defining the power conversion technology for the battery energy store. WMG's commitment to developing efficient power converters using wide band-gap semiconductors will provide the basis for future advances in Zapinamo's system."

