

Worth the

Diesel-electric hybrids offer considerable promise on the run up to all-electric commercial vehicles. But how long are we likely to have to wait for subsidised bus technology to make its way into trucks?

Ian Norwell reports

With an audience comprising predominantly truck fleet managers, there was almost palpable envy at the IRTE Conference over the subsidies enjoyed by PSV (public service vehicle) operators when it comes to hybrid drives. But maybe they should reflect that, as these help the technology development ride the rough road to market, they may ultimately be the beneficiaries of the new power delivery mechanism.

Either way, while hybrids have struggled to gain a foothold even with light trucks – with chassis typically double the price of diesel equivalents – the PCV sector has fared far better. So Matthew Lawrence, head of technical sales at BAE Systems' HybriDrive business unit, and Mike Kerlake, group technology manager with ADL (Alexander Dennis), started by telling delegates their success story with a series-hybrid powertrain and vehicle.

The government's LowCVP (low carbon vehicle partnership) was established in 2003 and steady progress has brought in a range of stakeholders. In 2008, however, ADL and BAE Systems joined the hybrid bus trail for TfL (Transport for London), and they now boast more than 700 hybrids on UK roads.

So why the success? Let's be clear: while emissions legislation surrounding trucks focuses on NOx, particulates, CO, etc, it does not yet tackle CO₂, although that is widely expected to be the next step. The same cannot be said of LCEBs (low carbon emitting buses). To qualify for government subsidies of 6p/km, a hybrid bus must emit 30% less CO₂ than an equivalent baseline diesel. And, as diesel consumption and CO₂ emissions are so closely linked, it is apparent that some electric propulsion must be used to deliver the power.

The technology is not new, but it is developing quickly. Globally, HybriDrive is powering bus fleets



“Automated connection to the charging network is the prize, as efficient energy access is very important”

Matthew Lawrence

that carry a claimed three million passengers every day, clocking up more than 500 million miles in the process. In simple terms, the ADL-BAE Systems series-hybrid has three basic components: a diesel engine coupled to a generator; an electric traction motor; and the fixed-ratio reduction gear.

Turning the wheels

The diesel powers the generator, which delivers power to the electric motor, batteries and engine starter motor. The electric motor turns the wheels of the bus. When it slows down, that motor functions as a generator, recapturing energy. Lithium-ion batteries store power for acceleration and capture energy generated when the brakes are applied.

A propulsion control system oversees the distribution of energy. It also supports the electrification of accessories, which buses have aplenty. Incidentally, the two worlds of bus and truck may have a common issue here. Current truck development engineers have warned that cab electrical demands are on a steep upward trend.

Green bus funding has seen four tranches of government support between 2010 and 2013, and

weight?



“There are now over 1,200 LCEBs on Britain’s roads and the collective savings in emissions are substantial”
Mike Kerslake

both the fuel savings and performance improvements reported by Lawrence and Kerslake were certainly impressive. They have achieved a reduction in on-cost of more than 20% since 2008, and almost doubled the system performance, with nearly full electric capability. With their second generation system and extended EV (electric vehicle) operation, fuel savings are now approaching 45%.

Start-stop benefits

“There are now over 1,200 LCEBs on Britain’s roads and the collective savings in emissions are substantial,” stated Kerslake. As experience grows, operators are also gaining confidence in their reliability and uptime is good. Driver technique plays an important part and fleet managers also report different levels of benefit, according to route. Urban routes with multiple stop-starts (bad for conventional vehicle fuel economy) see the best gains from hybrids, because regenerative systems get the chance to play a serious part. The same is not true of out-of-town routes over flat terrain. That said, if the topography is too severe, the limits on regenerative energy storage can also be a bar to economy. A fully

charged battery, unable to take any more, wastes the additional input.

“As trials continue, there is a huge field of telematics data to be mined,” stated Kerslake, indicating one route to further optimisation. However, to date, benefits in air quality have been modest and there has been limited progress in cost reduction. It’s a tough call for bus operators who are being told that enhanced performance and fuel savings will only come with higher costs.

That said, with LEZs (low emission zones), probably the forerunner to zero emission zones (ZEZ), there’s a signpost to the future – and a clue to why buses are getting the funding. Trucks can be selectively excluded from inner city zones, but buses can’t. A zero-emission hybrid might use diesel to drive from an outlying town or park-and-ride site and, on entering the ZEZ, switch to electric power.

So what are the future developments – those that will turn hybrids from suitability only for subsidised operation, to vehicles that can stand financially on their own feet? There are four key enabling technologies: energy storage; thermal management; charging systems; and efficient accessories.

The limits of energy storage are constantly being pushed. Indeed, if one thing can be said of Li-Ion batteries, it is that their progress has been spectacular. Improvements in power delivery, recharge time, weight and size have been largely responsible for bringing lighter, higher performance and extended range vehicles to market. Further increases in battery performance probably offer the greatest potential, not least because most other technologies have already had their big wins.

Getting an efficient driveline sits at one end of the telescope, while at the other is how to avoid wasting the power generated. Buses put high demands on electrical power – be it doors, passenger information displays or heating and ventilation. Making these systems more efficient will improve mpg, particularly since all the energy consumed, even from regenerative sources, has to be created first.

Several novel charging systems are being worked on, including induction lines in highways, overhead pantographs and even pit-stop style battery changing. However, BAE Systems’ Lawrence said: “Automated connection to charging is the prize, as efficient access is very important.” And he added that weight saving is also emerging as a route to gains.

How much? Hybrids have had a reputation for being overweight, which may have been fair in the early days of development. But ADL’s Kerslake said that the firm can now produce a hybrid double decker at less than 12 tonnes. With battery advances being among the swiftest, there’s great potential here.

“Weight saving is exceptionally important,” stated Kerslake. “But tailoring the vehicle to the application, and using the right size for the job, can often be the biggest weight saving you can make.” **TE**