Photo: Dean Smith, Camera Crew

Vans charge

Hybrids are one solution to cutting fuel and emissions, but manufacturers are making great strides with electric vehicles. Dan Jenkins examines how technology and engineering may yet enable longer ranges and greater loads

The next 18 months will deliver the most exciting developments in commercial electric vehicles (EVs) since the first plausible battery-powered vans arrived in 2005. Modec and Smith Electric Vehicles have virtually had the market to themselves for the past five years. But, by 2011, we will have experienced an explosion of new electric LCVs, from major OEMs including Mercedes-Benz, Ford and Renault.

After a flying start, Modec's striking 5.5t chassis cab has, by the company's own admission, struggled to gain traction within the UK. The requirement for a C1 licence and O-licence means the Modec is simply unsuitable for widespread applications in LCV fleets.

Martin Flach, product director at Iveco UK, sums up the challenge: "If you're a supermarket doing home deliveries, you want to run 3.5-tonne vans from the back of the shop. Drivers mostly won't have Class C driving capability or grandfather rights these days, so they're limited to 3.5t on a B licence. Also, they don't want to O-licence every one of their shops. Distribution centres are one thing, but not the shops."

State of the market

Beyond the UK, Modec is enjoying good times – more than 90% of the company's sales are exports, boosted by the recent joint venture with US truck manufacturer Navistar. Back on the British Isles, however, the market leader is Smith Electric Vehicles, which supplies the sub-3.5t Edison on the Ford Transit chassis and the 7.5 to 12t Smith Newton on an Avia truck chassis.

To date, Smith has supplied both of the two largest fleets of new technology EVs in the world. TNT has more than 50 7.5t electric trucks, deployed in urban deliveries and collections in cities across England and Scotland. By the middle of

onto electric

2010, Sainsbury's will have around 70 all-electric 3.5t vans, engaged in online home shopping deliveries in London. Aside from these two successes, however, Smith, too, has not yet driven a customer shift from fleet assessment to fleet purchase.

The third entrant to the market was Allied Vehicles, a specialist in taxi conversions, which followed the Smith philosophy of integrating EV technology into an OEM chassis. The Glasgow-based company now offers a range of electric LCVs and passenger vehicles on Peugeot platforms, under the Allied Electric banner.

The strategy for all three companies appears sound – Britain's van parc is the fastest growing vehicle segment. And tens of thousands, if not hundreds of thousands, of LCVs operate exclusively on predictable urban routes – ideal for electric vehicles.

Manufacturer development

That said, the major OEMs have now also recognised this perfect fit and are entering the market: Mercedes-Benz unveiled its electric E-Vito in February 2010, while a battery-powered version of the Iveco Daily – the Eco Daily Electric – is already available to order in the UK.

E-Vito will offer an average range of 80 miles, depending on driving style, from its 400V, 16A and 32kWh battery pack. Peak power is quoted at 90kW and the vehicle has a restricted top speed of 50mph. Initially, a fleet of around 100 vehicles will be delivered to 20 customers, according to the company, with a further 2,000 vans rolling off the lines in 2011.

Mercedes-Benz believes that it has the crucial advantage in product support; E-Vito will be serviced through the existing dealer network, using diagnostic systems already in operation. As a company spokesman put it: "Electric vehicles undoubtedly have a part to play in a broader alternative fuels solution. As the manufacturer, we will provide bumper-to-bumper product support for the Vito, which is what our fleet customers are telling us they want. There can be some confusion for fleet managers with other electric commercial vehicles over which company supports which part of the vehicle."

E-Vito is front wheel drive, with the motor mounted under the bonnet and the batteries fitted in the middle of the vehicle. The vehicle has a separate interior heating system to avoid drawing power from the traction batteries, which can be recharged flat-to-full in six hours.

But this Mercedes is pitched at the most hotly-contested space in electric commercial vehicles. Ford of Europe will introduce an electric Ford Transit Connect next year, when Renault will launch its much anticipated Kangoo ZE.

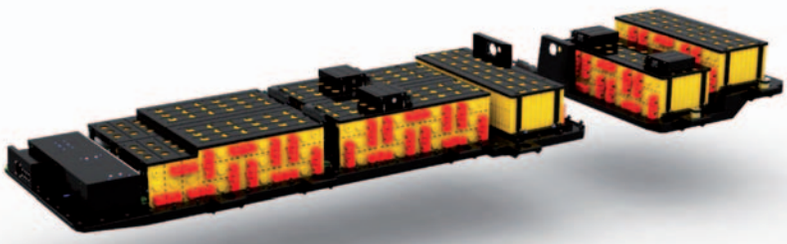
Delivered on the medium wheelbase Kangoo, the ZE promises a range of 100 miles and a top speed of 80mph, powered by a 20kWh battery pack. Its 70kW motor delivers 95bhp and a maximum 226Nm of torque. Meanwhile, the Transit Connect Electric offers a range of 80 miles and top speed of 75mph. It is powered by a Siemens 300V three-phase ac liquid cooled induction motor, delivering peak torque of 235Nm.

They're not alone: Iveco is also offering almost the full range of Daily platforms as EVs, from a 35S single wheel to the 50C twin wheel – the most complete range of electric vans to arrive on the market since the Edison.

Battery developments

It is no coincidence that EVs are establishing themselves at the same time as Lithium-Ion has emerged as the definitive base material for traction batteries. The core characteristics of the Li-Ion battery – robust, lightweight and long-lasting – have been honed from more than a decade of development in consumer electronics.

The chemistry currently favoured by almost all of the commercial EV manufacturers available in the UK is Lithium-Ion iron phosphate (LiFePO4). At cell level, this delivers around 110Wh/kg. Translated into commercial vehicles, this means performance capabilities of 80-120 miles on a single charge, depending on the trade-off between battery pack size, payload and range. Li-Ion batteries are at the heart of all the commercial EVs produced by Mitsubishi, Modec, Smith Electric Vehicles, Allied Electric – and the forthcoming vans from Ford, Renault and Mercedes-Benz.



From top: Axeon's battery pack in the Peugeot Expert; the Ford Connect battery from Azure Dynamics; Modec's dashboard display, and the charging point on an Allied Electric vehicle

Smith Electric Vehicles celebrated 90 years in business at the CV Operator Show. Its business has been boosted by a tie-up with US truck manufacturer Navistar

Iveco alone has opted for an older battery technology, which it claims is more established and well proven. The Daily is powered by Zebra Z5 Sodium Nickel Chloride (NaNiC12) batteries – the same technology that was adopted and subsequently discarded by Modec and Smith Electric Vehicles. The NaNiC12 battery pack certainly does roughly match Li-Ion in key performance indicators. The electric Daily provides a range of 65 miles and, fully laden, achieves a top speed of 43mph – not far off the capabilities of the same-sized vehicles from Smith and Allied.

The main drawback with NaNiC12 is that the battery's optimum operating temperature is north of 275°C. This means that, when stationary for long periods, it must be plugged in, whether it needs recharging or not – a process called 'cooking' the batteries. Leave a Zebra-powered vehicle off charge overnight and the battery temperature drops, meaning it probably won't start in the morning. Conversely, Li-Ion batteries retain their charge without being plugged in at night – and do not require cooking.

"Zebra is well known and understood for its good and bad points – and there's a complete recycling route at end of life," counters Flach, standing by the company's choice. "Li-Ion looks interesting, with benefits on cost, weight and performance, but there remain unanswered questions, in terms or how it will perform in the vehicle and what to do at end of life. So we're working on Li-Ion batteries and testing them, but being conservative before we jump. We don't want our customers to be guinea pigs."

Payload implications

While Modec can deliver a guaranteed payload of 2,000kg, all the other EV producers have had to sacrifice some carrying capability to accommodate the requisite batteries, while still hitting their gvw targets – in particular the all-important 3,500kg.

Most 3.5t electric vans lose 200 to 300kg in payload to accommodate the batteries, which is an issue for some operators. One novel solution, promoted by some manufacturers, is to move the legislative goalposts. In the Netherlands, for example, Modec has successfully campaigned for the law to be changed, so its 5.5t vehicle does not require the equivalent of a C1 licence. Modec is now calling for UK legislators to follow suit.

Iveco is airing a similar strategy via the SMMT (Society of Motor Manufacturers and Traders). Says Flach: "We're pushing DfT to do what they've done in France where, if you run an electric or CNG [compressed natural gas] vehicle, which is

OEM	Vehicle	GVW (kg)	Max Payload (kg)	Max Range (miles)	Max Speed (mph)	Batteries Type	Batteries Size	Recharge fast	Recharge standard	Availability (UK)
Allied Electric	Peugeot eExpert	2,963	580	100	70	LiFePO4	43kwh	n/a	6-8hrs	Now
Allied Electric	Peugeot eBoxer	3,500	895	120	70	LiFePO4	64kwh	n/a	7-9hrs	Now
Ford	Ford Transit Connect Electric	undisclosed	undisclosed	80	75	undisclosed	28kwh	n/a	6-8hrs	2011
Smith Electric Vehicles	Smith Edison (Ford Transit)	3,500-4,600	1,220-1,800	80-100	50	LiFePO4	40kwh	3-4hrs	6-8hrs	Now
Iveco	Iveco Daily	3,500-5,000	1,030-2,105	65	43	NaNiC12	63kwh	n/a	8/overnight	Now
Mercedes-Benz	Mercedes Vito	2,940	1,122	80	50	undisclosed	32kwh	undisclosed	undisclosed	2011
Mitsubishi	iMiEV Cargo	undisclosed	undisclosed	100	80	undisclosed	16kwh	0.5hrs	7hrs	2011
Modec	Modec chassis cab	5,500	2,500kg	60-100	50	LiFePO4	70kwh	n/a*	8hrs	Now
Renault	Kangoo Z.E	undisclosed	undisclosed	100	80	undisclosed	20kwh	30mins	6-8hrs	2011
Smith Electric Vehicles	Newton chassis cab	7,500 - 12,000	3,310-7,400	130	50	LiFePO4	80-120kwh	n/a	8-10hrs	Now
	* Modec also offers fast battery cassette swap-out									

considered low carbon, the government gives the operator a payload bonus. For instance, if it's a 3.5t van, the operator can run it at 3.8t to ensure no payload is lost. Supermarket delivery operations, for example, are very payload-sensitive – if you take 300kg off the payload of a 3.5t van, that's a big chunk to lose."

Battery chemistries

The key to eliminating this trade-off between range and payload – and achieving parity with conventional LCVs or LGVs – is improvements in the energy storage capabilities of Lithium-Ion batteries. And the answer to that lies in finding new chemistries to replace the iron phosphate electrodes.

Dundee-based Axeon, Europe's largest independent supplier of LiFePO4 batteries, is working on a new silicon alloy electrode that, it believes, could more than double the energy density of Lithium-Ion batteries, from 110Wh/kg at cell level to 260Wh/kg.

Allan Paterson, senior electrochemist at Axeon, comments: "At cell level, we think we can deliver nearly a 50% saving on size and remove at least a third of the mass from the pack, while retaining the same energy storage and discharge capabilities." That project is a partnership with electrodes specialist Nexeon and is part-funded by the UK's Technology Strategy Board. "At present, the only commercial silicon alloy anode battery is produced by Sony and it is AA-size," continues Paterson. "Nexeon's proprietary technology allows us to scale up to much larger cells, suitable for automotive use."

Smith Electric Vehicles is exploring a different approach. It is working with German specialist Proton Power Systems on a hydrogen fuel cell range extender, which it estimates could double the operational range of its Edison van. Again, there is an additional cost implication, but Smith feels there is sufficient customer demand to justify some trials, particularly in Germany.

Doug MacAndrew, technical director of Smith Electric Vehicles, comments in response: "The work that Axeon and others are doing is really exciting, but it is technology that is years away from commercialisation. I could integrate new electrode chemistries tomorrow that can deliver several times the performance of iron phosphate, but the costs would be extremely prohibitive. Battery technology will undoubtedly further improve over the next five years. But, right now, iron phosphate delivers the best marriage of performance and price per kilowatt-hour."

Barriers to market

Even established electric LCV technology comes at a high price, though. Smith's Edison retails at around £57,000, several times the list price of the Ford Transit on which it is based. While Edison, like all electric LCVs, delivers savings on 'fuel' and maintenance, the payback period can be extended.

Kevin Harkin, sales director for Smith Electric Vehicles, says the technology works and the customers like what they see. He maintains that the high capital cost is the only reason stopping EVs taking a larger market share. "All we need is some short-term government incentives to bring down the cost," he asserts.

One traditional method of defraying capital cost of commercial vehicles is to use leasing or contract hire. Major companies in this sector are now cautiously approaching electric vehicles. Carillion has a small fleet of electric vans operating with Continental Landscapes in Dorset and London, while Ryder has just leased its first electric truck – a 10t Smith Newton – to Bunzl.

However, full-scale leasing will not occur until realistic residual values are attributed to electric vehicles – something the valuation data firm CAP is currently examining. Until these issues are fully resolved, fleet managers will have either to find extra cash to procure EVs or, like many, continue to wait until the prices become more attractive.

"You've got to look at the market in several stages," says Flach. "In the next five years, I would say that a good start, as an industry, would be to sell 100 to 200 units a year in the 3.5t and above category. The price of the vehicles has to come down dramatically – and a key part of that is the cost of batteries. At the moment, each battery pack is around £10,000 and a 3.5t van has two or three batteries."

Flach also maintains that his company, and the industry itself, must work to reduce electrification costs. "That's about volume: at the moment, we build standard vehicles on the production line and then convert them. They need to be purpose-built in production to get the price down – but that's at least five years out from now."

With more vehicles, more R&D investment and the promise of more leaps forward in performance, the electric commercial vehicle market can only go one way from here. Fleet operators keen to lead the way in the adoption of electric LCVs have never had it so good. TE

Allied Electric's technology can be found on a wide range of Peugeot models