



## HOW TO RECHARGE BUS BATTERIES

BYD Europe managing director Isbrand Ho (above), points out that as battery longevity remains a concern for operators, the best way of ensuring a long and healthy life is to pay careful attention to how they are recharged. Ideally, that means employing an extended recharging cycle spread over four hours. Shorter recharging cycles of, say, an hour's duration are possible, he admits, but have implications for battery life.

"That's because they involve a higher current; and the higher the current you charge at, the shorter the life of the battery," he says. "It's a bit like eating five steaks a day," he adds. "If you keep doing that then you won't last very long."

"Most vehicle manufacturers treat batteries as just another solid component, but they are not," he muses. "They're a mixture of electronics and chemicals, and that makes it hard to get them to keep working for five or ten years. Creating them is a scientific art, and you have to be able to manage the ageing process they undergo."

# Batteries by the busload

**BYD is fast becoming the dominant global electric bus manufacturer, thanks partly to the vast scale of its Chinese battery manufacturing production base. Steve Banner visits the site, in Shenzhen, Guangdong province**

**M**ore advanced traction batteries may be available, but Chinese manufacturer BYD – Build Your Dreams – remains wedded to lithium-iron-phosphate (LFP), so far as its electric buses are concerned. Why? Safety.

"If a lithium-iron-phosphate battery receives a heavy impact, is punctured or crushed, then all it will do is smoke," says BYD Europe managing director, Isbrand Ho. "It won't start a fire." Other types of battery technology may offer more energy density, he agrees, but safety has to be paramount when 80 to 90 passengers are on board.

Nor does employing LFP batteries restrict the range of city buses unduly. He says that buses in service with

Go-Ahead in London equipped with BYD batteries are able to finish a full day's work with 25% of their charge left (see also <https://is.gd/ehukid>).

BYD is nevertheless conducting research into both nickel-cadmium and sodium-ion batteries for bus applications; the former's high energy density is undeniably appealing. But LFP's safety credentials mean that it will continue to dominate in electric buses.

Changes include the introduction of a thermal management system that should help extend the battery's life, as well as boost the range. BYD is also introducing a low-voltage electricity management and control system that is integrated into all the bus's electrical circuits. It can diagnose short circuits caused by excessive internal heat or voltage.



Now the biggest electric bus manufacturer in the world – it built 15,000 in 2017 alongside a range of electric cars, vans and trucks – BYD began life as a battery producer 23 years ago with just 20 workers. Based in the sprawling city of Shenzhen, China, not far from Hong Kong, today it has over 220,000 employees and a £15.3bn annual turnover.

The scale at which it produces batteries is illustrated by the 100,000 cells a day turned out by its highly automated traction battery plant in Kengzi. With only 200 workers, the factory operates round the clock, with production halted for just one day each month for maintenance.

Next year BYD will open its third battery factory in China, in Qinghai province, which the company predicts will be the largest battery factory in the world. It will cover an area the size of 140 football pitches. BYD has a bus factory in Hungary and will soon be assembling buses in France, too.

In the UK, over 200 buses using BYD electric technology are running in London. Others have gone into service in Liverpool and Nottinghamshire.

At the time of writing, BYD and ADL had between them just captured the bulk of London's first order for fully-electric double-deckers. Thirty-seven 10.9m BYD-ADL Enviro400EVs will join Metroline in the second quarter of 2019.

A joint venture with ADL set up three years ago means that BYD delivers the platforms for the vehicles, while ADL delivers the bodies. The vehicles are assembled in the UK by ADL. "The BYD-ADL partnership has a 90%-plus share of the London market for electric buses and a 50% share of the UK market," Ho says.

In addition, 105 Enviro400EV Cities should be operating with Stagecoach in Greater Manchester by early 2020. Stagecoach is contributing £34.6m to that £56.1m initiative, which includes the necessary supporting

infrastructure. However the plan is contingent on a £21.5m contribution from the UK government's Ultra-Low Emission Bus Scheme. The double-deckers will have an estimated range of up to 300km and be able to transport 80 passengers. They will supplant Euro III and Euro IV diesels, and should cut annual CO<sub>2</sub> emissions by 6,800 tonnes, particulates by 20% and NO<sub>x</sub> by 24%.

#### LOCAL LINKS

The southern China-based company has a ready-made test bed for its products on its doorstep. Shenzhen Bus Group is the biggest of the three bus operators in the Guangdong province metropolis near Hong Kong, and its urban fleet became fully electric last year. It runs almost 5,700 city buses, nearly 4,400 of which were supplied by BYD, and the fleet list includes 30 10.2m double-deckers.

They add up to what is at present the largest all-electric bus fleet in the world. It is supported by 101 charging stations with 1,665 charging posts (pictured, p31 and above). The average number of passengers per bus per day is 237, and the vehicle-in-service rate is 99.2%.

Despite Ho's advice (see box, p31), Shenzhen Bus Group typically recharges its buses in less than two hours using fast charging. "We try to do so at night because the electricity is a lot cheaper," says deputy general manager, Joe Ma.

"A full charge gives us a 200km range," he continues. "So we sometimes have to recharge a bus for half an hour during the day if it's being put on one

of our longer routes. Our energy costs are 50% lower than they would be if we still ran diesels. Maintenance costs are significantly down, too."

BYD warrants the batteries it fits to the group's buses for eight years. The warranty is triggered if a battery drops below 80% of its original charging capacity, and there have been some instances of this happening, says Ma.

Another development is that the fleet is gradually moving towards a greater degree of autonomy for its vehicles.

"We've got four buses on trial in Shenzhen operating at Level 1 on public roads in mixed traffic," says Ma. (According to the Society of Automotive Engineers, Level 1 refers to a situation where the driver remains in control of the vehicle but enjoys some assistance features.)

"We're aiming to go to Level 2, and to Level 3 by the end of the year," he adds. Both involve increased degrees of automation, but fall some way short of full autonomy. Scania is a technology partner, Ma says.

What about Level 5, which would mean a bus could run with complete autonomy? "The technology is almost there but requires a suitable infrastructure and a lot of the other vehicles on the highway need to be self-driving, too," he observes. He believes that Level 5 would be unlikely to appear before 2025. "We will always have a driver in the bus though – we need to think about passenger safety – but we may end up calling him a bus ambassador," Ma says. [TE](#)

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Joe Ma