

# Coaches inside out

After 40 years in engineering roles at National Express - including work on the Levante coach specifications - Richard Ball has become new vehicles director. A hydrogen fuel cell coach concept is his next quarry. He spoke with Will Dalrymple

Looking back over a career that began as an apprentice electrician, and then moved into overseeing engineering departments and workshops across the group, with the last 15 years in coach engineering, Richard Bell singles out one industry trend in particular: the progression of emissions standards.

He says: "There were none when I was an apprentice, and since then they have ramped up. At each point, we have added technology; every stage has required something new, and they have always added weight, to the point where it would be realistic to say that it has become half a tonne by Euro VI. According to passenger calculations, that's equal to 5-6 people."

"Our design priorities have been about being safe and light. We have done a load of work to minimise the unladen weight to match the increasing weight the emissions technology is bringing. Now we have finished that; we are at the pinnacle as to where we can be with diesel."

And not only in terms of packaging. He says that changing customer attitudes are forcing the operator to reduce its carbon footprint, or else. He observes: "I am sure that discerning



passengers might ask, what is my CO<sub>2</sub>/km for this journey, and choose [how to travel] based on that. If the answer is a zero-emission coach, then there can be a modal shift. We want to be the cleanest transport operator; we're already the safest."

The government has not yet published plans to restrict the sale of new diesel coaches, unlike its 2035 deadline for passenger cars, vans and HGVs under 26t, and 2040 for larger HGVs). But that's still not enough for the forward-thinking operator.

"We've already published a commitment that we'll never buy another diesel bus. And we would like not to buy another diesel coach. But we need a viable option. We have moved the entire fleet to Euro VI, and we are watching the market. Our target is to do a zero-emissions bus fleet by 2030, and zero-emissions coaching by 2035. We are just starting to lay the foundations now."

## RANGE ANXIETY

The biggest single issue in finding an alternative fuels for coaches is range. Observes Ball: "People think that hydrogen vs electric is like VHS vs Betamax. But it's not. Some services are okay for electric, but for our type of operation, we need something different." While National Express's urban bus fleet in the Midlands travels 50-80,000 miles/year, its coaches average about five times as much: from 225,000 up to 325,000 miles/year. And that is not exceptional of long-distance coaches.





As applied in an actual a vehicle, the demand for electric technology creates packaging issues, in terms of size and weight, Ball states. "The luggage locker of a standard coach is about 10.5m<sup>3</sup>. Anybody working on building an electric coach would find that the easiest place to place batteries and control gear is in the hold; it's a big, empty space. As a result, there are some offerings on the market that reduce available space in the hold by two-thirds. But as a national coach provider, that space is important to customers: it's where their luggage goes."

So that's why hydrogen, as a zero-carbon fuel, offers a key advantage: high energy density. Ball explains: "We can't put enough batteries on a coach to go all the way from London to Birmingham and still have payload for people. But we can with hydrogen and an electric powertrain. Think of it like a plug-in charger: an electric vehicle with a hydrogen charger." He adds: "That gets over the weight of the batteries, although not the weight of the storage tanks or where to put them, or the fuel cell. We are just at the beginning of those challenges."

Fortunately, the company has invested in some guinea pigs: 20 double-decker hydrogen fuel cell buses from Wrightbus for its National Express West Midlands operation (pictured, below left). They are the company's first, apart from a few trial units in Spain (though it also operates 29 full-electric buses in Birmingham, Solihull and Coventry). Funding was by the European JIVE project, by UK government (OLEV), Birmingham City Council and the local enterprise partnership.

Ball explains the operational significance of that fleet for the wider

company: "The buses will help form our strategy by providing real-world operational data. Once they are into service, we can look at operational performance. There may be constraints in infrastructure; depots might be better suited to one or another technology, or certain routes or operations. One fuel might be better than another. We could either make our own hydrogen or ship it in. If it is shipped, we don't need as big an incoming mains cable. If we make it on site, we need a big mains cable to run an electrolyser. If the site can access lots of cheap power, on-site electrolysis is a good answer."

### THE BIG PICTURE

That's just one part of the whole, Ball points out, which involves energy efficiency to minimise the cost of what is a very expensive new technology. He says: "The model has to change. It has to be about energy input, maintenance, and the potential to buy and fund vehicles. How do we get total cost of ownership as close as possible to parity [with diesel] through efficiency and design?" And, as he qualifies later, that is without any public funding, which he doubts the coach industry could attract as the bus industry has. Though that's not his area of personal responsibility. Instead, his levers are: unladen weight, aerodynamics, drag, tyre friction.

Expanding on that point, he adds:

"We are currently buying vehicles with cameras instead of mirrors; lots of people are doing it. That's a big frontal area removed, and there is an aerodynamic benefit. But we need to think about the coach holistically. Will there be energy savings from aerodynamics, or reducing tyre friction, or energy pricing? We are pushing the OEMs hard to get the best out of the shape and design, weight and materials, and take it back to the tractor design: the structural elements are the engine and the gearbox, and the wheels are hung off of that."

"Currently, people are looking at taking a diesel bus or coach and converting it to hydrogen. Future development builds should think about making a passenger compartment environment and fit the technology around it, making sure the driveline is integral. What can we do to get the very best out of the energy that we've already got? Can we recycle heat from the fuel cell to warm the saloon? Can we reduce solar gain? Can we change the glass design to maximise gain but flip it off in the summer to keep it cool?"

While reinventing the coach may be a massive challenge, it is one that Ball appears to relish. "I see this as a one-off opportunity. I'll never do anything as large-scale again. This is as big as the change from petrol to diesel in the 1930s. There won't be anything else as big in my lifetime."

When pressed, though, he argues that the first steps down this road are not far away. "I just turned 56. I am sure that we will see hydrogen coaches before I leave the business. This is a short-term horizon; not this year or next, but a short horizon." **TE**