BELOW The Radical SRZero could ultimately prove the inspiration behind one-make race series

THE LONG ROAD TO ELECTRIC CREDIBILITY

Chris Pickering meets the students aiming to conquer the world's longest road using an electric powertrain

"**EVERYONE'S** talking about making an electric car at the moment aren't they?" quips Radical Sportscars co-founder Mick Hyde, stood next to the gleaming SRZero prototype. Something in the tone of his voice suggests he's aware that few of them have actually materialised. The Radical SRZero, however, is very real. Sat on the floor of the company's Autosport show stand is the very car that its co-creators from Racing Green Endurance plan to drive the full length of the Pan-American Highway; the world's longest road, stretching 26,000 km from the southernmost tip of Argentina to Prudhoe Bay in northern Alaska.

The people behind this mammoth undertaking are a group of students, staff and graduates from Imperial College London. Last year they approached Radical looking for a car to apply their electric powertrain expertise to. It needed to be distinctive, with the looks and performance to dispel any preconceptions about electric power, but it also had to be fully road-legal. Enter the Radical SR8, the car which last year drove across Europe under its own steam before slashing the Nordschleife lap record and casually driving back.

"Initially the agreement was just to lend them a chassis," recalls Hyde. "Then, as things progressed we became more involved in the hands-on side of the project, providing tooling and engineering assistance." It wasn't long before the marketing potential of the project became apparent, and this led to a second aim. "We've now set ourselves two objectives," he continues. "The first is to build a car for these guys to drive up the Pan-American Highway – we plan to do that by the summer – and then when they return the second objective is to build a race car for short sprint races. Ultimately I see us producing a single-make race series."

So what's involved in creating an electric Radical? The batteries, as ever, have been the greatest challenge. The car carries three sets, located in the sidepods and the rear. In long-range Pan-American trim, they add a not-inconsiderable 300 kg to the total weight of the powertrain, but this is said to give the SRZero a range of over 390 kms on the US EPA highway cycle (similar to the European NEDC), with a theoretical maximum of 600 kms. In sprint form, the team say they could drastically reduce this to a single, smaller rear-mounted pack that would result in weight, performance and cost similar to the 2.6-litre V8 powered donor car.

The lithium iron phosphate cells from Chinese battery specialist Thunder Sky have a total capacity of 53 kWh and are capable of providing peak power outputs in excess of 500 hp. Meanwhile a high system voltage of 530v keeps the current, and

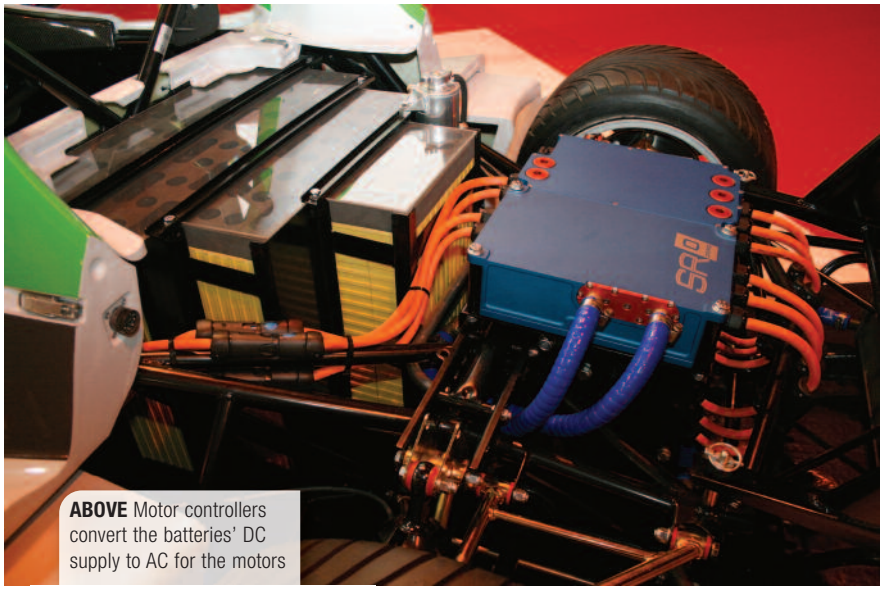
hence losses, minimal. "The batteries are extremely energy dense," observes Racing Green Endurance project manager Alexander Schey. "They demonstrate that electric cars can be a very exciting alternative to internal combustion vehicles."

There's more to it than simply connecting the cells up, though. The SRZero uses a custom-made battery management system from sponsors Frazer Nash. It regulates the voltage in each cell and ensures that they receive the same voltage on both charge and discharge to avoid mismanagement of current flow. It also monitors temperature and overall current to ensure the batteries operate at their peak performance.

A full charge takes around eight hours and equates to approximately 1p a mile at typical UK energy rates. However, the vehicle also employs regenerative braking at efficiencies of up to 50 per cent. "This obviously has no effect at a steady cruise, but in town driving it becomes a very significant range extender," observes Schey. "You can lock the wheels on just the motors alone… we only really use the mechanical brakes for the last few miles an hour and only then because it's simpler to do; they're largely there as a failsafe."

From the batteries, a set of cables leads into the motor controllers. These convert the DC supply to AC before sending it to the motors below. The two EVO Electric units – one for each driveshaft and hence no differential – are what's known as axial flux motors. Put simply, these sandwich the stators and rotors behind each other as discs on the same axis, instead of positioning them in concentric cylinders, like a conventional radial axis motor does. This disc-shaped geometry allows for a greater effective electromagnetic area, which means the torque is proportional to the cube of the machine radius, in contrast to a radial motor where it's proportional to the square.

The end result is that it produces significantly more power and torque for a given size and weight. EVO Electric claims the material costs are reduced as a result, as well as claiming a peak efficiency of 96.5 per cent. Combined, the two motors produce up to 450 hp and 1,200 Nm for short periods in race trim (200 hp and 450 Nm continuous) and weigh around 80 kg. This clearly doesn't account for the batteries, but it's worth bearing in mind that the dual electric motor layout eradicates the need for a gearbox, differential or fuel tank. The motor windings have been altered for the Pan-American trip, de-rating them somewhat, but the team plans to re-wind them afterwards and gear them slightly for much greater acceleration and top speed.



ABOVE Motor controllers convert the batteries' DC supply to AC for the motors

> "Electric cars can be a very exciting alternative to internal combustion vehicles"

Overseeing all of the electrical and control systems is a National Instruments CompactRio controller, packaged under the driver's seat along with the other electronics. It regulates the battery management system, motor controllers, driver interface and safety systems. It also provides torque biasing between the two wheels (in place of a differential) and individual traction control.

Perhaps not surprisingly, all these high power electronics have a tendency to generate heat. Unlike on some of the very high discharge KERS systems, the SRZero's battery packs don't require cooling, however a water cooling system is still used for the rest of the components. A water-glycol mixture flows into the control electronics first, through the motor and then out through a Porsche 997 radiator mounted at the rear. "The cooling capacity is about a sixth of the equivalent IC engine," comments Schey. "It only requires a flow rate of about eight litres a minute, so the pump consumes just 20 watts. Depending on the level of air cooling and the power demand, we probably won't even turn the pump on in cooler conditions."

And so, in May the team will head for Ushuaia in Argentina – the world's most southerly city – for the start of the Pan-American Highway. If all goes to plan it may well jump-start SRZero production, bringing with it the prospect of a fully electric race series. Based on Radical's track record and Racing Green's academic credentials, you certainly wouldn't bet against it. RT

RIGHT The SRZero system harnesses axial flux motors rather than the traditional radial units