

Off-the-shelf technology aims to spawn BMW i3 rivals



Range extenders banish the spectre of range anxiety in EVs. **Jesse Crosse** reports on a new British development aimed at making them easier to build

Car manufacturers who want to create a BMW i3 rival are being offered a shortcut – an off-the-shelf range extender system – by a British company. Mahle Powertrain of Northampton (formerly Cosworth Technology) has developed the 'REx' range extender generator unit as a panacea for range anxiety suffered by drivers of pure battery EVs.

Mahle's Daren Mottershead says: "Our REx EV demonstrator gives all the benefits of a pure EV with the added flexibility, convenience and reduced anxiety of having an auxiliary power supply on board to recharge the battery only when necessary."

The engine of a conventional parallel hybrid runs throughout most of a journey. In contrast, a range extender generator is not mechanically connected to the road wheels but tops up the battery of an electric-only drivetrain when it shows signs of becoming seriously depleted.

The REx comprises a simple naturally aspirated, twin-cylinder, 900cc petrol engine producing 40bhp. An integrated water-cooled generator consists of three discs, two fixed with another rotating between them.

The whole unit is very compact and occupies a space roughly equivalent to a piece of airline cabin baggage. The small size means that it should

be easy to integrate the unit into most EV designs.

Its 40bhp is the minimum power required from the engine to comfortably enable the purpose-built Audi A1-based REx EV demonstrator to cruise at a continuous 75mph while maintaining battery charge at 25 per cent. Maximum speed is 90mph and the minimum electric-only range is 44 miles.

The battery is a 14kWh, 350-volt, water-cooled lithium ion pack mounted below the boot floor and weighing 140kg. It can be charged from a domestic supply, so journeys can be started on a full charge. The total range is 311 miles.

The REx can be easily upgraded to produce more

power for larger cars by adding an electric supercharger. Mahle has developed both a 54bhp version of the engine and 67bhp version.

On the NEDC test cycle (which begins with a fully charged battery and, as usual, doesn't account for the CO₂ emitted generating the electricity), CO₂ tailpipe emissions are 45g/km.

The electric drive motor develops 86bhp, equivalent to a standard A11.2 TFSI. Even though the REx demo car weighs 300kg more than standard, it still achieves 0-62mph in 12.0sec, compared with the standard car's 11.8sec. Like all hybrids, the motor also acts as a generator to recover energy for regenerative braking.

What makes the REx demonstrator remarkable to drive is that it's so unremarkable. It's refined, with punchy response at urban speeds in electric-only mode. A fair bit of driving was needed to drain the fully charged battery pack and coax the range extender unit into life, but its awakening was virtually undetectable.

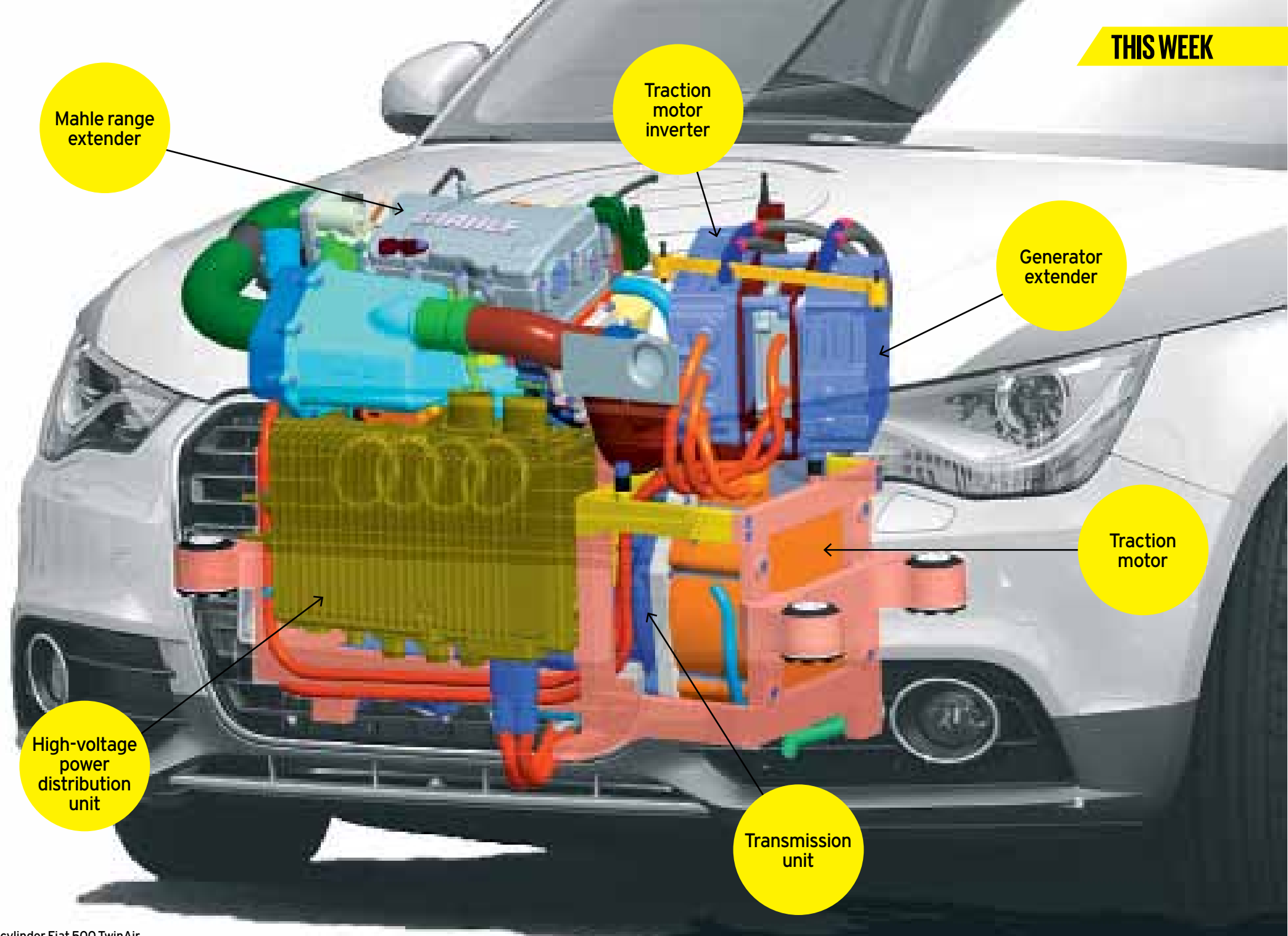
Engine mounts are softer than usual, because there's no mechanical drive to the wheels, and this helps with refinement. Electronic control of the generator also smooths out the vibration caused by infrequent firing impulses from the two-cylinder engine. But accelerating hard to 70mph, the engine reached 3500rpm to generate more electrical power and became noticeable. There's a slight shake when it stops, too, but it compares well with a production car like the

two-cylinder Fiat 500 TwinAir, even in this raw form.

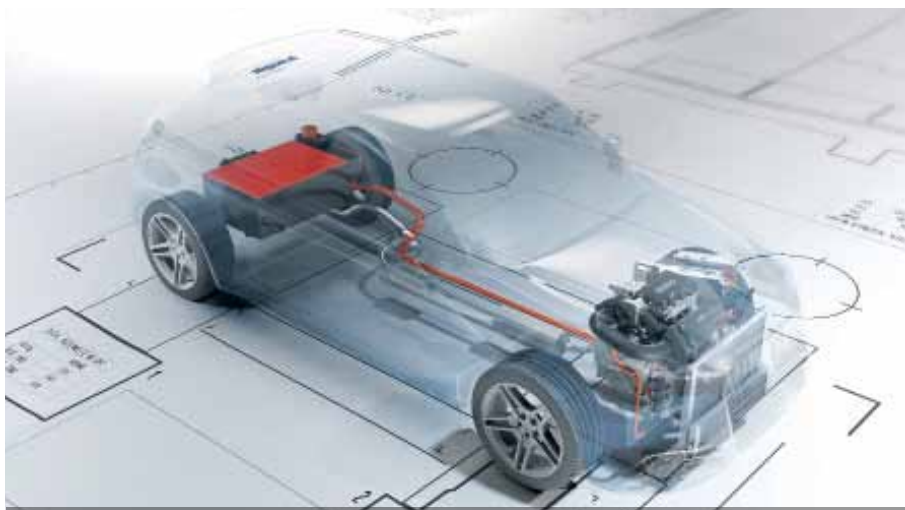
Mottershead says that, built in sufficient volume of at least 50,000 units a year, the cost of the REx is roughly equivalent to the saving gained by using a smaller battery than a straight EV would have and is similar to that of a conventional engine and transmission.

"The industry is watching the BMW i3 closely in terms of battery-only sales versus the more expensive range extender version, to assess potential demand," says Mottershead. Since BMW confirms that orders for the i3 are running at 55 per cent in favour of the range extender version, the future for the REx could be bright.

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Mahle's REx demonstrator is refined, with punchy response at urban speeds



Rear-mounted 14kWh battery pack can be topped up via the mains or the on-board 900cc generator



A1-based prototype has a range of 311 miles, can cruise at 75mph and takes 12.0sec to cover 0-62mph

Tried and tested concept

RANGE EXTENDERS, ALSO known as series hybrids, are definitely on the radar of major manufacturers. Apart from the BMW i3, Lotus developed a three-cylinder range extender that was used in Jaguar's XJ-based Limo-Green research project in 2010. Limo Green achieved 50g/km of CO₂ based on the NEDC cycle.

More recently, in 2011, Autocar drove Audi's own extended-range A1 e-tron research car, built to near-production standard in just one year. The range-extender generator

was mounted in the spare wheel bay and was based on a tiny Wankel rotary engine, producing CO₂ emissions of 45g/km.

Hopes that the A1 e-tron would make production were eventually dashed when Audi condemned the idea as being at odds with existing production techniques and too costly.

