Finding a place for electric tractors

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>
> ED DENNETT

Compressed gas fuels such as hydrogen and methane would appear to be the way forward for alternative propulsion in larger arable tractors, but might battery-electric power be more practical for smaller ones? Fendt believes so, and invited *CPM* to see its first production model.

By Martin Rickatson

Back in 2024, Fendt unveiled a production-ready battery-electric tractor prototype. Based on the brand's 200 series speciality models with a narrow build and a compact design, the e100 V was clearly aimed at tractor tasks requiring a light touch and zero emissions.

Its target audience was fruit and vineyard producers seeking to meet increasing industry expectations for minimal environmental impact, and to manage tasks with a low power requirement but repetitive nature such as inter-row mowing and tree/vine pruning.

That machine became commercially available soon afterwards as the e107 V Vario. At the time, it may have seemed the limit of Fendt's electrical ambitions would remain there, given the power and weight issues posed by larger battery designs, and the little-disputed limitations these pose in terms of powering larger tractors.

Despite this, the tractor finds itself with a more statuesque sibling – the e100 S – and while this may find more likely homes in situations such as turfcare and indoor horticulture, Fendt believes the machine could find a role in some specialist agricultural applications.

FLEXIBLE USES

The e100 S uses the same battery unit as the e107 V and while the brand acknowledges it's been designed primarily for the utility, amenity and leisure sectors, it believes in mainstream agriculture, its attributes may attract the likes of those seeking a tractor for 'position' rather than draught implements. For example, vegetable growers and farms with their own electrical energy production facilities. Indeed, in line with the fact this could relate to solar panel-derived electricity, Fendt promotes the e107 S as 'the first tractor to run on vitamin D'.

"We brought in an e107 S Vario earlier this summer for assessment and demonstration, and the tractor will be available to order from this autumn with UK-spec units arriving soon," explains Fendt's Ed Dennett.

"Both design and manufacturing take place entirely in-house – like all Fendt tractors, production is at our Marktoberdorf plant in Germany. And while dealer technicians will undertake specific training, the E models will be sold and serviced by the existing Fendt dealer network," he adds.

Standing 2.16m wide and 2.64m high on standard tyres, the e107 S is comparable in size to the diesel-powered Fendt 200 Vario models, and like larger Fendt tractors is available in Profi and Profi+ specifications.

Charging up
Full charging takes around five hours, and Fendt claims its ready for future developments in DC fast charging with up to 80kW charging power possible via a CCS socket.

At its heart, as with conventional Fendts, is the brand's Vario stepless transmission – driven by an electric motor powered by the battery pack, and synchronised by Fendt's established Tractor Management System (TMS) software.

Two driving styles can be controlled via the Vario joystick or the accelerator pedal with the operator setting target speed, leaving TMS to regulate the transmission setting and motor speed for optimised energy consumption.

When the motor comes under load, the load limit control takes over the motor speed and transmission setting. The motor speed is automatically increased when the corresponding power is required during operation, and as soon as the operating conditions allow, the motor speed is reduced back to the minimum required level.

The PTO shafts are also driven directly by the electric motor, eliminating energy loss possibility. Whereas energy recovery technology means that when decelerating or travelling downhill, pressing a recovery switch aids deceleration energy recovery, to extract more from the tractor's performance and operating time by utilising energy that'd otherwise be lost. If the tractor is stopped during operation, the motor is automatically switched off when start-stop mode is selected to further save battery energy and range/time potential.

DRIVING MODES

Three driving modes are available, allowing the operator to choose between maximum range, performance or additional power over a limited period of time. In Eco, up to 68hp (ECE R85) is available, this figure rising to 75hp in Dynamic and 90hp for short periods in Dynamic+ mode. Maximum torque is 347Nm.

Beneath the hood, the 100 kWh battery provides a 4-7hr operating time under partial load work such as mechanical weed control or planting. More energy-intensive operations such as haulage will reduce the operating time, acknowledges Ed.

"One of the key challenges with creating an efficient battery-powered tractor is ensuring there's enough cooling capacity to dissipate the heat generated. The primary components on the e107 S are a

Control logic

Fendt has incorporated many of the features of larger combustion-engined Fendt tractors into the e107 S control logic.

Fresh tyre design

Fendt and Trelleborg have jointly developed a new tyre – the TM1 Eco Power – especially for the e107 S, with 340/70 R24 units on the front axle and 480/70 R30s at the rear.

transmission oil cooler and water cooler.

"The air is drawn through the condenser to maximise cooling, with reversible fans governed by a control system which allows each cooling circuit to regulate the fan speed individually to minimise energy consumption."

To recharge the tractor, an automotive-standard CCS2 socket is compatible with standard wall outlets or public charging points. Because many rural areas don't yet have comprehensive infrastructure with DC fast-charging sockets, the Type 2 plug enables charging via alternating current up to 22 kW.

"Charging is also possible via commonplace industrial 32A sockets in combination with a 22kW mobile charger," highlights Ed.

"Full charging with this infrastructure takes around five hours, and we're ready for future developments in DC fast charging with up to 80kW charging power possible via a CCS socket.

"It's possible to charge from 20% capacity to 80% in around 45 minutes. We're also offering a mobile 22kW quick-charging cable set with adapters for 16A and 32A. The integrated software enables charging with 11 or 22kW."

Various auxiliary power consumers are supplied directly from the battery via the tractor's Power Distribution Unit (PDU) which transfers the energy to the air conditioning compressor, the AC/DC converter which replaces the alternator and the water heater.

Fendt suggests this is a particularly efficient solution to the power demands of these components, as no reactive power is generated and only the energy actually required by the auxiliary consumers is consumed, while no belt drives are required for power transmission.

Farms generating electricity from renewable energy – particularly solar or wind – have the potential to operate an e107 S in a virtually zero CO_2 production cycle, suggests Fendt, with its operating concept also significantly reducing the tractor's running costs.

"With no exhaust gas after-treatment components, engine filters or engine oil, running costs are reduced significantly," says Phil Mattey, tractor specialist at Fendt.

"And electrical power not only means the tractor is emission-free at work, but also that it's far quieter than a diesel-powered equivalent, benefiting the operator and those around the work area.

"Despite these benefits, there's no constraint on factors such as travel performance, with a top speed of 40km/h meaning the tractor is a viable power unit for low-cost, short-distance haulage. Lowest possible speed is 0.02km/h, ideal for vegetable operations," he adds.

"One of the first farmer customers is based in Norway where his tractor has been used for surface cultivation, bale wrapping and multiple other tasks on a small mixed farm. We see no reason why light operations using many existing trailed implements shouldn't be perfectly possible with the e107 S."

Although its bonnet conceals a battery pack rather than an engine, much like its 200 series conventional counterparts the e107 S features a wasp-waist design to allow the wheels to tuck in when turning, with a 4.2m turning radius.

BUTTON CONTROL

Fendt's 'intelligent' all-wheel drive management is push button-controlled with auto disengagement and 100% permanent 4WD functions. Intelligent differential lock management is also button-controlled, including automatic and 100% engagement for safety on slopes.

The tractor is equipped with front axle suspension including roll support with 80mm suspension travel, and anti-roll bar to reduce rolling movements. There's also a levelling control system that ensures ride comfort remains constant regardless of the load.

At the rear, Fendt uses its established HA 75 axle with recirculating pressure lubrication and a 5.3t permissible rear axle load, plus 100% multi-disc differential lock with reinforced brake system designed for a high permissible overall weight. A four-wheel braking system incorporates brake pressure monitoring and majors on a large-dimension wet ring-piston brake with brake booster on the rear axle.

Fendt and Trelleborg have jointly developed a new tyre – the TM1 Eco Power – especially for the e107 S, with 340/70 R24 units on the front axle and 480/70 R30s at the rear. The hybrid road/field tread design and low rolling resistance have been engineered to minimise battery usage on electric tractors, claim the two parties, and the tyre is manufactured from 65% renewable and recycled materials.

Then, the e107 S hydraulic system includes a load-sensing variable-displacement pump with Power Beyond capability and a maximum flow rate of 113 l/min. In a further plus for the tractor's environmental credentials, it's possible to use bio-based oil in its hydraulic system, while separate transmission and hydraulic oil reservoirs mean no mixing of oil and no potential dirt ingress into the transmission.

The tractor can also be equipped with a front linkage in a choice of variants. Base version is a single-acting arrangement, with a double-acting unit with position control as a further option, equipped with a changeover tap for single/doubled-acting operation. Third choice is a double-acting 'comfort' option. Like the rear hitches, all are controlled via the armrest and the 12-inch terminal. Rear linkage lift capacity is 2540kg.

While many things may seem a little smaller and perhaps stranger, those familiar with larger Fendt tractors will find some reassurance in the Fendt e107 S cab which is dominated by the FendtOne armrest and terminal. Like the unit in other Fendts, it's capable of managing guidance, telemetry and machine control.

Additional features include the ability to set charging timers via a charging management page to ensure the tractor is ready for use at the desired time and the battery is brought up to operating temperature.

"A lot of visitors to our stand at the Royal Highland Show – the e100 S Vario's UK debut event – expressed surprise that its appearance is one of a 'proper' tractor," comments Ed.

"We believe it offers some significant advantages in certain areas of agriculture and while its list price is approaching £200,000, it offers significant potential savings, while produce buyers in certain sectors are increasingly influential over their farmer suppliers' carbon footprint.

"For this and for other reasons – including the fact it can be 'fuelled' from farm electricity – we feel this tractor may well have a place on some UK arable farms," he concludes. ●