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March-April 2022

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COMMENT

When green is not so green

In mid-February, Indiana-based engine manufacturer Cummins announced that it would look to develop a range of engines which would be 'fuel agnostic'. In practise, this translates to a common engine block and interchangeable heads using diesel, natural gas and hydrogen (H_2).

A number of big OEMs are developing engines to use the H_2, including Deutz, JCB and now Cummins. Of course, there's a lot to like, particularly the reduced tailpipe emissions. But as a fuel, hydrogen is not always quite as angelic as it might first appear, relating to how it is produced.

A recent report from industry consultancy IDTechEx looked to analyse well-to-wheel grams of CO_2 per km emissions related to fuel cell passenger cars, referencing the results against tank-to-wheel emissions of cars with internal combustion engines.

The production of any hydrogen (H_2) fuel has a carbon emissions footprint. 'Green' hydrogen is produced by electrolysis of water. That electrolysis requires about 50 kWh of electricity to produce 1 kg of H_2, meaning that the carbon footprint of green hydrogen is unavoidably tied to the carbon intensity of the electricity used.

Although there are more projects on the way, green hydrogen production using renewable energy is still very low. The vast majority of hydrogen for fuel - about 95% - is generated by the steam methane reforming of natural gas. This process is cheaper, but the 'grey' or 'blue' hydrogen has an emissions footprint of around 10.9 kg CO_2/kg H_2.

The Toyota Mirai fuel cell electric vehicle (FCEV) is reported to have a fuel consumption of 0.86 kg H_2/100 km. This means that fuelled with grey hydrogen it emits the equivalent of 94 g CO_2/km. The Kia Nexo FCEV uses approximately 1 kg H_2/100 km, which translates to about 109 g CO_2/km. These numbers are not much (if at all) better than cars with Euro 6-compliant internal combustion engines. The conclusion is that vehicles must use green hydrogen produced with renewable electricity to actually be green.

You may recall that this issue's cover features our biomethane focus. While H_2 will boost emissions reduction efforts, until green actually means green there remains a strong case for biomethane, a fuel solution which has few compromises, is already here and can be implemented now.

Thanks for reading and I hope you enjoy the issue.

> "As a fuel, hydrogen is not always quite as angelic as it might first appear."

Julian Buckley
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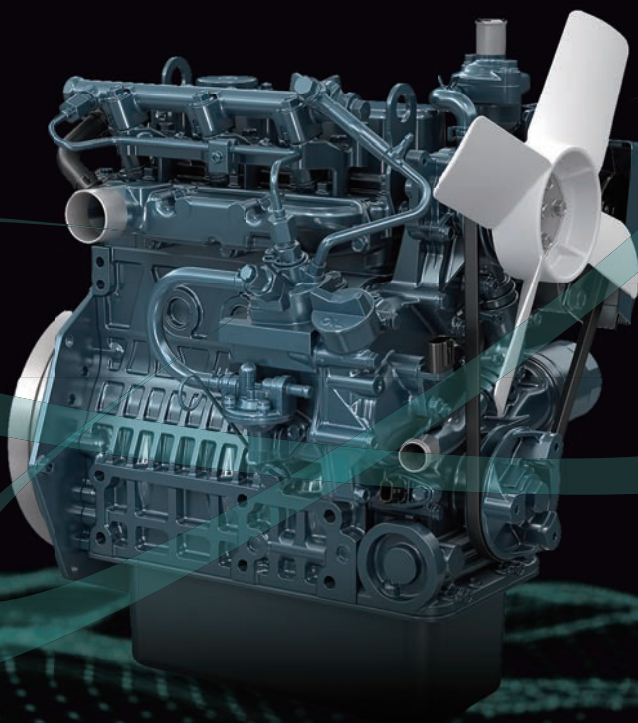

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OUTSIDE

Our biomethane focus looks at gas as fuel from four different perspectives

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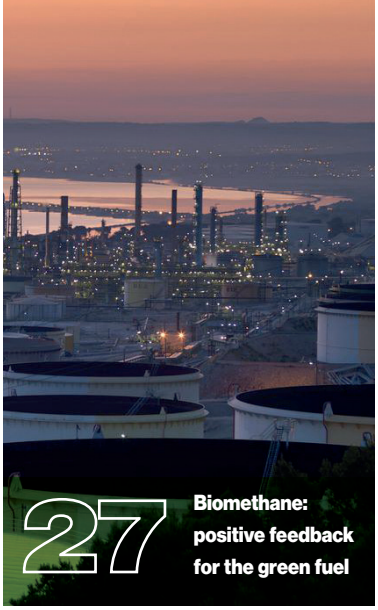

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Construction and machine OEMs halt business in Russia

Construction equipment manufacturers are joining the surge of Western companies winding down their operations in Russia, following the invasion of Ukraine.

Hitachi Construction Machinery (HCM), Komatsu and JCB have all announced decisions to suspend operations in the country, for the time being.

HCM said it is winding down operations but will continue to monitor developments in Russia and Ukraine, in the hope of a peaceful resolution.

SAFETY IS PRIORITY

In its statement, HCM said, "Our highest priority is on the safety of our stakeholders, including our group employees and their families, customers, dealers, and supply chain partners.

"Hitachi Construction Machinery has made decisions to gradually stop production at Hitachi Construction Machinery Eurasia LLC, its regional headquarters responsible for manufacturing and sales in Russia and the CIS, and halt exports from Japan to Russia until further notice, because of the potential risks associated with the business.

"We are committed to making the appropriate decisions as possible based on collection of information and close communication with our bases worldwide."

Komatsu said it was suspending shipments to Russia because of "the current supply chain disruption and the uncertainty of the financial and economic situation."

The company has set up an emergency task force, headed by its President and CEO Hiroyuki Ogawa, to gather information and discuss any future measures.

The company said, "Komatsu is deeply concerned about the current situation in Ukraine and is closely monitoring developments. The company sincerely hopes that the situation is settled peacefully as soon as possible."

JCB said it had "paused all operations [in Russia], including the export of machines and spare parts."

MARKET ANALYSIS

Chris Sleight, MD of market research and forecasting company Off-Highway Research, offered this insight into the Russian equipment sector: "According to the Association of European Businesses, the Russian construction equipment market grew 48% last year to 21,375 units. This is based on data collected from all the major international suppliers selling equipment in Russia, along with several major domestic OEMs and comprises earthmoving and road building equipment.

"Last year was the fifth consecutive year of growth for the Russian market, and the volume of machines sold was almost twice the average annual sales in the preceding seven years.

"The imposition of economic sanctions on Russia, particularly its debarment from international banking and payment networks, is likely to see equipment sales plummet this year. Off-Highway Research estimates that only about a third of the equipment sold in Russia is manufactured domestically (although this is hard to gauge accurately, due to the large number of local manufacturers).

"We believe that even without specific sanctions against construction equipment or without manufacturers voluntarily suspending sales, shipments to Russia are likely to cease due to payment uncertainties." **dpi**

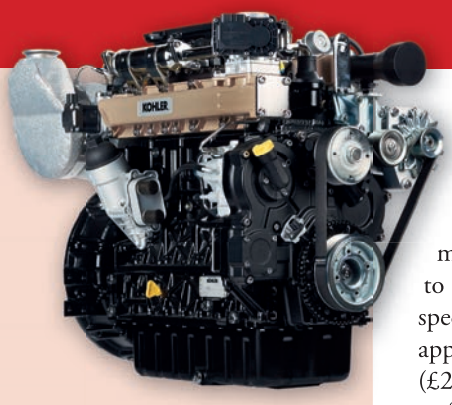
NEWSBITES

→ **Danfoss** has revealed 2021 sales increased 29% to €7.5 billion, a record for the Denmark-based manufacturer of drive, hydraulic control and climate systems technology. The company reported organic growth reached 18% year-on-year, while its five-month ownership of Eaton's hydraulics business added €786 million.

→ The joint venture between **John Deere** and **Hitachi Construction Machinery** has officially ended, with the two OEMs now offering competing products in the Americas. Hitachi will supply Deere with whole goods excavators, components and parts under a new OEM supply agreement.

→ **Manitou Group** is to invest $80 million in its two North American manufacturing facilities in South Dakota. The investment will be used to extend the sites in Yankton and Madison. A further $23 million will be dedicated to the development of electric equipment ranges, including electric compact loaders and telehandlers.

→ **ExxonMobil** is planning a hydrogen production plant and one of the world's largest carbon capture and storage projects at its integrated



Kohler KDI 2504 Stage 5 engine

Kohler approves HVO for diesel engines

Kohler has approved the use of EN15940-compliant hydrotreated vegetable oils (HVOs) for all its diesel engines. The fuel can be used pure or as a blend with conventional diesel in any liquid-cooled (KDI, KDW ranges) or air-cooled (KD) engines from Kohler.

The approval comes after laboratory and field testing by Kohler's engineering team.

Diesel engines will not require any type of modification or specific upgrade to use HVO, although the company reports that aftertreatment systems will still be necessary, where required.

HVO is a renewable paraffinic fuel also known as synthetic or renewable diesel. It is produced from oils collected from meat and fish industries. Unlike biodiesel it does not use agricultural resources or contribute to deforestation.

A 90% reduction in CO_2 output can be achieved, dependent on the source. Also, in comparison to conventional diesel, HVO has a very low sulphur content, which supports lower vehicle emissions.

"We are witnessing a growing interest from customers for use of synthetic fuel (HVO) and other renewable fuels. eFuels are especially interesting, not only for their positive environmental impact but also because they reach performance levels comparable to diesel fuels," stated Luigi Arnone, director of engineering for diesel engines at Kohler.

HVO can be distributed, handled and stored as any other fuel. The fuel does not change maintenance schedules and all Euro warranties will be supported.

Cummins announces purchase of Meritor

Engine specialist Cummins has announced that it has made a definitive agreement to acquire global powertrain specialist Meritor for approximately $3.7 billion (£2.85 billion, €3.39 billion).

"The acquisition of Meritor is an important milestone for Cummins," said Tom Linebarger, chairman and CEO of Cummins. "Meritor is an industry leader and the addition of their complementary strengths will help us address one of the most critical technology challenges of our age: developing economically viable zero-carbon solutions for commercial and industrial applications."

NEW SYNERGIES

Linebarger continued: "This acquisition adds products to our components business that are independent of powertrain technology and by leveraging our global footprint we expect to accelerate the growth in Meritor's core axle and brake businesses. There is also a compelling financial case for this acquisition, with significant synergies expected in SG&A, supply chain operations and facilities optimization."

The integration of Meritor will position Cummins as one of the few companies able to provide complete powertrain solutions across combustion and electric power applications. Cummins believes eAxles will be a critical integration point within hybrid and electric drivetrains. By accelerating Meritor's investment in electrification and integrating development within its New Power business, Cummins said it expects to deliver market-leading solutions to global customers.

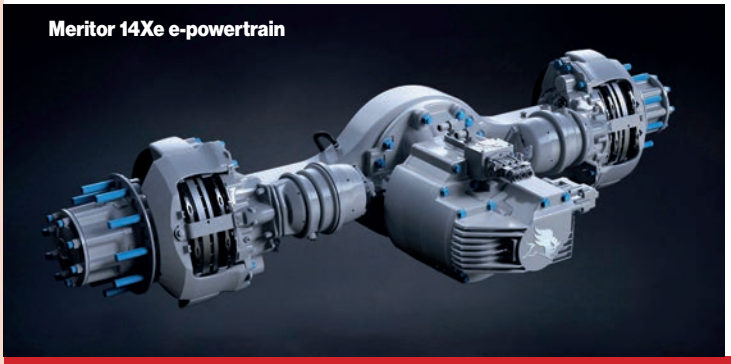
"This agreement with Cummins builds on Meritor's track record of outstanding performance and service to our customers." said Chris Villavarayan, CEO and president of Meritor. "Our offerings will continue to play an important, strategic role as commercial vehicles transform to become electric and autonomous."

Also in February, Cummins announced that it would purchase Jacobs Vehicle Systems from Altra Industrial Motion for $325 million (£247 million, €294 million). Widely known for its 'Jake Brake' engine braking technology, Connecticut-based Jacobs also supplies cylinder deactivation, engine start/stop and thermal management technologies.

PATH TO ZERO

The Jacobs deal came just two days after Cummins announced it would buy out Westport Fuel Systems' stake in the Cummins Westport joint venture, which manufactures and markets gas-fuelled engines.

Each of the recent acquisitions supports Cummins' 'Path to Zero' decarbonisation efforts. The concerted push to reduce the company's wider environmental footprint was highlighted earlier this year when the company took 50% ownership of Momentum Fuel Technologies from Rush Enterprises. **dpi**



Meritor 14Xe e-powertrain

refining and petrochemical site at Baytown, Texas. The proposed facility would produce up to 1 billion cubic feet per day of 'blue' hydrogen, produced from natural gas and supported by carbon capture and storage. There is capacity to store up to 10 million metric tons of CO_2 per year, more than doubling ExxonMobil's current capability.

➔ **Eaton** has created a new ePowertrain business unit within its Vehicle Group. The new division will focus on developing products within Eaton's electrified vehicle transmission, reduction gearing and differential portfolios.

➔ **Proman** is to supply **AP Moller - Maersk** with green methanol for Maersk's new methanol -fuelled container vessels. Proman will aim to supply the shipping company with up to 150,000 tonnes of methanol per year from a new production facility in North America, starting in 2025.

European Energy solar park at Rødby Fjord

E-methanol production project revealed

Siemens Energy has reported it has secured an electrolyzer order from European Energy for the world's first large-scale e-methanol project. European Energy is a Danish developer and operator of green energy projects.

The plan involves development of a commercial e-methanol production facility, with hydrogen provided by a 5 MW electrolyzer plant from Siemens Energy. Located in Kassø, southern Denmark, the project will be close to a 300 MW solar park also being developed by European Energy. This means there will be access to low-cost renewable electricity needed for production of the e-fuel.

End users of the e-methanol will include shipping company Maersk and fuel retailer Circle K. The project secures the fuel supply for Maersk`s first e-methanol container vessel. Start of commercial methanol production is planned for second half of 2023.

Stefano Innocenzi, senior VP, New Energy Business, Siemens, said: "With this project we will bring e-methanol to market at scale. E-fuels are predestined for long-distance ship and road transportation."

Speakers announced for NPP Summit 2022

KHL Group has released details of the New Power Progress Summit 2022, to be held online at 1500 (GMT), 1600 (CET) and 0900 (CST) on 3 May.

Under the headline banner 'Technologies for CO_2 Neutrality', a series of industry leaders will outline routes which companies can take to achieve their emissions reduction goals.

Keynote speaker for the event will be Amy Davis, Cummins vice president and president of the New Power Business. Other speakers will include:

- **Tim Burnhope**, JCB's chief innovation and growth officer
- **Peter Tepfenhart**, ZF's product manager for Construction Machinery Systems
- **David Stockbauer-Muhr**, ZF's head of Electric Systems Development for Off Highway
- **Benjamin Oszfolk**, systems engineer at Rolls-Royce Power Systems
- **Deepak Shekhar**, product manager for e-Mobility Solutions at Scania

For more details and information on the upcoming summit, please go to www.npp-virtual.com. **dpi**

Amy Davis, Cummins

MAN invests in hydrogen production

MAN Energy Solutions is to invest up to €500 million in its subsidiary H-Tec Systems to support development of PEM electrolyzers used to produce hydrogen.

Speaking about the investment, Uwe Lauber, CEO of MAN Energy Solutions, said: "We are transforming H-Tec Systems into one of the world's leading players in the field of PEM electrolysis. Over the next five to 10 years, green hydrogen will become one of the most important primary energy sources for the global economy as it continues to decarbonize."

According to MAN, H-Tec Systems not only benefits from a global sales network and the experience MAN Energy Solutions has in major projects, but also from direct access to the expertise and experience of the VW Group in production scaling and supplier-based series production.

H-Tec Systems already markets solutions for the electrolysis of hydrogen, offering customers integrated container solutions in the megawatt range. **dpi**

MAN H-Tec electrolyzers

NEWSBITES

Hino Motors has admitted falsification of engine data covering the A05C medium-duty and the A09C and E13C heavy-duty engines. Manufacturer of commercial vehicles and engine supplier for Toyota and Isuzu Motors, the deception could affect more than 100,000 vehicles, or double the company's annual sales in Japan.

Engine emissions results are said to have been manipulated by using non-stock exhaust systems to produce the required test results. Hino has now stopped shipment of the truck and bus models involved in the scandal, which the Financial Times reports could go back as far as six years.

Hino, which has an estimated 33% share of the Japanese commercial vehicle market, has been looking to develop electrified vehicles. This includes a tech sharing agreement with Volkswagen Group's Traton truck and bus unit signed in 2018.

Hino A05C engine

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Kumbier joins Briggs & Stratton

Briggs & Stratton has announced that **Michelle Kumbier** has joined the company as senior vice president and president of its Turf & Consumer Products business. This includes such brand as Ferris, Snapper, Simplicity, Billy Goat, Victa and Branco.

Kumbier joins Briggs & Stratton after more than 22 years at Harley-Davidson Motor, where she most recently served as chief operating officer for the motorcycle manufacturer. Prior to Harley-Davidson, she spent 11 years at Kohler Co. and currently serves on the board of directors for Tenneco, Teledyne Technologies and Abbott Laboratories.

Kumbier succeeds Harold Redman, who served as senior vice president and president of Turf & Consumer Products. The company said it is thankful for the contributions and leadership from Redman throughout his years of service.

"Briggs & Stratton is quickly transforming its business and requires fresh perspectives and different experiences to drive change and success," said Steve Andrews, president and CEO at Briggs & Stratton. "Michelle's leadership and expertise in operations, supply chain and product development will be integral in continuous improvement efforts and positioning Briggs & Stratton as a best-in-class provider of innovative power products and solutions."

Favre, Andres, take top spots at Hella

Hella has announced that its Shareholder Committee has appointed Michel Favre and Yves Andres as new members of the management board of Hella GmbH. Favre, currently executive vice president, group chief financial officer at Faurecia, will take over as Hella chief executive officer on 1 July.

He will succeed Dr. Rolf Breidenbach, who will terminate his management contract by mutual agreement on 30 June but will continue to support the de facto Faurecia/Hella group in an advisory capacity.

Yves Andres, currently executive vice president Clean Mobility at Faurecia, will join the Hella management board on 15 April. After a transition period, the company said Andres will take over responsibility for the Lighting Business Group from Dr. Frank Huber, who will then leave the company by mutual agreement.

A native of France, Favre has been EVP Group CFO at Faurecia since 2013. Prior to that, he spent 13 years at automotive supplier Valeo, where he held various specialist and management positions, including leading the lighting business there.

"The fact that Hella is so well positioned today is largely due to the work performed and the successes of the previous management team," said Carl-Peter Forster, chairman of the Hella Shareholder Committee "At the same time, I am pleased that, with Michel Favre and Yves Andres, we have been able to attract two highly experienced, international executives to the Hella management team to continue the company's successful course."

Michael Klein, Daimler Buses

Faurecia bought an 80% stake in Hella earlier this year, a move that reportedly formed the seventh-largest automotive supplier in the world and one that it was said would allow the suppliers to pool their expertise in production of original equipment and aftermarket products. **dpi**

Müller takes over as interim CEO at Torqeedo

Following a series of significant changes to its top management team, Deutz has announced that Dr. Markus Müller, currently chief technical officer at Deutz, will take over as interim CEO and MD at Torqeedo with immediate effect.

Torqeedo is a subsidiary of Deutz which specialises in marine electric drives.

Müller will replace Dr. Ralf Plieninger, the company's current COO and MD. Plieninger will leave the company on 1 May.

"We would like to thank [Plieninger] for his contributions to Torqeedo and his major efforts to support the launch of the E-Deutz strategy. We wish him every success for his future career," said Müller.

"Together, we have brought innovative electric products to the market, where they have transformed entire segments of the marine industry," said Plieninger in a statement to employees. "At the same time we have turned a small, innovative startup into a market leader."

Müller, who has been CTO at Deutz since 2021 and will retain that role, has served in various senior technical roles for the company since 2006. **dpi**

Markus Müller

DEALERBITES

→ **Bergen Engines** is to open a sales and service centre in Querétaro, Mexico. The new facility will become the headquarters for the company's operations in Latin America, including commissioning support for upcoming projects, long term service agreements, and ad hoc service needs.

→ **Xos**, a California-based manufacturer of Class 5 through 8 battery-electric vehicles and powertrains, has entered into dealership agreements with MHC Xos, a subsidiary of Murphy-Hoffman Company formed to operate the MHC Xos dealerships.

As part of its initial rollout, Xos will partner with MHC Xos in seven locations across six states: The partnership will cover commercial electric vehicles and a full parts inventory to maximise uptime.

→ **Taylor Power Systems (TPS)**, manufacturer of standby and prime power products, has announced a partnership with FTG Equipment Solutions which will see TPS distribute and support TecnoGen and Trime equipment, including generators and light towers.

The gen sets cover a range of applications, including construction, rental, telecommunications, first response and emergency standby.

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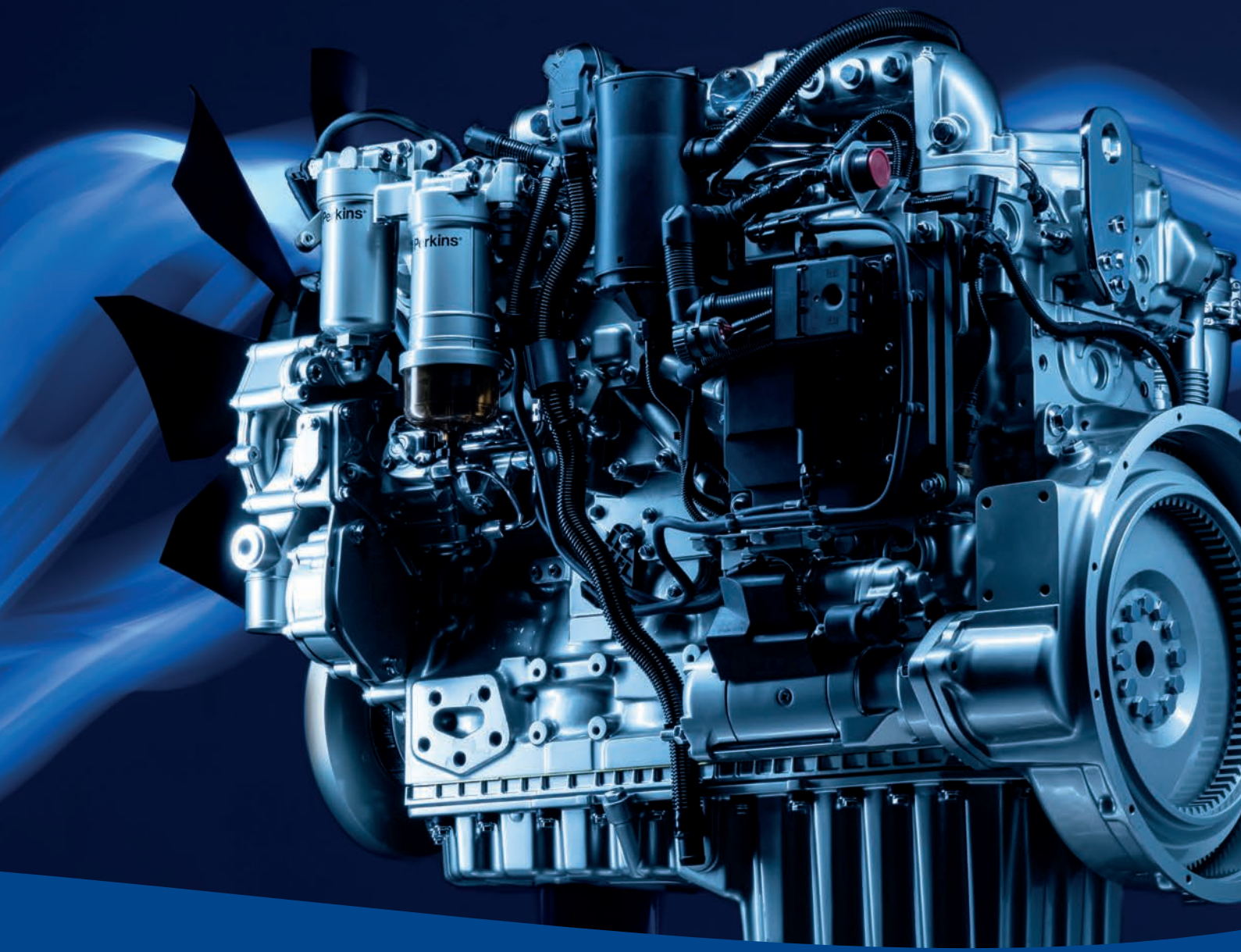

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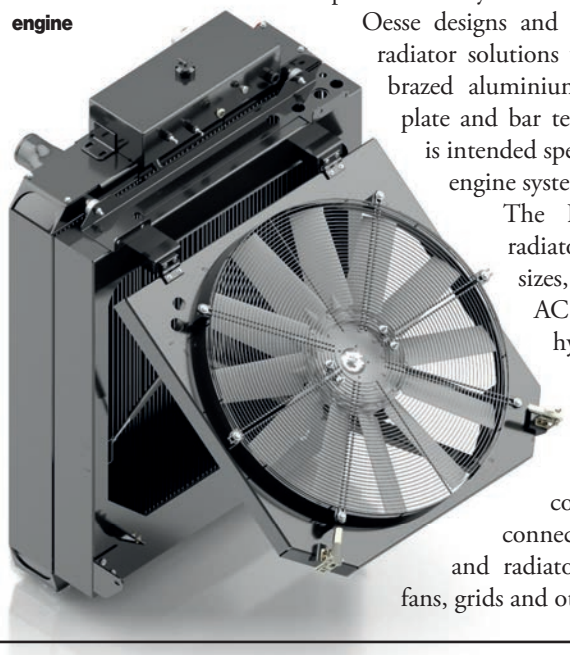
Oesse intros self-cleaning radiators

Radiators in agricultural machines frequently get blocked, especially in harvest vehicles. It is something which most operators assume will eventually happen due to the design of the external fins which allows dirt to pass through to the cores. In particularly difficult conditions, further measures are needed to allow quick and easy cleaning of the radiator cooling system.

Oesse has supplied a radiator for a 230 kW Mercedes-Benz OM936 diesel engine which is fitted to a sugar beet harvester. The radiator conveyor is equipped with two pneumatic cylinders which support rapid inspection and cleaning of the radiator.

Operator safety is ensured through the addition of a sensor plate on the inspection door; when it is detected that the door is open, the cooling fan will stop automatically.



Oesse radiator used in Mercedes-Benz OM936 engine

Oesse designs and manufactures a series of radiator solutions with cross-flow, vacuum-brazed aluminium heat exchangers using plate and bar technology. The HR range is intended specifically for cooling diesel engine systems.

The HY series includes 71 radiator models and 15 different sizes, with fans driven by AC or DC using electric or hydraulic motors.

The company supplies all necessary system components, including connections, pipes, conveyors, brackets and connection bases between engine and radiator, plus expansion tanks, fans, grids and other accessories. **dpi**

AS series hubs from NSK feature a newly-optimised flange design

AS series hubs from NSK

Bearings and bearing component specialist NSK has introduced an updated range of A-series Agri disc hub bearing units. The new AS series disc hubs cover three sizes, AHU28117AS-01 (four holes), AHU28117AS-02 (five holes) and AHU28117AS-03 (six holes).

The hubs are suitable for a range of machines, including cover-crop units, tillers, front packers, seeders, row cleaners, mowers and finger weeders.

The new range is said to have a selection of attributes designed to enhance performance in challenging agricultural applications. These include: new seals to prevent outside contamination; lifetime lubrication that offers maintenance-free operation; a reinforced housing to facilitate high momentum loading; and ease of installation to reduce downtime.

The new hub bearing units support such activities as mechanical weeding, which is being introduced to reduce the use of glyphosate. In addition, the sealing system can withstand such harsh applications as tillage.

The new hubs will be produced at the NSK Neuweg manufacturing facility in Munderkingen, Germany.

ZF introduces Ergocontrol II TCU

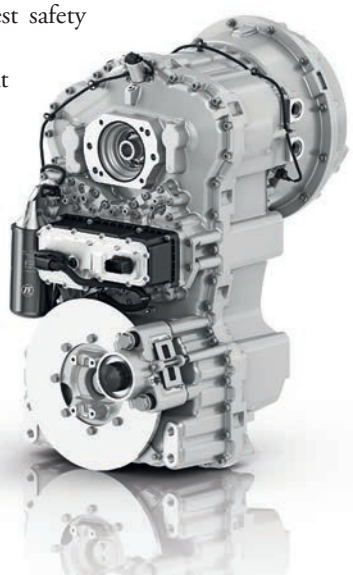
ZF has launched a new onboard transmission control unit (TCU), the Ergocontrol II, which will be rolled out to replace the existing Ergocontrol I.

Used in combination with the Ergopower powershift transmission series, the new control unit is said to bring a series of advantages for related construction machinery. These include direct mounting to the transmission, specially designed electronics and a hydraulic control unit.

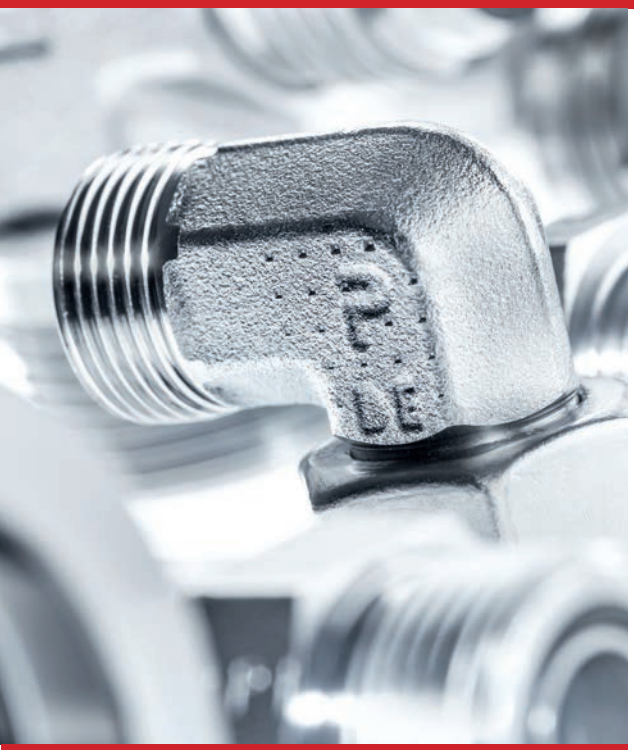
In addition, the Ergocontrol II uses a new software platform which enables integration into OEM service tools. As part of this, the new TCU features a standard CAN interface for all construction machinery transmissions, supporting ease of maintenance (UDS, Unified Diagnostic Services, ISO 14229). The system also complies with the latest safety requirements, up to level D (ISO 13849).

Despite maximum functionality, ZF says that installation of the new TCU is relatively simple. The unit is installed directly to the transmission, meaning that cabin space is not impacted. OEMs can further benefit from reduced mounting and wiring complications.

The all-new electronics onboard the Ergocontrol II is said to exceed the functionality of previous component generations in terms of memory and performance, making the units remarkably future proof. **dpi**



ZF Ergocontrol II for the Ergopower powershift



ToughShieldPlus coating from Parker Hannifin

ToughShieldPlus from Parker Hannifin

Motion and control technology specialist Parker Hannifin has introduced its new ToughShieldPlus zinc-nickel surface treatment for all tube fittings and adapters.

The plating provides increased resistance against corrosion, while maintaining part properties and ease of assembly.

The surface treatment has been under development for several years at the Parker Fluid Connectors Group in the US and Europe. This has helped determine the optimum surface treatment and related properties.

The basis of the new plating builds on the proprietary zinc-nickel alloy, passivated by a hexavalent chromium-free layer. The topcoat is said to provide superior friction and assembly control.

Standard industry methods were used to test ToughShieldPlus, including Neutral Saltspray Testing and Cyclical Corrosion Testing.

This testing programme found that the ToughShieldPlus plating system can provide rust resistance for parts in fluid power systems for up to 3000 hours.

Once it takes hold, rust can quickly spread across the part and to other components. This makes it important to prevent rust from starting by using the most resistant components.

ToughShieldPlus can prevent rust from starting, which helps to save time and money through extended tube fitting and adapter life, which adds to ease of maintenance. It can help improve equipment up time, prevent aesthetic discolouration and save on warranty costs.

The ToughShieldPlus system complies with industry standards, such as DIN and SAE, and also the RoHs, REACH and ELV environmental standards.

Yanmar launches new portable diesel water pumps

Yanmar has re-launched its existing YDP series of portable diesel water pumps, which are now equipped with air-cooled L series engines that comply with Stage 5 and Tier 4 Final emissions regulations.

The heavy-duty pumps will be produced in Italy, as this is also where Yanmar's L series engines are manufactured. The company said that production of the pumps in the same location will ensure faster and more efficient customer deliveries.

"Preceding models have pioneered prominent levels of durability and reliability, even in some of the harshest operating environments across the globe," said Carlo Giudici, Sales and Marketing director at Yanmar Europe. "However, newly designed and augmented models powered by Yanmar Stage 5-compliant engines are best-suited for the European market niche."

The new models have a maximum capacity of 1750 L/min. They are suitable for operations in various sectors, including construction, agriculture, marine and other day-to-day water pumping requirements.

The newly-designed YDP series is available in bore sizes from 5.08 to 10.16 cm for fresh, semi-trash, and trash water. They have a suction lift capacity of 7 metres.

The series includes 44 models, with capacities ranging from 550 to 1750 L/min, catering to a wide range of water solutions and emissions requirements. The pumps will be available across Europe and in other global regions.

Electric and recoil starting options are available for all models, as well as a wheel kit option for ease of transport to and around the site.

The YDP water pumps are CE certified, a key European conformity mark, which means it complies with European safety, health, and environmental protection standards.

The new series also features a 13-L diesel tank (reported to be the largest in this segment) that supports a running time of up to eight hours. The units further feature cast iron (FC150, FC200 and FC300) and cast steel (Hcr) impellers.

The Yanmar L series vertical air-cooled diesel engines are covered by a two-year, 2000-hour warranty. Giudici said that ease of maintenance is also a major attraction for operators: "For instance, cleaning the casing internally requires only the removal of a few bolts."

The new YDP pump are already available to order and deliveries are expected to start in the first half of 2022. **dpi**

Yanmar YDP pump

Pile driver rig from Stump-Franki

Safety rotary encoders

Heavy machinery in specialist civil engineering requires precise operation to perform reliably and safely. Pile drivers from Stump-Franki Spezialtiefbau are now using WV58MR absolute rotary encoders, part of the Pure.Mobile sensor range from Siko, to detect the position of individual winch elements in the rigs.

Stump-Franki specializes in creating subsoil which can support large structures, such as football stadiums, bridges, shopping centres or wind turbines. The company manufactures pile drivers used to construct the necessary foundation footings. These divert structural loads to deeper, more suportive layers.

"We have our own mechanical engineering department to develop, design, assemble, commission and then use the equipment that suits us," explained Stefan Hemmerle, head of Mechanical Engineering at Stump-Franki.

The Franki pile driver has four winches, each of which have different tasks during the driving process These include pulling the driving pipe, driving the pile driver, moving buckets of concrete and gravel filler, and an auxiliary winch to move a reinforcement cage.

Three of the four winches are monitored using rotary encoders from Siko. These define where the pile driver, the auxiliary lift and the bucket are located. The auxiliary line is a safety feature which ensures the pile driver shuts off before a hook passes through a rope pulley. This means the rotary encoder has an end position beyond which the winch must not continue to rotate.

The winch pulling the pipe is the most sensitive area; despite the hard blows into the driving pipe, measuring the position is of critical importance. The rotary encoders are integrated into an automatic control system which constantly updates the positions and so controls tracking of the cable.

ROTARY ENCODERS WITH PL-D SAFETY PERFORMANCE

"What is most important to us is the precision of the position detection and the redundancy as a safety function of the rotary encoder," said Hemmerle. "As a multi-turn encoder, it can detect up to 4096 revolutions of the winch in absolute terms; in addition, we have also integrated a gear ratio so that we receive an enormous number of signals that enable us to accurately detect the position."

> "Rotary encoders must be able to withstand this load - and they do."
>
> **STEFAN HEMMERLE, Stump-Franki**

Using a rotary encoder with the PL-d safety class is vital to such applications. Two separate sensor circuits deliver operational redundancy, helping to ensure the rig is safe. In addition, it is an absolute encoder, which recognizes exactly where it is, even when powered off. It also needs no travel to reference its position.

"What is also important for our application is the absolute robustness. When the foot is impacted, on the one hand 240 tons are pulling on the pipe - at the same time, the pile driver falls into the pipe with 6.5 tons. Practically the entire machine is jumping! The rotary encoders must be able to withstand this load – and they do," said Hemmerle. The magnetic measuring principle of the rotary encoders, ideally suited harsh environments, also meets this requirement.

FOUNDATION PILES IN POOR SOIL

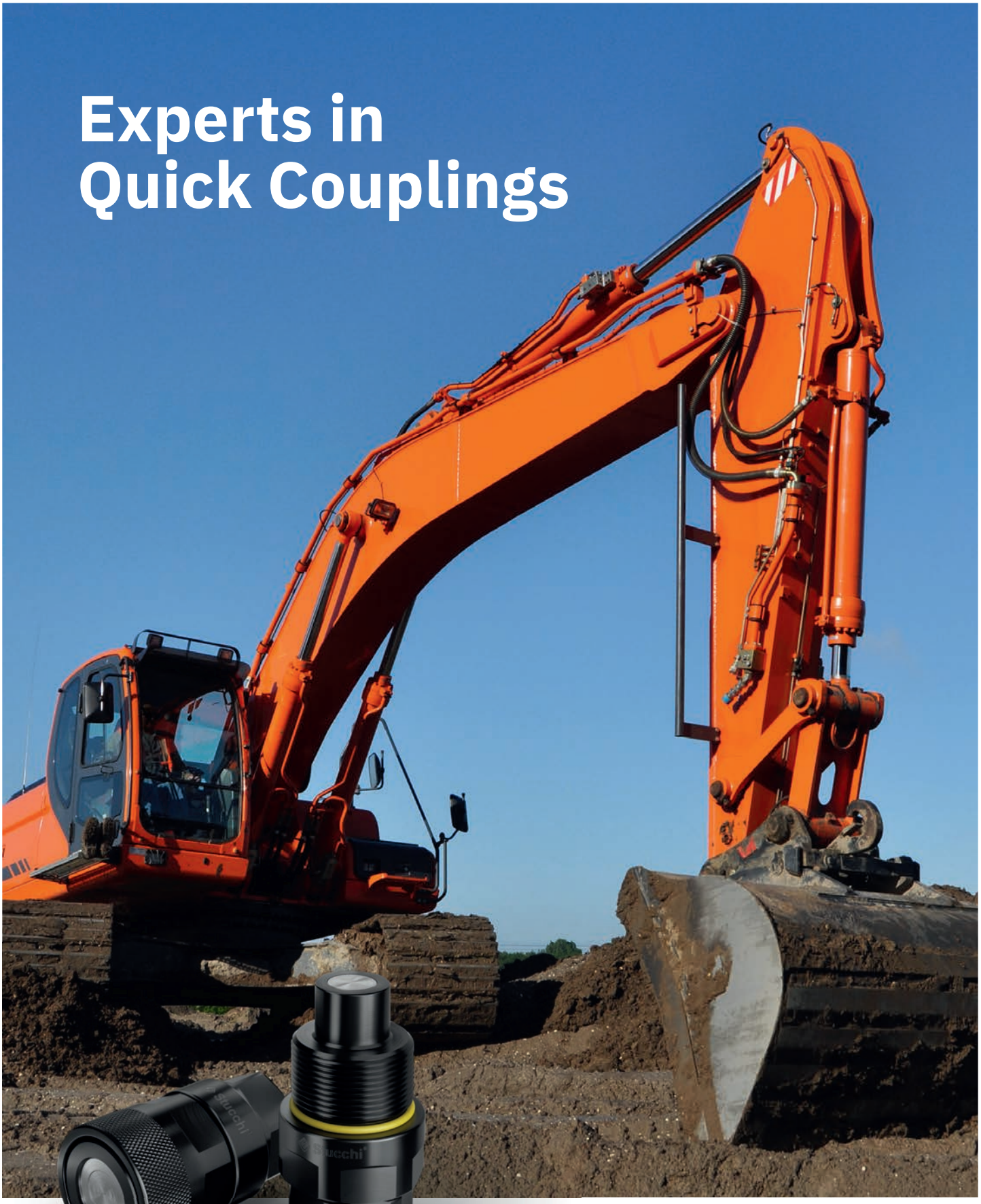
Driving foundation piles is required where there is poor soil quality and heavy structures.

"The advantage of our Franki pile system is that it is a full displacement pile system. As a result, we have no excavated soil and do not have to dispose of anything," explained Hemmerle. "With the impacted foot, we can adapt to any soil. If it is not possible to drive particularly deep, we can simply impact the foot a little larger and compact it more strongly, thus giving the structure the necessary stability."

WV58MR absolute rotary encoders from Siko

Rotary encoders from Siko offer various features, including operational temperature range from -40 to 85 °C (optional: +105 °C) and protection classes up to IP6K9K. **dpi**

Experts in Quick Couplings



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Attendees at the Energy Storage Summit 2022

Energy Storage Summit

Battery tech takes centre stage

The move to renewable energy sources, including wind and solar, has created a series of peripheral business opportunities to supply supporting hardware and data services. A range of these solution providers were represented at the recent Energy Storage Summit 2022. Held in London, UK, and organised by Solar Media, the event highlighted the products and services now on offer as companies and countries look to make the switch from fossil to green energy sources.

The sector is still relatively new, which translates to a long list of companies vying to win a slice of this lucrative market. HMS Networks, based in Ravensburg, Germany, delivers data systems linking battery storage installations. Speaking with DPI, Christian Adolph, marketing director, said: "It's fast moving, growing. It changes a lot, very quickly. There are a lot of market predictions, enormous growth numbers. There are a lot of startups, but also the big names are in the game."

Louise Dalton, CMS

Keith Burns, commercial director at Natural Power, an energy storage specialist based in Sterling, Scotland, said that market demand had seen the company post some impressive numbers. "The [battery storage] market is hugely active. Our revenue from 2020 to 2021 more than quadrupled. It's exponential growth."

This level of return is indictive of an industry awash with investor capital. James Felstead, sales director at SMA Solar, a supplier of power conversion systems, noted the same: "Businesses in the UK are investing billions in green energy; there's more money than we know what to do with."

SMA Solar has installed a series of standalone solutions, ranging from networks used to supply remote communities, through to power generation for delivery into national grids. In one case, a public utility in Germany contracted the company to set up delivery of green energy to the grid, while also using battery storage to secure electricity supplies for the surrounding region.

Supply contracts such as these generally come with a series of caveats, which are the specialty of legal firms working in the sector. Louise Dalton is a partner at CMS, a law firm which recently started working with companies delivering projects in the green energy space. "You will have a connection date, which you don't want to miss because you need to make sure you're energised when you're expected to be. If there's a delay in coming online, there are a number of cost impacts," she said.

Ole Jakob Sørdalen, Pixii

HARDWARE HASSLES

Dalton added that projects need to factor in hardware shortages. Such issues had extended lead times by 25% at the negotiation stage. Burns agreed, saying that a lot of hardware is coming out of Eastern Asia, where national policies and the declining relationship between China and the US have been detrimental to hardware sourcing.

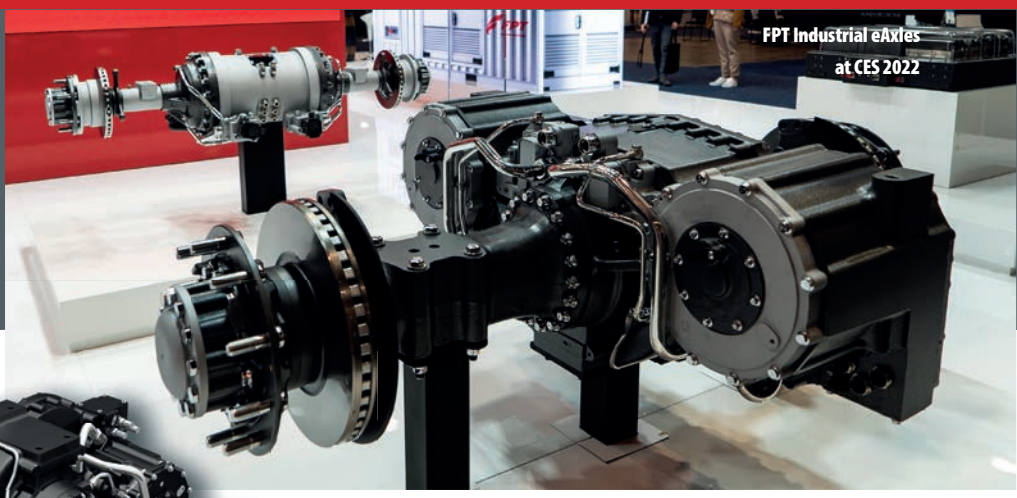
Ole Jakob Sørdalen, chief innovation officer at Pixii, a Norwegian battery storage systems supplier, said that the company had also experienced sourcing issues. "There's some challenges getting components from around the world. Prices are also increasing." He also said that this was being further compounded by an increasing interest in the tech across all markets.

In one such case he noted that there had been problems with a lack of power capacity across Scandinavia related to electric vehicle charging. Sørdalen said that battery storage solutions had been leveraged to deliver supplementary charging capacity for EVs.

Storage systems related to green energy generation are still so new that Burns said the product cycle had not yet come full circle to where there was a focus on recycling. "Project lifecycles are about 20 years, so they're still active. Only now are people beginning to talk about battery recycling in the wind industry." NPP

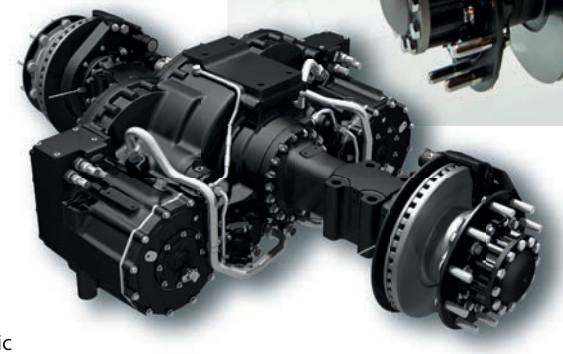
eAxles take to the road

ROBERTA PRANDI LOOKS AT THE LATEST ELECTRIFIED COMMERCIAL VEHICLE DRIVETRAINS FROM FPT INDUSTRIAL



FPT Industrial eAxles at CES 2022

At the CES 2022 show in Las Vegas, FPT Industrial presented an ePowertrain for heavy commercial vehicles (HCVs), otherwise known as Class 8 trucks in the US, and one for light commercial vehicles, both featuring integrated electric axles. The company also introduced a battery pack with a customized battery management system (BMS) for both ePowertrain versions.



FPT eAxle for the Nikola Tre HGV

The HCV electric axle was jointly developed by FPT Industrial and Nikola; the hardware features on the battery-electric Nikola Tre truck. European production involving Iveco was started at the site in Ulm, Germany, in September 2021.

The unit for HCVs delivers 840 kW peak output power from two off-axis electric motors (420 kW each). Power delivery from the traction motors is managed by a pair of inverters.

Davide De Silvio, director of Sales – ePowertrain at FPT Industrial, said that the integrated electric axle is suitable for heavy-duty 4x2 and 6x2 articulated 44-ton gross vehicle weight (GVW) trucks. "Our electric axles have already been delivered for the Nikola Tre, with various destinations in the USA." The Nikola Tre BEV has a range of up to 560 km (350 miles). The truck is described as offering dynamic performance characteristics.

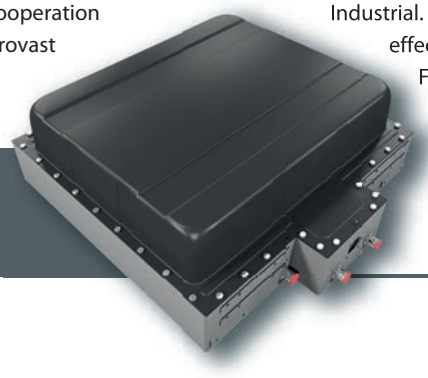
De Silvio continued: "The electric axle also features in the Nikola Tre fuel cell electric vehicle (FCEV); some prototypes have already been delivered in the US and production in Europe is planned to begin in Ulm in late 2023."

Andrea Abbà, FPT Industrial product marketing manager for On-road, explained that the version of the electric axle for LCVs is also powered by two electric motors – in this case, on the same axis. "This version allows for sophisticated torque vectoring, with independent management of the two rear wheels in LCVs and pickup trucks."

The 37 kWh battery pack has been developed by FPT Industrial and Texas-based Microvast, a specialist in energy storage and related management solutions.

De Silvio said that the collaboration with Microvast, which designs and produces long-life battery power systems supporting ultra-fast charging for commercial vehicles, is especially relevant for FPT Industrial. "The battery pack has been specially developed for commercial vehicles. It is a lithium nickel manganese cobalt (NMC) formulation in a pouch cell, targeted at the commercial and industrial vehicle market where Microvast is becoming a leader."

Within the cooperation agreement, Microvast manufactures battery cells and related pack modules for delivery to FPT Industrial's plant in Turin, Italy, where the final battery packs are assembled.



FPT battery module housing

FUTURE DEVELOPMENTS

In terms of future developments for FPT Industrial, Abbà said that the experience in on-highway applications will form the basis for developments in other markets; for example, the company is planning a fireproof battery pack suitable for marine craft and other solutions for off-highway machinery and power generation applications.

"Nowadays OEMs for off-highway machinery wanting to develop electrified solutions usually work with small battery manufacturers. They soon realize that industrialization on a large scale for these solutions is not an easy feat," commented De Silvio. "The cooperation with Microvast offers FPT Industrial the unique possibility of accessing these products directly from a manufacturer that is focused on the industrial and off-highway markets, and not a derivative by-product of the automotive market, with the related flexibility this allows."

The assembled battery pack uses a BMS developed by Potenza, now part of FPT Industrial. De Silvio reported that Potenza has effectively become the third pillar of FPT Industrial's research - along with the R&D centers in Turin, Italy, and Arbon, Switzerland – and the competence hub for electric powertrain solutions.

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A power swap

BRIGGS & STRATTON'S NEW SWAPPABLE BATTERY PACKS PROVIDE FLEXIBLE, MOVABLE POWER. BY **MIKE BREZONICK**

In taking the next step in the evolution of its Vanguard battery systems, Briggs & Stratton decided to think small.

Not small in the sense that the company's new Vanguard lithium-Ion 1.5 kWh Swappable Battery Pack is in any way a minor development. The new battery packs, combined with the company's existing 3.8, 5 and 10 kWh Vanguard Commercial batteries, give the Milwaukee, Wisconsin-based power provider as wide a standard product line as any in the industry.

Rather, it's small in that one of the primary attributes is essentially borrowed from smaller batteries that have long been used in power tools and small outdoor power products such as Briggs & Stratton's own Snapper Pro 82 V outdoor power products.

"We're not necessarily reinventing the wheel," said Dave Frank, global vice president of Commercial Sales – Engines & Batteries at Briggs & Stratton. "We took what we've done with our Snapper products and what the hand tool guys have been doing for a number of years and are bringing it to larger equipment.

"You can think of this 1.5 kWh battery like being that Snapper battery on steroids. There are tons of power that you can get out of it because it is obviously much bigger. But it's similar in that it's maneuverable and easy to swap in and out of a machine."

MANY APPLICATIONS

First unveiled as a concept late last year, the Swappable Battery Packs target a broad range of construction, agricultural, lawn & garden and industrial applications. The batteries can be taken from one machine to another and can be used in parallel with as many as 10 batteries to meet larger power needs.

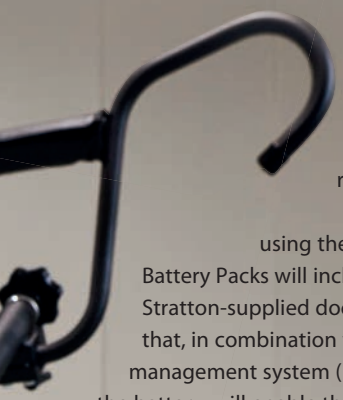
The battery packs are similar to the larger Vanguard batteries in that they consist of cell module assemblies incorporating cylindrical cells connected through a wire bonding

The Vanguard Swappable Battery Pack is targeted at a range of equipment, such as concrete trowels and other construction, agricultural, lawn & garden and industrial applications.

Briggs & Stratton is adding to its commercial battery line with the new Vanguard Lithium-Ion 1.5kWh Swappable Battery Pack.

process that maintains a gap between the cells. "We could probably get 2 kWh in that enclosure if we didn't care about safety," Frank said. "We prioritize safety over cell density.

"Knowing how these batteries are going to be used and how they will be moved around and dropped sometimes, we wanted to make sure that each battery – and I mean each single cell – is protected. Each cell is separated from one another so in case there is something like a thermal event, it's going to be in one cell and it won't migrate to the rest of the pack."



Machines using the Swappable Battery Packs will include a Briggs & Stratton-supplied docking assembly that, in combination with a battery management system (BMS) integral to the battery, will enable the battery to be optimized for each application.

"When it gets mounted to a log splitter, it will know what the power characteristics are expected and how we want that battery to perform on that log splitter," Frank said. "When we put that battery on a concrete saw, there are rpms we want to keep the machine to in order to keep the vibration as low as possible. We can tell that battery to run at that constant speed for that machine.

"The controller that will ultimately tell the electric motor how to run is mounted to the docking station which we provide and we're able to flash that. Now when you take that battery to a different machine the BMS asks, what are you expecting of me, controller? The controller tells it the characteristics, the battery accepts and then performs however needed for that machine."

The battery chemistry of the Swappable Battery Packs is essentially the same as the larger batteries, with a different mix of capacities. "In most batteries, you have some cells that are designed for long life," he said. "They're like an engine that runs all its life at 2200 rpm and are never asked run harder. Mid-power range cells, which are what we're using today in the majority of our permanent battery packs, give more of that perfect mixture of long life and performance.

"The cells we're using in these are really more dedicated to performance. The reason is because we want to make sure that no matter what we ask that battery to do – whether it's an application that needs a lot of power in a short amount of time or it needs to run over an extended period of time – it has the ability to do that."

In testing, Frank said Briggs & Stratton saw "applications where the battery life is 15 minutes and applications where the battery lasts seven hours," making it difficult to predict operating hours or range. "But if you run out of power and you've still got work to do, you can just swap one battery out and put another one in," he said.

CHARGING OPTIONS

The Swappable Battery Packs will be available with two charger options, a 400 W unit that plugs into a standard wall socket and will provide a full charge in four hours. A 1425 W charger, which can also be plugged into a standard wall outlet, can recharge the battery in approximately 1.5 hours. "What's more impressive," said Frank of the high-capacity charger, "it'll get the battery to 80% of a full charge in a little bit less than an hour."

Along with its targeted machine applications, Frank said the batteries would be especially suitable for the rental industry. "The rental operator could have a number of different electric powered machines, and they wouldn't all have to have their own integral battery," he said. "He could just have a bank of batteries that he could pull off the wall and send the customer out the door. Or with a couple of batteries and a charger.

"Now that rental yard has another source of income because now, they can charge for the usage rather than charging them for time. Some customers rent a machine for four hours and will use it nonstop for four hours. Another customer will use it for 45 minutes. They can charge them for the actual usage of the machine."

The battery packs will ultimately incorporate dual CANJ1939 (29-bit, 500 kbps) networks, enabling communication to and from the machine, as well as to the internet via an IoT device. That connectivity also enables remote monitoring and control of the battery and machine.

The Swappable Battery Packs are designed to withstand machine environments and are fully sealed and able to endure a lot of handling. "We wanted to make sure they're droppable," Frank said. "The production samples are going to be made out of a diecast aluminum – we're leveraging one of our major strengths from Vanguard engines, which is diecasting – and we'll be adding extra shielding around that to really make sure we're protecting those batteries."

The Swappable Battery Packs are expected to begin pre-production around the end of the second quarter of this year, with regular production expected early 2023. The initial units will be built at the company's Ion Works within the company's Milwaukee headquarters facility, but Frank noted that Briggs is "making a huge investment" at its plant in Tucker, Georgia, "where we'll be able to manufacture these at a high volume to support our customers." NPP

> "WE TOOK WHAT WE'VE DONE WITH OUR SNAPPER PRODUCTS AND WHAT THE HAND TOOL GUYS HAVE BEEN DOING FOR A NUMBER OF YEARS AND ARE BRINGING IT TO LARGER EQUIPMENT."
>
> **DAVID FRANK, Briggs & Stratton**

The safer side of

FLASH BATTERY'S **MARCO RIGHI** TALKS PRODUCT DEVELOPMENT AND SAFETY IN LITHIUM BATTERIES WITH **ROBERTA PRANDI**

DPI: Referring to developments in batteries for industrial use, it seems that lithium iron phosphate (LFP) batteries are the preferred choice for characteristics such as longer lifecycle and safety. Can you explain these advantages in more detail?

MARCO RIGHI: Among the available battery types, those utilizing LFP chemistry are the ones better responding to the needs of the industrial sector. LFP is the most stable and safe technology and is available in large capacity formats, something that's required by industrial and off-highway machinery as it avoids the parallel connection of several small units to reach the necessary capacity. That's a less stable solution that can compromise the safety of the entire working machine.

The intrinsic safety of the [battery] chemistry and the achievable lifecycle are the most important parameters to consider when choosing what type of batteries are most suitable for a certain application. Flash Battery chose $LiFePo_4$ chemistry for industrial and off-highway applications, as the operating life can exceed 4000 charging cycles.

What are the limitations of LFP technology?

The energy density. LFP chemistry has about 30% higher volume and weight than lithium nickel manganese cobalt (NMC) technology. For industrial and off-highway use these are not major problems though, as very often there is quite some space available on the machines. Sometimes it is even necessary to add ballast in counterbalanced applications.

On the other hand, for applications needing high power and light weight – for example, motorbikes or racing cars – more compact and lighter battery types need to be chosen, even if the lifecycle might be shorter.

For all those applications where energy is more important than power and where discharge cycles are longer, as in most industrial applications, safer and longer-life batteries like LFP are preferred.

It seems like LFP batteries need more precise balancing and consequently a more sophisticated control strategy. Can you give more detail about the control tech developed by Flash Battery?

The software for battery management systems does make the real difference in optimally exploiting the battery technology, guaranteeing reliability and performance over time. It also has a crucial role in the discharge phase, but even more so in the recharging process.

Flash Balancing System is the proprietary electronic balancing system of Flash Battery; it acts on every cell with a combined balancing – that is, both active and passive – which is 20 times superior to that of conventional lithium batteries in all phases. This technology supports balancing below 30 minutes in cyclical applications, which makes it insignificant in the total time for recharging. The lithium cells are balanced across the whole battery life, which is approximately 4500 recharging cycles.

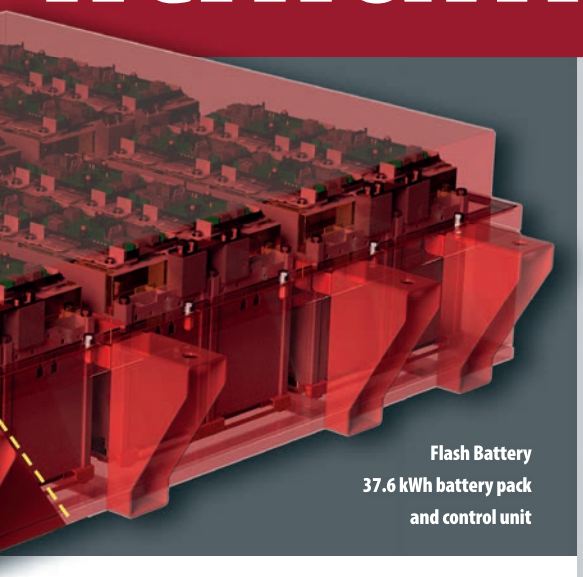
When a BMS is designed with care and attention to detail, it guarantees complete control of the battery pack, including performance stability over time, malfunction prevention, self-diagnostic and predictive maintenance.

This is one of the reasons why Flash Battery developed its Flash Data Center, a platform that continuously analyses the charge and discharge cycles of the connected batteries. Through AI algorithms, the center can prevent anomalies before they happen and sends automatic alerts to Flash Battery's service center, avoiding expensive stops in machine operation.

What is the future of batteries for industrial applications? Are there any alternatives in sight to LFP chemistry?

LFP chemistry is having renewed success. From the 100 Wh/kg available a few years ago, now the performance has reached 170 Wh/kg. The automotive market has shown some interest, too, including Tesla with the Model 3 and some other companies, like BYD and the Volkswagen Group. We believe LFP still has quite a few successful years ahead, both in automotive and in industrial/off-highway applications.

lithium batteries



Flash Battery
37.6 kWh battery pack
and control unit

LITHIUM BATTERY GLOSSARY

Lithium NMC Lithium Nickel Manganese Cobalt
Lithium NCA Lithium Nickel Cobalt Aluminium
Lithium LFP Lithium Iron Phosphate
Lithium LCO Lithium Cobalt Oxide
Lithium LMO Lithium Iron Manganese Oxide
Lithium LTO Lithium Titanium Oxide

LCO and LMO are the oldest technologies and less common today. NMC and NCA are the most common in the automotive sector, especially on premium vehicles, as they offer the highest energy density and longer driving range. LFP is the safest chemistry, followed by LTO.

Technologies are constantly evolving, but the chemistry characteristics remain the same. So NCA and NMC are the best for energy density and the most popular for achieving high performance. Lifecycle is not a primary concern for the automotive industry as vehicle use is not intensive and daily battery charges usually cover top ups; complete charge/discharge cycles are estimated to be between 100 and 200 per year. Under these circumstances, the automotive battery pack will have a longer life than the vehicle.

Looking at the safety of LFP batteries, Flash Battery has listed a series of favourable characteristics, including highest decomposition temperature, lower heat dissipation, reaction to internal short circuits. Can you explain these in detail?

Flash Battery has been able to guarantee the highest safety levels for its batteries by working on three main aspects: using the correct lithium chemistry, correct assembly of the battery pack, and the proprietary electronic control system.

The fact is that Flash Battery is focused on the industrial market only, which allows the company to work with several European OEMs to deliver tailor-made batteries that fit within the vehicles and offer specific capacity and tension for the job at hand.

We have two characteristics to consider, decomposition temperature, where the highest score highlights the lowest chance of reaching decomposition conditions and heat dissipation, measured in Joule per gram and an indication of the energy the battery cell is releasing as heat. The lower this value, the safer the battery.

Our target is to identify the right battery technology for the customer vehicle. Our R&D technicians do not just study the different chemistry types, but also perform stress tests to analyse behaviour and develop improvements. One of the tests we perform is the Nail Penetration test, which consists of inserting a nail in the battery to simulate an internal short circuit.

Clearly, these are lab tests conducted under controlled conditions. The chance a battery cell will get perforated during use is quite low. But we conduct this test to simulate the worst that can happen to a cell, that is an internal short-circuit due to a manufacturing fault or abuse.

Cell assembly is the second element contributing to safety. When lithium batteries are assembled in small cells, it's necessary to connect a lot of cells in parallel. Take a 400 Ah battery pack, for example. If it is composed of cylinder cells of 3 Ah each, you will need 130 cells in parallel. If it is composed of prismatic cells of 50 Ah, you need only eight cells in parallel.

In the first case, should one of these cells short circuit it would be absorbing 130 times its capacity. In the second case only eight times.

Flash Battery packs are assembled with a maximum of four cells in parallel. According to our studies, it is the best configuration for our batteries to operate safely under any condition.

The third and last aspect to guarantee safety of lithium batteries is the electronics that control the battery: the BMS. It is key to monitoring the tension and temperature of each cell, as well as interacting with the vehicle and the battery charger to stop charge and discharge in case of critical conditions and, if the case, intervene on contactors.

One of the differences between lithium battery manufacturers is the functioning of the control electronics in dangerous situations.

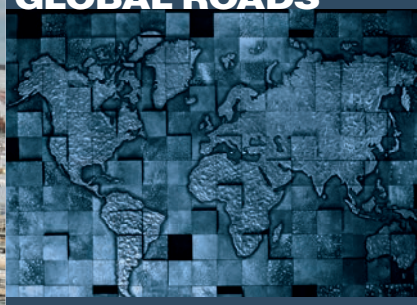
Flash Battery has built upon critical issues that were limiting the reliability and safety of the batteries. This is why we decided to invest, to differentiate from other manufacturers; the balancing system and the remote control. With Flash Battery products, temperature measurement is capillary and covers all key points. We can even verify contact resistance thanks to two temperature sensors on each cell.

	SAFETY	DECOMPOSITION TEMPERATURE	HEAT RELEASE
NMC	★★★	210°C(410°F)	600J/g
LFP	★★★★★	270°C(518°F)	200J/g
NCA	★★	150°C(302°F)	940J/g

SOURCE https://www.flashbattery.tech/sicurezza-e-rischi-delle-batterie-al-litio/

Comparison completed by Flash Battery covering three main battery chemistries used in industrial applications

Off limits - oil treatment plant in the Yarakta Oil Field, Russia PHOTO: REUTERS/VASILY FEDOSENKO



ABOUT THE AUTHOR

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Keeping the lights on

Our correspondent says that while we should not ignore the human tragedy in Ukraine, it has brought energy supply issues into sharp focus.

By **Oliver Dixon**

The global economy – and its constituent regional and national stakeholders – is a place in which success (or at least continued solvency) is predicated upon both the availability and ease of access to energy. This is very far from being a new observation and it is also one that falls firmly into the category of the blindingly obvious. In order to keep the lights on you need to keep the lights on.

ENERGY SUPPLY

Availability and ease of access to energy are the primary constituents of the notion of energy security. While it is the gut-wrenching tragedy that is the ongoing war in Ukraine that remains uppermost in our collective consciousness, the reality is that in time we will have to revisit much that we have come to believe as almost a holy writ in terms of energy supply security.

There's a lot of stuff going on here. While the United States' reliance on Russian oil exports is pretty limited – Russian oil accounted for 3% or so of total imports last year – the decision to ban further imports will put obvious upwards pressure on fuel supplies. In a year of mid-term elections, this is a significant risk on the part of the Biden administration.

There is also a not inconsiderable risk attached to the European Commission's development of a pathway to an almost 80% reduction in Russian gas imports. The EC has a significant challenge on its hands here. According to Bloomberg, European Union markets import somewhere around 155 billion cubic metres of gas from Russia per year.

The mooted pathway to ease dependence on this supply aims to offset this figure by 112 billion cubic metres via a combination of increased LNG imports and pipeline switches, together with an increase in renewables and an acceleration in the shift towards electrification. European heating costs have risen exponentially over the past few months and whilst there is near universal condemnation of Russia's actions in Ukraine, so too is there a distinct unease among Europeans with huge energy bills landing on their doormats.

PRICES PUSH TECH

This feels like a watershed moment in the way we regard our energy supplies. There was a significant oil price shock in 2008 that, with the benefit of hindsight, brought significant structural change to the US transportation industry.

Would we have seen such a rapid acceptance of vertical integration and SCR technology, to name but two outcomes, had we not been confronted by a need to drive fuel efficiency as diesel peaked at $5/gallon? Correlation, causation, etc., but like it or not, what happened in US trucking before 2008 and what happened after 2008 were not one and the same.

Go back a few decades further to the oil embargo of 1973. This gave birth to the 55 mph speed limit but more importantly, it ushered in the Corporate Average Fuel Economy (CAFE) standards. It could be argued that considerations for fuel efficiency were born due to the realization that the fuel supply was neither infinite nor guaranteed. Over the past few weeks, that realization has been underlined in thick, black marker pen.

There is no telling what will happen in Ukraine. We can only speculate while hoping for an end to the conflict and suffering. But although it may seem premature to ponder the ramifications of the Russian invasion of its neighbour, it is by no means premature to consider the impact of this action on energy markets. Energy security is a fundamental consideration for all of us.

This is a war, it is a tragedy and it is a needless exercise in the loss of human life. It is also a very significant inflection point; we now have no excuse for living in the past in terms of energy. We have to look to the future. **dpi**

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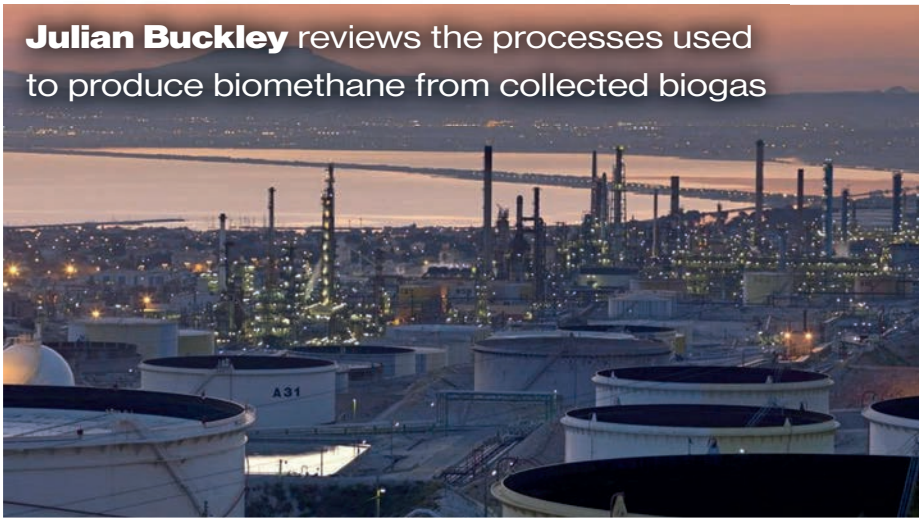
Producing the fuel

Julian Buckley reviews the processes used to produce biomethane from collected biogas



Sunrise at La Mède biorefinery

While hydrogen is getting a considerable amount of media coverage, there are concerns relating to sourcing, the energy levels needed to produce the H_2 fuel.

An alternative is biomethane, a clean fuel which can be used in engines and vehicles already on the market. The most basic methane product is natural gas, a fossil fuel with related CO_2 issues. But low-CO_2 biomethane (also known as renewable natural gas, RNG) is becoming more widely available. It is offered as a gas through most national grids, or at regional distribution points. It can also be delivered as a compressed gas (bioCNG), or liquified gas (bioLNG).

With transport, agriculture and off-highway vehicle operators looking to reduce their respective carbon footprints, biomethane offers a considerable reduction in emissions-related CO_2 output, while it also returns lower NOx and particulate totals in comparison to diesel.

Alkylation and visbreaker at la Mède biorefinery, Provence

BIOGAS FROM WASTE

In February this year, waste specialist Veolia and fuel supplier TotalEnergies announced that they had agreed to recover biogas (untreated biomethane) to support delivery of biomethane from Veolia's water- and waste-processing plants in 15 different countries. The goal is to produce 1.5 terawatt hours (TWh) of biomethane per year by 2025, in turn preventing the release of between 200,000 and 400,000 tonnes of CO_2 into the atmosphere.

This, though, is just a portion of the 6 TWh of biomethane produced annually by Veolia, one of the world's largest suppliers of the gas. At a site in Soudan, France, approximately 20,000 tonnes of organic waste collected from agriculture (manure, slurries, cereal waste), the food industry (whey, glycerin) and household food waste is put through an oxygen-free anaerobic digestion process to produce raw biogas. The digestate waste which remains is processed for use as agricultural fertiliser.

In another tie-up between the two companies, investigations which could lead to the production of biomethane using microalgae cultivation are currently underway at a site in La Mède, France. Using sunlight and CO_2, the resulting algae can be used to produce biofuels with a very low CO_2 intensity. Key to the project was managing the water used to grow the aquatic algae, while also developing algae with a higher CO_2 absorption rate.

Converting raw biogas into biomethane involves three steps; pre-treatment, compression and methane separation. Pre-treatment during the drying and cleaning stages removes various unwanted products from the biogas, including any VOCs (volatile organic compounds). After this process, the gas is compressed to between 12 and 16 bar at which point it is passed though a high-pressure separation membrane. These are arranged in cylindrical cartridges in a patented three-stage setup. This delivers the biomethane at a purity of between 97 and 99%.

The process has a series of advantages, including a raw biogas throughput of 10,000 Nm^3/hour. In addition, there is a very low energy requirement of between 0.3 and 0.4 kWh/Nm^3, with no additional chemical or water consumption.

It is also critical to remove any sulphur compounds (H2S) in the raw biogas, as these can cause severe corrosion in boilers and engines running biomethane. To do this, Veolia uses the Sulfothane process; in practise, the biogas is directed through a scrubber column where it is mixed with and separated from wash water, removing the H2S. A second step sees the wash water enter a slightly aerated bioreactor where aerobic sulphur bacteria oxidise the H_2S to produce elemental sulphur. This can be reused or disposed.

According to the International Energy Agency, only a very small percentage of all biogas produced globally is converted into biomethane (approx. 3.5 million tonnes/year). But the IEA states that there are government policies in various countries, including the UK, Germany, Italy and the Netherlands supporting the use of biomethane in transport. **dpi**

Find out more about how biomethane is distributed, how engines have been developed to use the fuel and how the end-user experience of running biomethane vehicles compares to diesel in the following pages.

Transport and

Julian Buckley speaks with Gasrec's **James Westcott** about how the company manages supply for gas-fuel trucks

Gasrec is a leading supplier of gas fuel to the road transport sector in the UK. Founded in 2003, the company has gone on to build 11 natural gas refuelling stations across the country. These include the first open-access facility, located at the Daventry International Rail Freight Terminal logistics park. The installation is reported to be one of the largest liquified natural gas (LNG) refuelling stations in Europe.

James Westcott, chief commercial officer for Gasrec, says that the company was originally involved with liquefying landfill gas to produce biomethane, but then started the gas fuel logistics business to support commercial sales. The company now works with a series of major supermarket chains and logistics companies, supplying methane-based products for their gas-fuelled trucks.

Westcott explains that all gas sold as fuel in the UK is natural gas – which about 90% methane – whether it is in the compressed or liquefied state. But biomethane is slightly different, in that it is sold by mass balance.

"If you imagine the gas network as a giant grid, there are different inputs and outputs," says Westcott. "Biomethane is put into the system and the gas that we take out reduces that total. This links the use and purchase of the biomethane and certifies the fuel we deliver as being 'green' under the Renewable Transport Fuels Obligation Scheme."

Rather than biomethane being directly added and removed, the process serves to certify the supplied natural gas is taken from biomethane stock.

SUPPLY ROUTES

There are effectively two different routes to supplying gas to transport customers. These are either through the gas grid network as compressed natural gas (CNG), or through a dedicated delivery system which supports dispensing of LNG. Westcott points out that CNG is more frequently used for regional and lighter transport applications. On the other hand, the energy density of LNG makes it ideal for national and international operations.

> "LNG has an energy density that is very close to diesel. For broadly the same volume of LNG, you'll do the same distance as with diesel."
>
> **JAMES WESTCOTT, Gasrec**

"LNG has an energy density that is very close to diesel," he explains. "For broadly the same volume of LNG, you'll do the same distance as with diesel."

The gas supplied by Gasrec largely comes from food waste which has been through an anerobic digestion process. There, the waste is treated in an oxygen-free environment and the resulting biogas is collected. At this point the raw product is about 50% methane, so it is cleaned to remove impurities, such as sulphur. This leaves about 90% pure biomethane, the same methane percentage as natural gas supplied to household customers.

Westcott says that Gasrec prefers its stock to come from food waste. "You can get biomethane from other sources, but we prefer it to be from food waste as that's where you get the largest CO_2 reduction benefit."

Reduction of respective CO_2 footprints is the basic motivation for logistics companies to make the switch to using gas fuel. Westcott puts forward that while trucks only represent about 5% of all traffic on UK roads, they produce about 25% of the pollution. Most quick wins for

Trucks filling up at a Gasrec station

delivery

Gasrec uses biomethane fuel to move gas to customers

reducing that pollution have already been put into practise and switching to a cleaner fuel is the only card left to play.

"It's a disproportionate impact, which creates the opportunity for a massive impact in reducing those emissions," he adds.

Westcott says the customer journey for making the switch to a methane-based truck fleet usually starts with the company purchasing a small number of vehicles with gas-fuel engines. Should those tests prove successful, the next step is to decide whether the fleet can use a regional supply location or if a dedicated onsite facility is required.

"The whole thing is about resilience," says Westcott. "You can have a skid-mounted facility and we can deliver into that. It's quick to deploy and can support about 30 trucks. There are also other sites, they use a larger tank with more gas, more dispensers. Or we might have a large facility nearby, but the company wants to deploy their vehicles more quickly than that will allow, so we put something in for a short period."

He notes that the diesel market had seen companies bunkering fuel at their sites for refuelling trucks. But as the market continues to fracture into different energy types, this might not be the one-stop fix it once was and companies are now looking more favourably at off-site refuelling facilities. No longer having to sink capital into stored diesel, gas can be delivered on a just-in-time basis.

Filling a gas-fuel truck

BP INVESTMENT

In late 2021, BP acquired a 28.57% stake in Gasrec. The deal will see the global fuel giant supply the distributor with renewable biomethane, produced primarily from food waste and dairy manure.

Speaking about the investment, Carol Howle, EVP Trading and Shipping at BP, said: "Bio-LNG and bio-CNG play a crucial role in the energy transition and decarbonization of the heavy-freight industry and is another example of how we're helping decarbonize hard-to-abate sectors.

"We're excited to work with an industry leader like Gasrec to increase the supply of biomethane for HGV customers. This investment further expands BP's global renewable gas portfolio, an area which we believe will have an increasingly important role on the path to net zero."

Westcott says that the investment shows how BP is looking to secure routes for getting biomethane to customers and get green energy into the market. "For us, the importance of this deal goes back to mass balancing," he continues. "Through BP we will be able to make sure we have access to sufficient biomethane to support our deliveries and get fuel into the vehicles, either through the network or through our site deliveries."

Westcott says that the money from BP will be used to expand the supply network. "This year we're adding about one facility per month, including customer depots and larger network facilities. That's the scale of investment and we're always looking for new sites."

All sites operated by Gasrec now feature a remote monitoring function. This involves CCTV and a related intercom system which is staffed 24-hours per day. This helps to ensure the facilities remain open and available to customers.

"Diesel has been the solution for a long time, the supply chain is set up around it," says Westcott. "We need to match that, be better in some cases, so customers can continue to operate efficiently."

Asked what it will take to get more companies onboard with using gas products and biomethane, he has a positive response: "I think it's already happening. Over the past six months there has been a sea change in mentality. It takes a few years for OEM vehicles to work through the vehicle churn, but once the trucks are in place customers will see the savings." **dpi**

Developing a gas-fuel engine

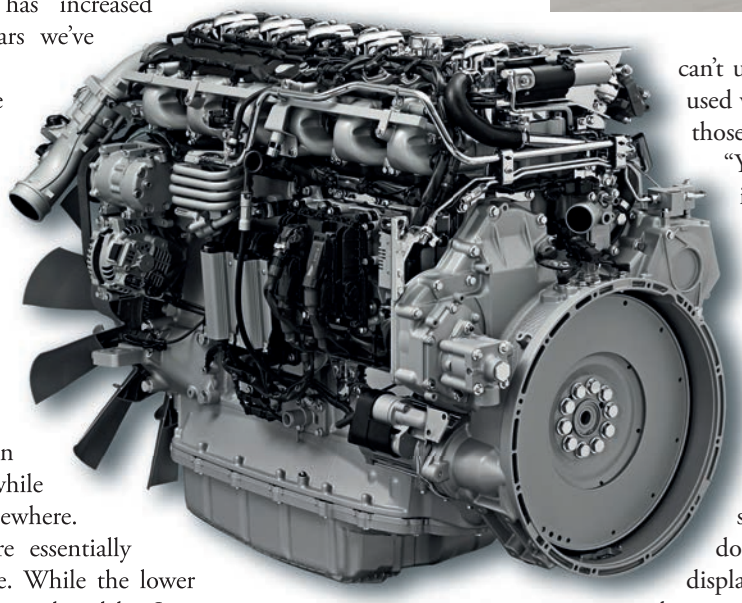
Scania has been manufacturing gas-fuel engines for 25 years. **Julian Buckley** finds out how the company has developed the powerplants

LNG logo on Scania truck

Scania G 410 LNG LBG 4x2 general cargo transport

"Getting the diesel engine to work on the Otto cycle was an issue, there were some difficulties," says Zoran Stojanovic, product manager and gas vehicles expert at Scania. "But the efficiency of the gas-fuelled engines has increased dramatically over the 25 years we've been developing them."

Stojanovic says that there were two primary reasons why Scania starting work on developing gas-fuelled engines. "Sweden started to produce biogas about 25 years ago, so we looked to take advantage of that. Second, countries in the Middle East have a lot of gas and that helps to support the business." He adds that gas-fuelled trucks in Sweden use only biomethane, while the picture is more scattered elsewhere.



Scania OC13 410 hp gas-fuel engine

Biogas and natural gas are essentially the same compound: methane. While the lower half of the gas-fuelled engines produced by Scania (crankshaft, rods, etc.) are functionally the same as any other diesel, the head is designed specifically to work with the CH_4 methane molecule as fuel. This includes using spark ignition instead of compression. "It's not a rebuilt diesel," Stojanovic observes, "rather a gas-fuel engine from scratch."

As of this year, he estimates that production of gas-fuelled engines at Scania equates to a fraction less than 10% of all engine production. In total, this is about 9,000 units per year. These engines are popular across various European countries and also in Russia. Stojanovic: "[The Russians] have a lot of natural gas."

COMBUSTION CHAMBER

The head unit is the key difference between diesel and gas-fuel engines produced by Scania. Cast-iron head covers are produced by Scania and suppliers to support assembly. Stojanovic says that while they can't use aluminium, the head castings used with gas engines are thinner than those used to manufacture diesels. "You don't have the same pressure in the combustion chamber. Plus, you can cool the engine more efficiently with thinner head material."

Currently Scania produces three engine displacement sizes in its gas engine range; 9- and 13-L units for trucks and a 16-L version for industrial applications, including generator sets. It's noted that gas as a fuel does lend itself to engines with large displacements; efficiency levels fall if the same setup is applied to an engine with reduced displacement.

When compared with other gases, such as hydrogen, methane is far easier to manage in the combustion chamber. "Hydrogen can self-ignite, methane cannot," says Stojanovic. "You need to heat it to more than 700° C to ignite and add a spark. Also, we have developed in-house a gas injection system that does not inject gas all at the same time. We've invested a lot of knowledge there. Mixing gas and air is not easy, but we've mastered the process."

Scania's development team has essentially produced a stoichiometric engine that, for the most part, has a fuel-to-air ratio of 1:14. The mix is difficult to maintain over the full rev range, but a proprietary camshaft and valve timing support the correct mix. "The critical part is when the exhaust valve is closing and then the opening of the intake valve," says Stojanovic. "This is completely different to a diesel."

ON THE ROAD

The experience of driving a gas-fuelled truck is quite different from a standard diesel due to the reduced noise, as Stojanovic explains: "The noise in a gas-fuelled truck is much lower. The truck [cab] is very quiet." He says that while being less noisy and with reduced vibration, the engines generally produce equivalent power and torque.

Asked whether there is any lag between depressing the accelerator and engine response, he states that gas engines deliver slightly better performance at lower engine speeds, where the torque build up is marginally better than diesel – interesting, considering torque is generally diesel's key selling point.

Vehicle performance is not dramatically affected by the specific fuel type. "Whether you're using natural gas, biomethane, renewable natural gas – the American name for biomethane – as long as there's CH_4 methane as the energy carrier, you can use it in the engine."

Stojanovic says it doesn't matter if the stored fuel is compressed or in a liquid state. While the liquid gas needs to be kept cold – very cold – at -160° C and compressed to 200 bar, by the time it reaches the combustion chamber it's in the same state as the basic compressed gas. "As a test, we built trucks with dual fuel systems using a tank of compressed gas and one of liquified gas. The engine doesn't care which tank is feeding it."

While there are clearly difficulties with using liquified gas, such as keeping the tanks at the necessary temperature, there are also considerable benefits. Stojanovic reports that liquified gas represents eight times the energy density of the same volume of compressed gas. Balancing the greater cost of the fuel storage system with the extended range, LNG is generally used with long haul vehicles and CNG is used in city trucks.

Scania has conducted some tests with untreated biogas, but while the fuel has some potential for use with gen sets, untreated biomethane can't be used for truck engines. Untreated biogas generally has just a 50% methane content (by volume), which would reduce the maximum range and overall driveability.

MAINTENANCE AND COST

There are some noteworthy environmental benefits to running a gas fuel engine. The units manufactured by Scania are clean to the point that they do away with much of the hardware (SCR, DPF, etc.) which diesels need to meet Stage 5/Euro 6D/Euro 6E emissions levels. To match these requirements, gas-fuel engines need only use a three-way catalytic converter.

The engines do need more frequent oil changes, but that is due to the basic chemistry of the fuel. "Hydrogen is created when burning CH4," explains Stojanovic. "That one part of hydrogen oxidises and becomes water. That must be absorbed by something and that is the oil."

While other companies have been experimenting with hydrophobic lubricants to deal with similar issues, such as burning hydrogen in an internal combustion engine, Stojanovic says that while water being absorbed by the oil requires more frequent fluid changes, it is important to remove the humidity as otherwise it could corrode the crankcase from the inside.

Overall, he says that maintenance costs for a gas-fuelled engine are about 10 to 12% more than an equivalent diesel. That is in addition to the cost of the fuel tanks and related fuel delivery hardware. But these costs are typically off-set by the lower fuel price. Some countries further incentivise the use of biomethane and other gas fuels, making it still more attractive.

Maintenance frequency and running costs have been coming down and Stojanovic says that new developments will see these reduced further.

"There's a lot of potential still in gas [engines] which has not yet been explored," Stojanovic says in closing. "Next decade, we might have less expensive, more efficient BEVs to compete with, so it might look different. But we will be introducing more features for gas-powered trucks. Gas is a natural part of the Scania portfolio." **dpi**

> "Whether you're using natural gas, biomethane, renewable natural gas as long as there's CH4 methane as the energy carrier, you can use it in the engine."
>
> **ZORAN STOJANOVIC, Scania**

Scania Citywide LF 4x2 gas-fuel bus

Eco road warriors

Graham Thomas at Ocado Group talks about operating the company's gas-fuelled truck fleet. By **Julian Buckley**

Branding on the Ocado gas-fuelled trucks

Launched in the early 2000s, Ocado Group was the first online grocery retailer in the UK. While other supermarket chains had home delivery services prior to this launch, Ocado was the first to offer buyers a wholly online experience without the support of a dedicated chain of high street stores.

Graham Thomas is Fleet Operations manager for Truck at Ocado Group. In this role, he is responsible for the trucks and trailers moving groceries around the UK from the four national customer fulfilment centres to 17 regional spoked hubs, all to enable last-mile deliveries.

The company now uses a fleet of gas-fuelled trucks for moving customer orders through to the hubs, which comes on the back of broader company commitment to the environment. "We believe the hub-and-spoke operation we run, instead of delivering from stores, is more efficient and less impactful to the environment," says Thomas.

POWER DELIVERY

Ocado started with its fleet of gas-fuelled trucks in 2018, following the launch in 2016 of the new range of natural-gas trucks by Iveco. Thomas explains that the company had looked at using similar trucks prior to this, but they didn't offer either sufficient range or the horsepower needed to haul the required weight. "We're pulling double-deck trailers which are almost five metres tall," he observes. "That's about 12 van routes of shopping, all picked to customer orders."

The rollout date proved to be a watershed moment, where OEMs started producing gas-fuel trucks which offered comparable power to diesel. Ocado selected to use CNG trucks manufactured by Iveco over equivalent LNG alternatives. "The latest four-by-two CNG trucks offer between 500 and 600 km range, that's sufficient for us," says Thomas. "LNG has more range, but there are other challenges, it's cryogenic and refuelling is more sensitive."

Ocado is currently operating 60 gas-fuelled trucks, with a further 30 units to be delivered over the course of this year. Thomas says that there's nothing that the CNG-fuelled truck can't do that a diesel truck can. An added benefit is that noise levels are about 10 decibels lower, which has helped somewhat with nearby neighbours. "We're looking at new hub sites and if there's any environmental issues, we will look to use gas trucks. It usually carries some favour with local authorities," he says.

> "We believe the hub-and-spoke operation we run, instead of delivering from stores, is more efficient and less impactful to the environment."
>
> **GRAHAM THOMAS, Ocado Group**

The company uses two different fuel supply strategies. At the Hatfield location in Hertfordshire, the hub is connected to the main grid. That gas is compressed from 0.3 to 250 bar before being dispensed to the trucks. At another site, in Dordon, Warwickshire, the gas main doesn't have sufficient pressure. This means LNG will be tankered into the site and CNG delivered to the trucks. "We just had to make sure the delivery tanker is also a gas truck!" says Thomas.

Most routes will see the trucks operate out and back to a fixed hub, but Thomas mentions that the vehicles can get fuel topups from various public stations around the country.

Biomethane is the gas of choice, which is certified through a renewable fuels certificate. As with distribution, which sees the 'green' fuel sold by mass balance, this means that any fuel being used in the trucks has come from biomethane volumes being added elsewhere in the network.

There is some driver training when it comes to using gas as a fuel. "It takes a little longer than diesel to fill," says Thomas, "but you have a secure

Iveco Stralis NP as used by Ocado Group

connection. Press the button and its on. It's very clean, there's no diesel to spill." When it comes to driving, the trucks are marginally different as the torque build up is a little later in the power band when compared to a diesel truck.

Thomas says that the gas-fuelled truck is typically 20% more to buy than a diesel version. "But there's a total-cost-of-ownership benefit because of the fuel duty differential," he points out. That would ordinarily off-set that difference, but he says the current high fuel prices have eroded that gain. "We're waiting to see what the impact of the situation in the Ukraine will have, whether the price will continue to climb," he says.

But, ordinarily, he says that there is between a £9,000 and £11,000 advantage per truck, per year, to running a gas-fuel truck over a diesel model. "You've got a 70% reduction in NOx, 99% reduction in particulate matter, about 90% reduction in CO_2 if you're running biomethane. The money is really just the icing on the cake."

> "We could've waited for hydrogen fuel cells to come along, but we should take advantage of what's available now to help reduce our carbon footprint."
>
> **GRAHAM THOMAS, Ocado Group**

KEEP IT GOING

Maintenance is more frequent on a gas-fuelled truck, generally because they run a non-lubricative fuel. That means instead of changing oil at 150,000 km, it needs to be done at 90,000 km. In addition, while the engines are based on a diesel block, they have a spark ignition head, so the spark plugs also need to be changed. Thomas says that these are fairly standard, so not so expensive, though they need to be changed every 70,000 to 90,000 km, dependent on the engine size.

Thomas says the gas trucks are marginally heavier, primarily due to the fuel tanks. But where older trucks have eight tanks, new models have just two larger units. He says that he has been closely watching tyre and brake pad wear, but the gas-fuel units have not needed more frequent changes. "The gas trucks have very efficient intarders for engine braking," he observes. "If you train your drivers well, these can help reduce brake wear."

Ocado brands each gas truck to highlight its environmental credentials, which Thomas thinks is justified. "We could've waited for hydrogen fuel cells to come along, but we should take advantage of what's available now to help reduce our carbon footprint. I'd recommend using trucks using biomethane as a fuel to any fleet operator." **dpi**

Sensor explosion

The number of sensors on a given vehicle has more than doubled in the past decade. DPI speaks with Continental to find out about the latest innovations. By **Julian Buckley**

When it comes to sensors and sensing, there's not many (if any) bigger players in the market than Continental. According to Mario Branco, head of Business Development, Off-Highway, the German component and systems supplier delivers about 300 million sensors each year - and that's just for the automotive business.

"We have a very wide sensing portfolio," he says. "I don't think there's another company which has the same breadth of scope. It's a core activity when looking at Continental."

The company has a range of sensor solutions covering every area of a given vehicle, including engine, transmission, suspension and tyres. In addition, there are onboard and remote systems which take the collected data and deliver insight into vehicle performance. This is of particular importance for fleet operators tasked with getting the best return on investment from their vehicles.

"We provide solutions to monitor fleet health, diagnostics to understand the condition of your vehicles. This covers performance and maintenance. With more intelligence you can start looking at predictive maintenance to increase vehicle availability." Branco adds that there's a dedicated platform to help optimize vehicle uptime, including data analysis designed to deliver actionable insights and improve overall fleet efficiency.

Every earthmoving tyre produced by Continental now has a sensor capable of monitoring pressure, but tyres used in construction and mining go much further, with the capability to measure such factors as load, speed, distance and temperature. This data can then be analysed by the ContiLogger system, which provides options to improve tyre longevity and ultimately, productivity.

Graphic showing comms connectivity between vehicles

Cloud-based agritech sensing from Continental

MARKET GROWTH

Branco says that there has been "an explosion" in sensing over the past decade; he estimates that there are twice the number of sensors on the average vehicle than there were 10 years ago. He says that there are a series of drivers behind this growth, including carryover from various other industries into the off-highway world. Case in point is the ProViu 360 surround camera system. The tech has been adapted for use on various off-highway vehicles, including a camera-based 'transparent chassis' feature which helps the operator avoid obstacles that would otherwise be out of sight.

"Off-highway industries are a major growth area for Continental," says Branco. "There won't be a large increase in the number of machines, but there will be more sensing. In the case of an autonomous dumper truck, fitted with lidar and all the related sensing systems, those systems can represent a similar value to the vehicle itself."

Despite the apparent advances in sensing systems, the technology is continuing to evolve. Branco reports that systems which combine information from different sources is now coming into the market, supported by advances in electronic architecture. While some of this is based on carryover

from automotive, the architecture is largely new to commercial vehicles and off-highway machines, particularly the capability to process and manage the data.

But there are also new sensors offering improved capability. In 2021, Continental invested in FeelIt, an Israeli startup focused on developing new sensing potential. A programme started by the company has resulted in sensor technology said to be up to 50 times more sensitive than current equivalents.

These products offer considerable potential for electric vehicles, which are of particular interest in underground mining due to zero-emissions operation. "Battery electric vehicles need data collection covering battery management, terminal management," says Branco, speaking about the recent investment. "These are new opportunities that are making fundamental changes to the sensing capability, so it'll have a big impact."

A critical issue when planning a sensing solution for an off-highway vehicle is placement of the sensing hardware. For example, 'vision' sensors in passenger cars are generally located behind the front grille; while there is some potential for damage, this is countered by the actual damage, which is limited. The front of an off-highway vehicle might be subject to material far more substantial than gravel chips and unlucky insects.

"[The hardware] will be in a different place, depending on whether it's backhoe, a tractor, or a forklift. Then you need to investigate, elaborate on the proposed solution. Even when you find what you think is the right spot you have to validate the system. Which is another challenge we manage with the OEMs," says Branco.

> "Translating data into insights and solutions, that's what sensing is all about."
>
> **MARIO BRANCO, Continental**

He also says that applying sensing capabilities across the wide variety of vehicle types and models in the off-highway space does impact costs, but these can be mitigated by adapting a carryover solution. Branco points out that Continental is always looking to leverage applications from other sectors to make the solution more affordable, while considering best use and fit of the tech.

But beyond the physical sensors, he says that the software driving the systems for commercial and off-highway systems will be largely unique. "A tyre sensor is generally the same, no matter the application. But the software will be designed for additional parameters for off-highway products. Continental has 50,000 engineers around the world, which includes 20,000 software engineers. By 2023 we're planning on having 2,500 engineers dedicated to artificial intelligence, to support improved data diagnostics."

TASK COMPLEXITY

AI, or artificial intelligence, could also support autonomous vehicle operation. Asked whether it would be easier to develop a self-driving system for an off-highway vehicle, Branco suggests that the complexity of tasks makes it more difficult to achieve.

"Certainly, mining equipment won't be driving at 150 km/h. But it still has to be safe, protecting the people around the vehicle. Also, in addition to the machine moving autonomously, it must also complete its process itself. If it can't do that, then there's no benefit to removing the driver." He adds that it's an area worthy of investment, simply due to the macroeconomics related to a shortage of skilled workers.

Machines working autonomously also feeds into a conversation about machines working together. Continental recently introduced the Load Sense system, a conveyor for gravel and other mining products which features a radar monitoring system for measuring material flow. Branco says that a future area of investigation will see the integration of multiple data sources into a unified platform, creating new and varied values for managers.

"It would be a benefit to orchestrate all machines on a site," says Branco. "We're approaching that from different angles, but it's where the market's going in terms of development."

In closing, Branco recalls a presentation where a tech manager complained that every supplier was now coming to him with 'smart' products. But being smart is far more than adding a chip to support limited functionality.

"I think the customer is looking for more. Sensors are getting smaller and faster, but it's the full package that provides functionality. That's what makes life easier and makes business more efficient. Translating data into insights and solutions, that's what sensing is all about." **dpi**

Boost

Brett Fathauer of Cummins Turbo Technologies details how turbocharging has become critical in current engines and will remain so in future powertrains. By **Julian Buckley**

Seventh-generation advances feature in the HE400VGT turbo

The automotive sector has been gradually replacing naturally-aspirated engines with those using forced-intake, which in most cases uses a turbocharger to deliver more air into the combustion chamber. More air can support either a higher fuel-to-air ratio to deliver more power, or it can disperse less fuel in an improved mix to improve fuel economy.

Early turbochargers were slow to achieve boost pressure, resulting in turbo lag. Modern turbos, with improvements in the architecture, materials and part design, have largely eradicated that characteristic and now deliver smooth power output across most engine speeds. In addition, modern turbos can generate greater boost, meaning that the engine works less and so emits reduced CO_2 emissions.

MORE POWER, ANY FUEL

Brett Fathauer, executive director for Research and Engineering at Cummins Turbo Technologies (CTT), says that beyond petrol and diesel, modern turbos are now being developed to make the most of alternative fuels, including natural gas and hydrogen. CTT, together with its partners the University of Bath, Holtex Limited and Aeristech, was recently awarded a portion of UK government funding made available through the Advanced Propulsion Centre, located in Coventry, UK, to support further developments in this area, together with air-handling for hydrogen fuel cells.

"The focus is on CO_2 reductions across diesel, through to hydrogen fuel cell powertrains. We've been working on that for about two years and we're looking to accelerate that technology," says Fathauer. "We're looking at air-handling tech, including compressors, turbines, efficiency improvements, together with e-machine upgrades and developments applicable to hybrid and fuel cell powertrains."

These improvements are based around changes in air flow and a reduction in friction. CTT has used computational fluid dynamics to study the physical mechanics and understand how to achieve these gains. In addition, the latest 7th generation turbos from CTT take advantage of 'pulsed' energy, essentially how the emissions stream leaves the engine manifold and interacts with the turbine stage, to provide optimised power levels.

TIGHTER TARGETS

To date, CTT has been focusing on developing turbo units for diesel engines, as Cummins, together with OEM and Tier 1 customers, prepares to tackle anticipated Euro 7 and EPA/ARB (US) emissions targets. The Euro 7 standards will likely require vehicle CO_2 output reductions of 15% by 2025 and 30% by 2030, using current numbers as a baseline. But while continuing work on diesel turbos, Fathauer says that the company is looking to develop turbo units for other fuel types, including fuel cells.

"Turbine efficiency translates to fuel economy in the engine."

BRETT FATHAUER, Cummins Turbo Technologies

"The fuel cells need the air flow to get the power density and you need to package that so the fuel cell stack can still fit in the vehicle. We're developing these e-machines to provide the air flow needed for the fuel cells," he explains.

The e-machines are turbo units which use electrical energy to support a more rapid response; they can be a purely electric independent stage, or they can combine electrical power with turbine power in a hybrid arrangement.

VGT TURBOS

In addition to improved vane design of the turbine and impellers, the 7th and forthcoming 8th generation of CTT turbos will feature new variable geometry upgrades.

In practise, variable geometry takes the shape of a sliding nozzle across the shroud plate, which provides the appropriate engine delta P (backpressure) needed for the engine to drive the appropriate amount of EGR flow efficiently. The latest multi-clearance shroud has tight clearances to minimize losses in the turbine stage before the gas reaches the turbine wheel. This serves to adjust and optimise the delivered backpressure used to force air back into the combustion chamber.

"Aerodynamically we've made additional

technologies

improvements to reduce aero losses in what we call our shroud interface while still maintaining a durable and reliable product," says Fathauer. "We've made significant improvements in fuel economy; turbine efficiency translates to fuel economy in the engine, associated with air handling characteristics of the unit."

The increase in backpressure can also serve to improve engine braking and even downstream thermal management. But generally, the changes are intended to improve fuel economy. Fathauer claims that while efficiency varies based on vehicle operation, the generational upgrades could result in 10 to 12% efficiency improvements on the low-pressure side of the turbo and between 3 and 4% at the turbine.

CTT has a variety of testing regimes in place to ensure these changes will not affect the life expectancy of the turbo. "The turbos work in a harsh environment. High speed, high temperatures and pressures, vibration. Over the 70 years we've been in business, CTT has developed accelerated aging tests to put those moving parts through their paces. We do that in all our tech centres in Huddersfield [UK], in Wuxi, China and also in Pune, India."

> "Turbos work in a harsh environment. High speed, high temperatures and pressures, vibration."
>
> **BRETT FATHAUER, Cummins Turbo Technologies**

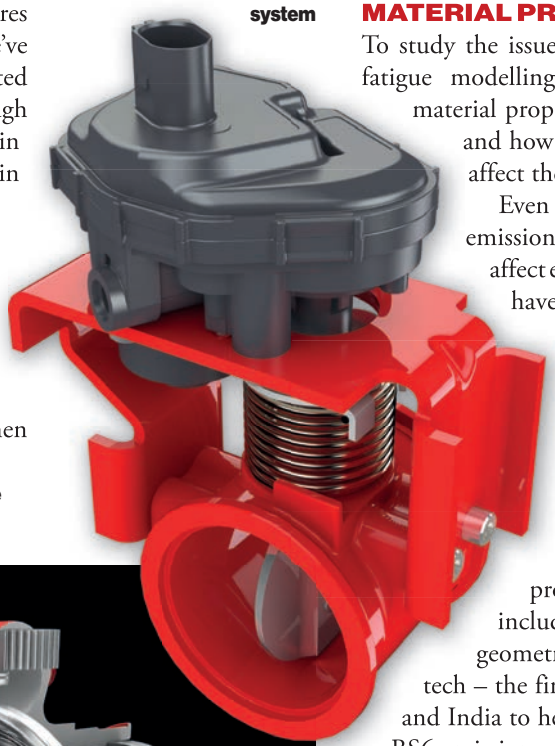
TEMPERATURE MANAGEMENT

According to Fathauer, customers are now using thinner engine oils with a lower viscosity to help reduce parasitic energy loss across the lube circuit. As the turbo units share that same fluid, it's important to consider such changes when looking to achieve longevity across the internal parts.

"We have to think about bearing systems, in terms of robustness when using oil with a lower viscosity. This has also meant we needed to improve our oil seals. The improved oil leakage robustness allows our rotor systems to run at lower speeds. This helps with thermal management downstream; sometimes customers need a lower exhaust flow speed to keep the aftertreatment systems hot," says Fathauer.

He continues by covering work being done on turbo units intended for natural gas engines. While peak temperatures are an issue, the key here is to manage temperatures across the full duty cycle. This puts the focus on thermal fatigue, preventing the turbo's turbines from cracking. Asked if gas is worse or better than diesel, Fathauer has a short response: "Much worse."

CTT Exhaust Throttle Valve (ETV) turbo system



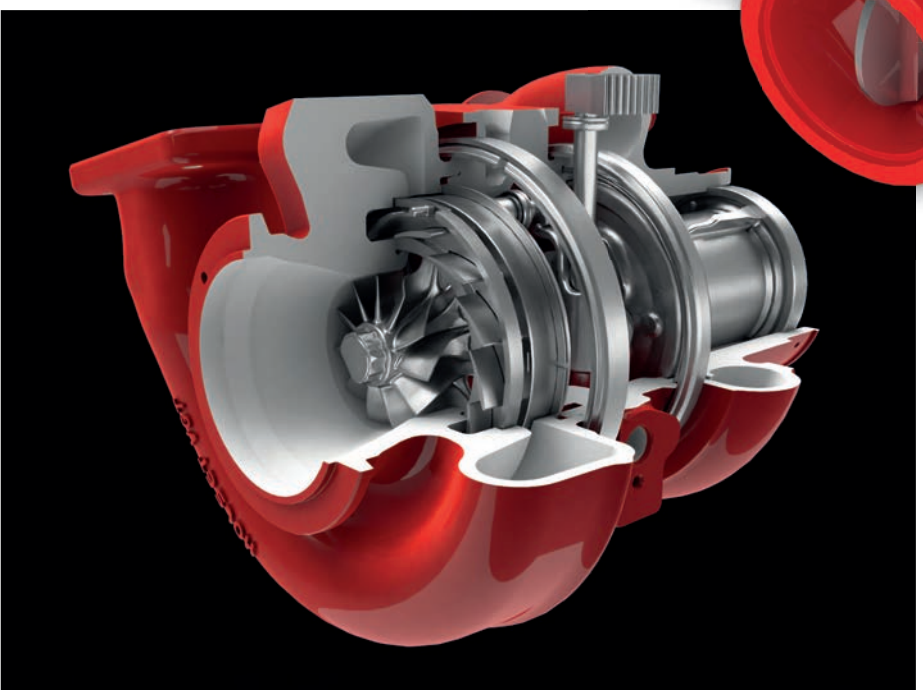
MATERIAL PROPERTIES

To study the issue, CTT uses thermo mechanical fatigue modelling. This involves the study of material properties in relation to tensile stress and how those changes to vane geometry affect the base material.

Even features intended to reduce emissions, such as stop/start systems, can affect engine temperature and by default have an impact on turbo design. "Such systems can create more [engine] heat," says Fathauer. "In some cases, we use water cooling in the bearing housing. This can prevent coking of the oil, particularly with harsh duty cycle applications."

CTT offers a wide portfolio of products under the Holset brand, including fixed, wastegate, variable geometry, two-stage, and exhaust throttle tech – the final element introduced in China and India to help customers meet the NS6 and BS6 emissions regulations. The exhaust throttle promotes thermal management with regards to the aftertreatment systems, while the pressure can in some cases also be used for engine braking.

Cutaway of the HE400VGT turbo highlighting the turbine shroud surrounding the turbine



FUEL AGNOSTIC

Cummins recently announced that it is now planning to release a series of engines which are 'fuel agnostic', meaning that similar engine blocks will use different head units to support a variety of different fuel types. Asked if CTT would be able to support this wide-ranging project, Fathauer has a succinct answer: "We'll be ready for it." **dpi**

Lubricants produced by Fuchs for on-highway applications

Julian Buckley speaks with lubrication specialists from Fuchs to see how the company is developing its product range

Smooth

Fuchs is reported to be the largest independent supplier of lubricants in the world. Based in Mannheim, Germany, the company has relationships with most major engine manufacturers, OEM manufacturers of commercial and off-highway vehicles, plus aftermarket customers.

The company is not involved with the production of crude oil, or the related refining of oil-based products. This allows Fuchs to focus on the development of tailored engine lubricants. In addition, the company works with established producers of base oils and additives, which supports selection of the most advanced solutions on the market.

Asked whether Fuchs supplies primarily natural or synthetic oil products, Bastian Keller, head of Global Product Management, Automotive Lubricants, says he will first offer some background information.

"We use a wide range of base products, from conventional mineral oils through to synthetic base oils such as polyalphaolefins (PAOs) and synthetic ester oils. Mineral oils still play an important role for conventional heavy-duty engines [15W-40 to 20W-50 products], but hydrocracked and synthetic base oils are more important for modern engines to help with product stability, better wear performance, removal of engine deposits and longer oil change intervals."

SUSTAINABLE LUBRICANTS

Keller says that biodegradable products and products containing raw materials from renewable sources will play a larger role in the market, which will also see ester oils used in greater volumes. But in the end, base oil composition depends on technical performance requirements, customer demand and price positioning in the market.

To further address the sustainability issue, Lars Eggers, head of Global Business Segment, OEM Off-Highway, says that Fuchs was the first lubricant supplier to offer a biodegradable engine oil with OEM approval, Planto Mot SAE 10W-40. But there are drawbacks: "Although the Planto Mot product is inherently more sustainable," says Eggers, "demand is still low due to the comparatively high price. But we expect that more stringent legal requirements and an increasing awareness of sustainability will drive market demand."

"Fuchs has increased oil-related fuel efficiency in the last 20 years."

BASTIAN KELLER, Fuchs

Although renewable products are generally more expensive and available in limited quantities, this doesn't mean that sustainability has taken a back seat to volume, as Dr. Frank Finzenhagen, head of Global Business Segments, OEM Engines, Drivelines, Commercial Vehicle, explains: "Since 2020, our internal production has been gate-to-gate CO_2 neutral. Our next goal is to offer well-to-gate CO_2-neutral products by 2025. To make this happen we will not only reduce our own emissions, but also include the supplier's emissions into our numbers."

DEVELOPMENT DIRECTION

While looking to improve sustainability, Fuchs has been on a product development trajectory of reduced oil viscosity levels in many applications – this can cut friction within the engine and, while leaving a suitable coating to prevent damage and remove heat, can also help to improve fuel economy. Keller: "Fuchs has increased oil-related fuel efficiency in the last 20 years by decreasing oil viscosity and using tailor-made additives."

He adds that in the 1990s the company was the first to launch a 0W-20 oil. This was partly based on renewable raw materials, even before these products were requested by any OEMs.

Dependent on application, from passenger cars

Improving oil longevity

Getting the most out of your engine oil delivers a series of benefits, ranging from improved vehicle availability, through to reduced costs and the related environmental benefits. There are some basic tips for extending the life of these lubricants, as Fuchs' Lars Eggers explains.

"The best thing a commercial vehicle or off-highway equipment operator can do is select an oil which best fits their requirements. Transient oscillating heat loads must be taken into account, as do certain features, such as stop/start and aftertreatment systems."

He adds that while a cheap oil might be appealing from an initial cost perspective, it's more than likely that it will result in more oil changes and increased wear on engine parts, ultimately reducing the working life of expensive machinery.

For larger vehicle fleets, oil testing is a good route to understanding the condition and longevity of engine lubricants. This data will allow operators to get the most life from the oils, reducing total cost of ownership without undue wear on critical components.

> Since 2020 our internal production has been gate-to-gate CO_2 neutral."
>
> **DR. FRANK FINZENHAGEN, Fuchs**

operators

> Transient oscillating heat loads must be taken into account [when selecting an oil type]."
>
> **LARS EGGERS, Fuchs**

through to commercial vehicles, Keller says that Fuchs has achieved fuel economy improvements of between 3% and 1% respectively; larger engine displacements generally achieve reduced gains, primarily due to operating parameters and lower overall engine speeds.

This, though, is countered by the prevalence of smaller engines and turbocharging. Forced induction creates higher temperatures and loads, putting additional pressure on engine oils. Exhaust gas recirculation systems can reduce engine temperatures, but with the drawback of higher soot and acid volumes. Diesel particulate filters (DPF) and selective catalytic reduction (SCR) units also require adaptation and reformulation of the engine oils, as Keller explains: "These units require limitations of specific performance characteristics to support the durability of these units, particularly with regards to reductions of phosphor and sulphated ash in the engine oil."

But engineers at Fuchs have still managed to extend the intervals between oil changes by increasing the thermal oxidative stability of the products using additives and quality raw materials, says Finzenhagen. He points out that these oils help to achieve a reduced total cost of ownership figure for the end customer.

Testing also plays a major role in development of the lubricants, from the preselection of base oils and additives, through to engine bench tests. Eggers explains that product development starts with 'standard' chemical and physical lab tests, conducted at Fuchs' own R&D hubs in Germany, China and the US. That is followed by rig tests, to support analysis of the lubricants in engine types.

This is supported by field tests conducted by independent partners, which ultimately delivers the data needed to adjust the direction of investigation.

In 2016, Fuchs expanded its testing capability with the addition of a new test centre in Mannheim. The company is still continuing to expand its R&D capacities around the world.

The pattern of incremental improvements is supported by Fuchs operating its own production plants. In total there are 35 locations globally, with key sites in the US, China, India, South Africa, Brazil and Australia. In addition to the global core product portfolio, Fuchs offers product solutions developed specifically for conditions in those regions.

RECYCLED OIL

The holy grail of sustainability would be to recycle collected oil and refresh the product with new product and additives, delivering an oil which could replace virgin lubricant. But Finzenhagen says there are a series of issues with this picture.

"The market share of recycled lubricants is currently very low due to fluctuations in quality. The waste oil varies in composition, which results in fluctuating quality," he explains.

A reduction in the volume of used oil could further impact any plans to develop a recycled oil market. Keller points out that on the back of increased development of electrified powertrains, some passenger car OEMs have already announced that they will no longer look to develop new internal combustion engines.

But he thinks there will still be a demand for engine oils, particularly in the agriculture, construction and forestry industries, as electrification is not yet viable for machines with high energy demands. There are, he says, another sustainable replacement for diesel in these industries, such as biofuels and hydrogen, but that will not be available in all regions. Which means that commercial vehicles and off-highway machines will continue to depend on quality lubricants. **dpi**

Product testing at Fuchs

Particulate capture science

Mann+Hummel is about to launch a series of new filter solutions for mobile hydraulic applications. **Julian Buckley** speaks with company engineers to find out what customers can expect

Filtration could be described as the unsung hero of mobile hydraulics. Unfiltered hydraulic fluid, loaded with particulates from engines, pumps or related hardware, would inevitably result in a loss in efficiency and potentially lead to failure of the hydraulic system.

Mike Maertz is lead engineer, Hydraulic Filtration, at Mann+Hummel. While the company headquarters is located in Ludwigsburg, Germany, Maertz heads up activities of the worldwide Mann+Hummel hydraulic engineering network from a dedicated facility in Speyer. The team specialises in development of filters which are generally used in construction and agricultural machines.

"We cover liquid filter solutions for oil, fuel, urea and other special filter applications," says Maertz. "Within that team are the hydraulic filters. We have development engineers around the world working on a new hydraulic product portfolio."

Martin Postel, manager for Engineering Liquid Filters, explains more about the new portfolio. "Our target is to use specialised filter media and technologies from existing product groups to develop a new product range. This means using our base knowledge, competences, engineering and production know-how for new product development."

Martin Postel, Mann+Hummel

Mike Maertz, Mann+Hummel

PARTICULATE MATTER

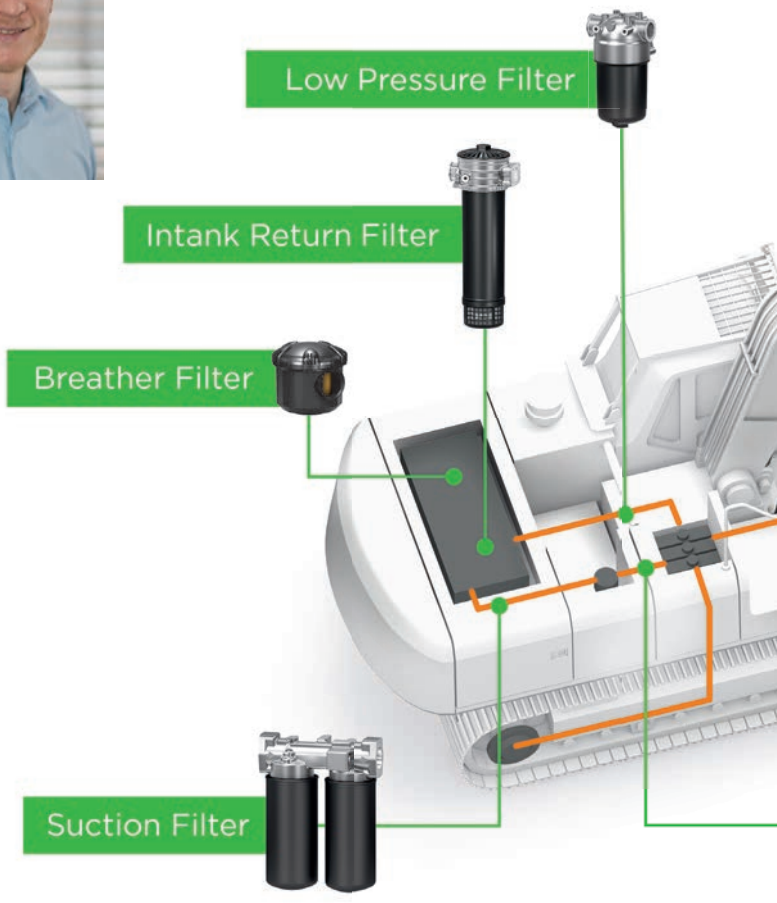
Before jumping into details covering the new products, Maertz describes where the filters are used and the source of the particulates they capture.

"Depending on the system and customer needs, the filter can be located before or after the oil pump," he says. "Another common application is to have it after the activator, that's in the return line where the oil comes back to the reservoir."

The particulates removed from the hydraulic fluid are mainly a result of abrasion. The primary source is the pump system, where there is mechanical friction between moving parts creating pressure in the system. Even servicing can see dirt and dust getting into the fluid reservoir; these particles need to be removed from the system.

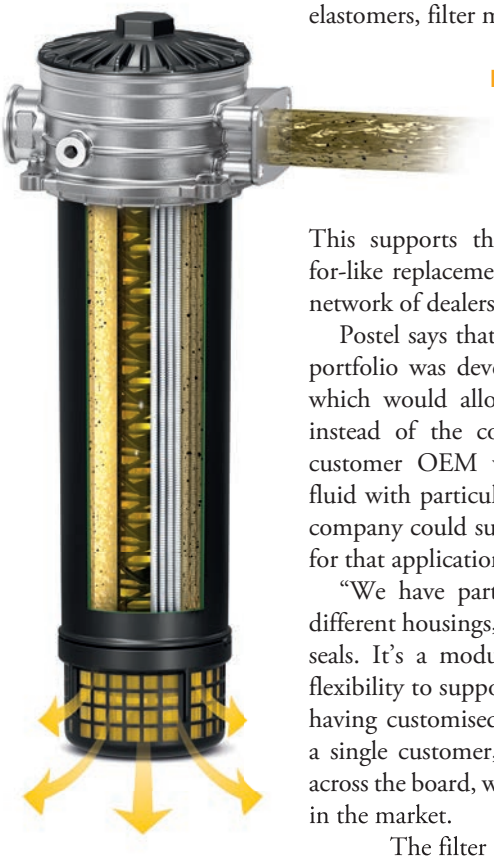
Maertz says the performance of the latest filters has improved a lot in recent years. This translates to an increase in filtration efficiency and related capacity, but also higher performance with regards to differential pressure. "The goal is to maintain – or even reduce – the differential pressure while increasing the particulate holding capacity," says Maertz. This, he adds, will help to increase service interval times and cut related costs.

Too much particulate matter in the filter will cause the differential pressure to increase. Should that go beyond preset parameters, generally around 3 bar, a warning light will illuminate on the machine control panel. This is controlled by a related sensor, but Postel says the latest filters can also include sensors dedicated to testing the quality of the hydraulic



fluid. This supports predictive, rather than scheduled maintenance, another route to cost reduction. But the feature comes with its own set of problems.

"A challenge for us is working with the oil supplier," says Postel. "Each company uses special additives with different chemical properties. This means we have to continuously adapt materials, including elastomers, filter media and plastic parts."



Intank hydraulic return filter from Mann+Hummel

NEW FEATURES

Mann+Hummel delivers to original equipment manufacturers (OEMs) and aftermarket suppliers. This supports the company offering like-for-like replacement of filters through a worldwide network of dealers.

Postel says that a key target for the new product portfolio was development of a modular 'toolbox' which would allow replacement of specific parts, instead of the complete filter. In cases where a customer OEM was looking to use a hydraulic fluid with particularly aggressive characteristics, the company could supply just the specific seals needed for that application.

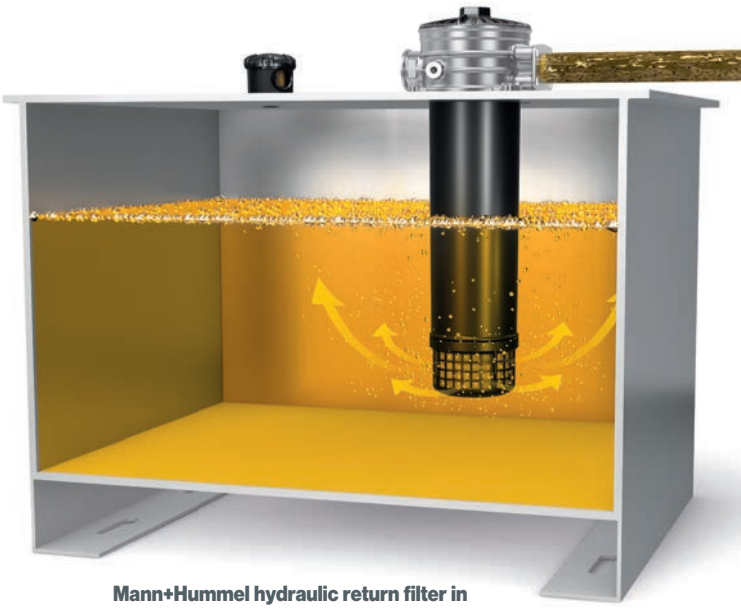
"We have parts which can be combined with different housings, different filter elements, different seals. It's a modular system that can provide the flexibility to support a customised solution, without having customised tools or individual products for a single customer," he says. The system cuts costs across the board, which helps to be more competitive in the market.

Filter applications for off-highway machinery

The filter medium still uses largely the same materials, glass fibre and some synthetics. But Mann+Hummel has brought in new simulation tools to achieve the best combinations of those materials to achieve the optimum balance between particulate holding capacity and filtration efficiency.

"The filter medium uses a combination of layers to improve performance," says Maertz. "This will include a prefilter, for larger particles, together with a finer filter for smaller elements. There's also a metallic mesh to support the pleating. This is the core, but the simulation system has allowed us to improve our internal knowhow, understand the best combinations and orientations of the filter medium."

Sounds simple enough, but there's more. According to Maertz, there are grades of filter media and each application of these materials has to be balanced to achieve optimal differential pressure. Essentially, while you can use a filter to capture particles measured in single-digit microns, the capture of these could cause an unnecessary increase in the pressure. So this must also combine a increased holding capacity so as to not adversely affect the service interval.



Mann+Hummel hydraulic return filter in fluid reservoir

Another new feature is the genuine part protector. This involves a small opening on the filter housing which has a reciprocal insert on the filter. Maertz says that this can help to guarantee original filters are used in servicing, ensuring that machine owners can expect the best performance.

AERATION REDUCTION

A selection of filters in the new portfolio include an aeration reducer. In action, this breaks up any bubbles held within the hydraulic fluid as it is returned to the reservoir. Postel says that, much like an automotive brake line, air in the system is the enemy of efficiency.

"When the gas content in the oil is very high it will influence the hydraulic cylinder behaviour and control of the system. When there's 400 bar of pressure you can't compress the oil. But you can compress the air and this will compromise the system." He points out that in operation, air in the system could make almost impossible to achieve an accurate action/reaction between the control joystick and machine arm.

Adding the aeration reducer is new to the industry. While a clear advantage, it created a new set of problems. Postel highlights that due to the technology being so new, the company had to develop a special test bench to trial the part.

"There were no standards [related to performance], so we've looked to get international standards put in place," he says. "I'm sure competitors will go in a similar direction, so it made sense to have an international test standard – it will help to support accurate comparisons."

New filter tech will certainly improve the performance of mobile hydraulic machinery, but Postel says there's still no replacement for basic good advice. "If you're bringing in new oil, it's critical to have a new filter. Also, you need a good tank system, it has to resist dust ingress. If you have a bad tank breather, you'll get particles in the system and the filter will have to work unnecessarily hard." **dpi**

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PETER MÜLLER-BAUM, CIMAC Secretary General, Managing Director VDMA Power-to-X for Applications

ARMIN ROESELER, Gas Product Definition and Strategy Manager with Caterpillar Energy Solutions

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Systems & Components trophy winners

Innovative off-highway solutions receive Engineers Choice awards.
By **Julian Buckley**

Bosch Off-Highway Surround Sensing

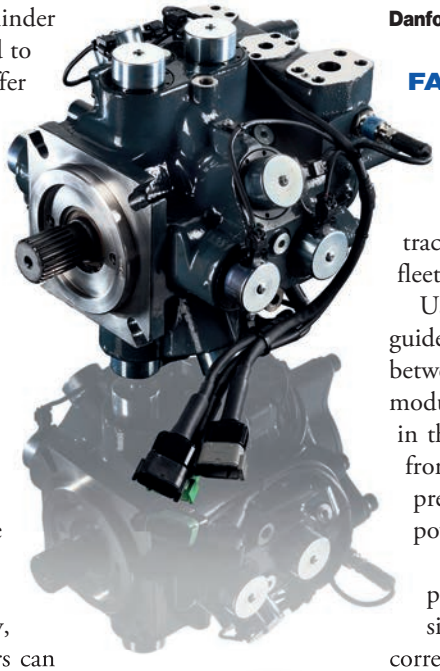
The DLG (German Agricultural Society) has published the winners of the 2022 Systems & Components Trophy – Engineers Choice trophy. Part of the Agritechnica trade show, these awards recognise the contributions made by suppliers to the agricultural machine industry.

Just the second time the awards have been held, the judges selected the three winners from 20 shortlisted companies based on the capability to make a significant contribution to the development and production of off-highway machinery.

DANFOSS PUMP

The first winner was Danfoss Power Solutions' DDP096 digital displacement pump. Using a radial piston arrangement, the unit delivers hydraulic power that is both efficient and controllable. Solenoid valves allow active control of each cylinder on a shaft-turn-by-shaft-turn basis. Compared to conventional pumps the system is said to offer a response rate improvement of up to 90%.

The setup allows activation and deactivation of cylinders in real time, reducing energy losses by up to 30% when compared with swash-plate machines. In addition, the pump produces less high-frequency noise.


Danfoss Power Solutions' DDP096 pump

BOSCH SENSING

Another winner of the Systems & Component trophy was the Bosch Off-Highway Surround Sensing system (see opening photo). This new technology can measure and maintain a pre-determined distance between the off-highway vehicle and nearby obstacles. Using radar and ultrasonic sensors in tandem, the system localises objects in close proximity, warning the driver of the danger. The sensors can simultaneously determine the position and direction of up to 40 static or moving objects.

Intended for use with such hardware as a sprayer boom or grape harvester, the system complies with IP69K and with any E/E mobile machinery architecture. To add further functionality, the sensing setup can add Bosch camera systems, either used independently or in a support role for the other sensors. These deliver displays of the direct surrounding and sensor visualisation.

FASTER CONNECTIONS

The final trophy winner was the Faster ABC from Italian sensor specialist Faster SpA. This solution allows the user to create and save settings related to the pairing between tractor and implement, an added benefit for farm fleets with multiple tractors and tools.

Using a smartphone app, the Faster ABC system guides the user through making the connection between vehicle and tool. In addition, a system module can be connected with the CANbus line in the tractor, which supports shared information from the implement (nominal working power, pressure, oil flow, etc.) to allow fine tuning of power and related fuel savings.

A green LED highlights the best connection port for each implement hose on the tractor side, while also giving confirmation that the correct connection has been made and that it is secure between the male and female couplers. The system goes on to collect additional data from the coupler, which can help with determining when it is time to replace the coupler unit. The Faster ABC app provides visual support through the coupling process, while a warning will be triggered if a connector is faulty or if the connection is determined to be incorrect. **dpi**

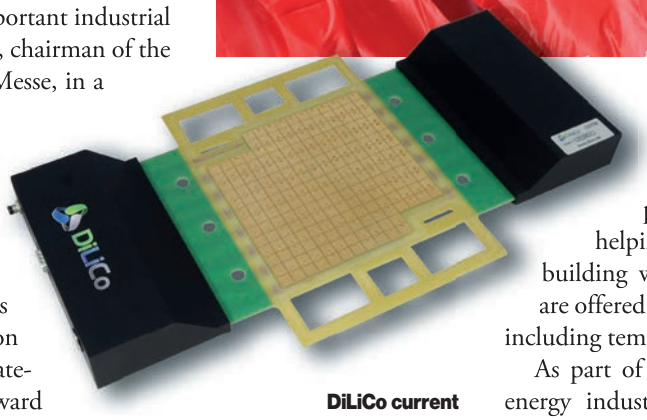

Faster ABC system

Industrial tech goes green

Hanover Messe 2022 will now be held from 30 May through to 2 June, after concerns related to the COVID pandemic saw the trade show moved from its original dates in April.

"As we cannot currently assume that the [pandemic] will have eased sufficiently by April, this early postponement gives our customers the greatest possible planning security to present their innovations at the world's most important industrial trade fair," said Dr. Jochen Köckler, chairman of the Board of Management, Deutsche Messe, in a release from January.

The focus of the upcoming industrial technology show will be digitalisation and sustainability. These are put forward as the key areas to be leveraged as players in the business and industry sectors look to transition away from fossil fuels to climate-neutral value creation. It is put forward that low-energy digital solutions will be needed for significant reductions in CO_2 output.



DiLiCo current density sensor

In addition, the event will see Portugal as the show's partner country. With participation organised through the Portuguese Trade & Investment Agency, the country will have a central pavilion and three other themed areas covering Engineered Parts & Solutions, Digital Ecosystems and Energy Solutions. Portugal recently became the fourth European country to stop using coal for electricity generation. With no national coal, gas or oil production, the country has turned to green tech to supply power. The Energy Solutions pavilion will highlight some key strategies behind the move.

INNOVATION ON DISPLAY

Bosch Rexroth will be premiering its ctrlX Automation system. This package is said to overcome the boundaries which have stood in the way of integrating machine controls, IT and the Internet of Things (IoT). Using a Linux OS and with app programming, web-based engineering and IoT connections, ctrlX Automation is said to support component engineering cost reductions of between 30 and 50%.

Also in this field, Enerthing will be showing its EnerSense CO_2 sensor. Instead of using a battery, this unit is powered by indoor light using Enerthing's proprietary photovoltaic technology, helping to improve air quality in any building without any related waste. The units are offered with a series of other included sensors, including temperature, pressure, humidity and light.

As part of this, a series of companies from the energy industry will show how to generate and transmit energy both efficiently and sustainably.

Within this sector, German company Condensator Dominit will be showing its Thyra system, designed to correct fluctuation in electricity supplies. Using the thyristor switched control dynamic compensation system, with detuned steps for transient free reactive power compensation, Thyra can reduce voltage dips within milliseconds.

Another German company, DiLiCo, will be premiering new hardware designed for measuring current density and temperature distribution in a fuel cell membrane. This helps to evaluate and improve the design and performance of bipolar plates, gaskets and other internal fuel cell components. Dependent on the membrane surface, the sensor layer, number and distribution of segments can be adjusted to requirements so as to obtain optimal data covering current and temperature range.

In addition to hundreds of exhibitors, Hanover Messe will offer a series of related support events. These will include WomenPower, which will see a series of speakers deliver presentations looking at such topics as diversity, equal opportunities, sustainability and career development. There will be a related Engineer PowerWoman Award, together with a series of other award programmes. **dpi**

Some of the latest developments in the people-mover industry

Optimal-EV signs marketing agreement with Vicinity Motor

Optimal Electric Vehicles, developer of low-floor electric shuttle buses, has signed a licensing and marketing agreement partnering with Vicinity Motor, a manufacturer of electric, CNG and diesel medium-size buses. Canada-based VMC will serve as the exclusive North American distributor of the company's all-electric product line through Vicinity's dealer network.

The agreement allows VMC to license and sell the Optimal S1 and E1 product ranges for a period of 10 years in exchange for an investment of $20 million. Optimal-EV will produce the vehicles and chassis for Vicinity Motor, which will sell the vehicles directly in Canada and through a dealer network in the US. Vehicles will be branded as VMC Optimal.

Introduced in 2021, the Optimal E1 is a full-electric low-floor chassis built on a Ford E450 frame. According to Optimal-EV, the E1 powertrain system delivers a range of about 125 miles. The rear drive, rear motor design uses a 113 kWh Proterra Powered lithium-ion battery pack. The vehicle can complete a full recharge in about two hours using optional DC fast charging.

Gillig transit bus

Gillig, RR.AI agree to develop ADAS systems

Transit bus manufacturer Gillig and autonomous mobility solution specialist RR.AI have agreed to develop advanced driver assistance systems (ADAS) and SAE Level 4 autonomous vehicle (AV) technology for transit buses in North America.

"We see this partnership as a great fit for both our companies," said Gillig president and CEO Derek Maunus. "The Gillig team is passionate about delivering transformative products and solutions that make transportation safe, efficient, and help eliminate roadway congestion. RR.AI is equally committed to those important goals. We're excited to work with such a technology leader to bring advanced vehicle automation technologies to cities across America."

The companies will develop and test safety features such as automatic emergency braking, precision docking, plus bus yard automation, blind spot detection and pedestrian avoidance. **dpi**

Enviro 500 buses arrive in Berlin

Alexander Dennis, subsidiary of independent global bus manufacturer NFI Group, has delivered the first series-production Enviro500 buses for Berliner Verkehrsbetriebe (BVG) of Berlin, Germany. Future deliveries will take the Berlin fleet of double-deck buses to 200 units.

BVG signed a multi-year contract with Alexander Dennis Germany as the supplier of its next-generation double-deck buses in 2018 and placed its main order in March 2021. The order came after a test programme with two pre-series vehicles. Production has ramped up at the ADL factory in Scarborough, UK, to deliver up to five buses per week for most of 2022.

The Enviro500 for BVG is 13.8 m long and 4.06 m tall. With a maximum capacity of 112 passengers, the buses retain three doors and two staircases to ease passenger movement. The buses use 8.9 L Cummins L9 diesel engines rated 365 hp (272 kW) with a ZF EcoLife transmission. **dpi**

Total Transport selects UniqueEV

New York-based Unique Electric Solutions (UES) has revealed that Total Transportation Corp, provider of transportation services in New York, New Jersey and Pennsylvania, has chosen its UniqueEV battery electric repower solution to convert six existing school buses from diesel to electric. The buses will be operated by New York City's Department of Education.

The all-electric UniqueEV repower is designed for Type A to Type D school buses. Using a high-torque electric motor and modular battery packs, the company said a variety of range options are available at different price points. The system is available with various HVAC options and is compatible with all school bus ADA equipment, including wheel chair lifts.

Alexander Dennis bus in Berlin

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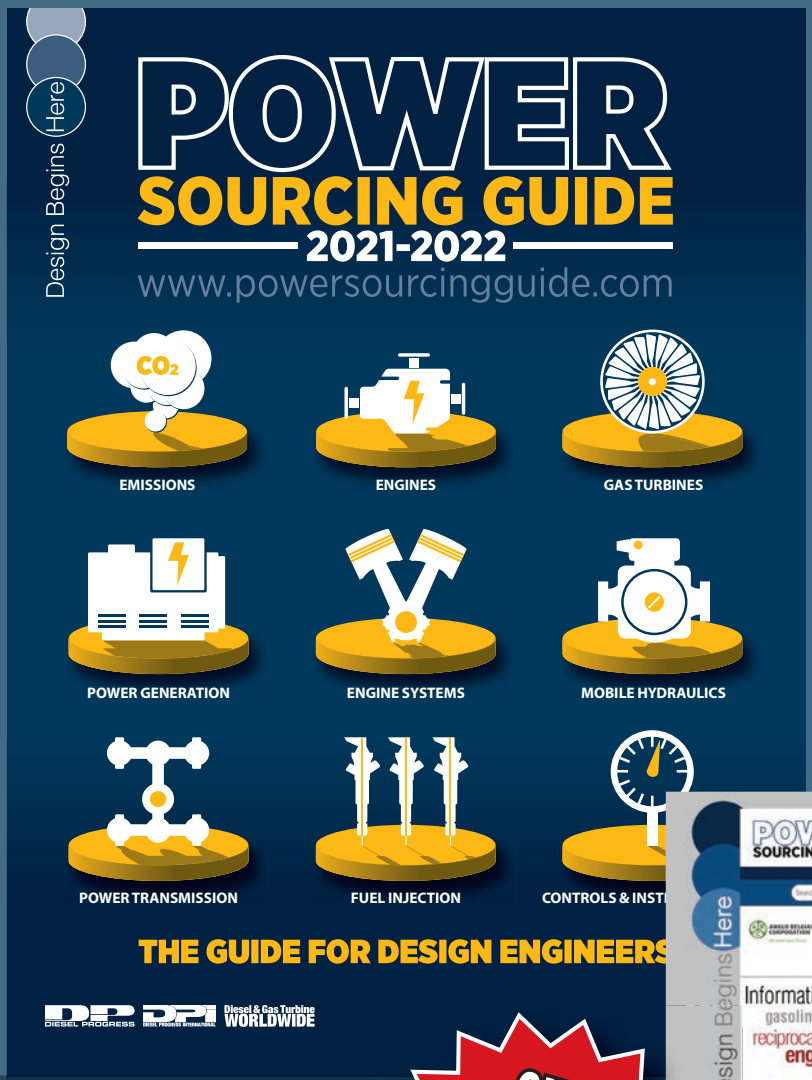

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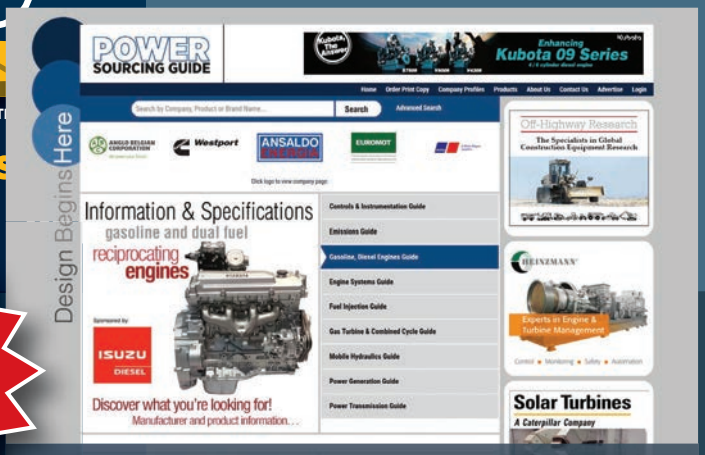

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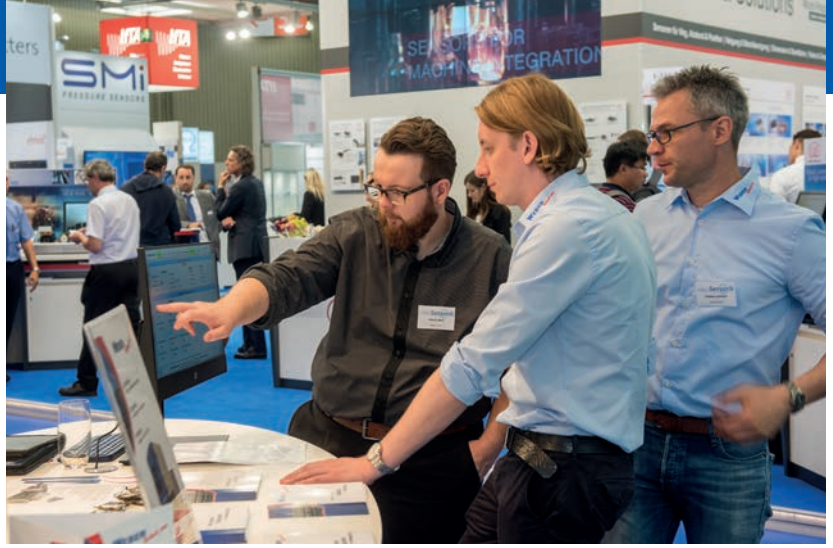


MTMS inclination monitoring system in action

Sensor tech expo

Sensors and sensing will play a key role in future operation of commercial vehicle transport, agriculture and off-highway vehicles, as original equipment manufacturers and operators rely more on collected data and related analysis to reduce emissions and improve overall vehicle performance.

Sensor+Test 2022 will be held at the Nuremburg Messe in Germany from 5 – 10 May, 2022. Organised by AMA Service, the event will further feature the PCIM Europe and SMTconnect conferences.

Read on to find out about some of the featured innovations which will be on display at the upcoming trade show.

Althen Sensor and Controls is based in Kelkheim, Germamy. At Sensor+Test 2022, the company will be featuring the MTMS mobile inclination monitoring system, a tilt measurement system for heavy-duty transport, including trains, ships and heavy haulage trucks. Housed in an aluminium casing, the unit is designed to display quasi-static changes in the inclination angle of measured objects within +/- 10° and with a resolution of 0.1°.

Using a display panel which can be viewed from up to 20 metres, the measurement is offered in both numeric and bar graph formats.

MACHINE MONITORING

Also at Sensor+Test 2022, Disynet, a company based in Brüggen, Germany, will be showing a system supporting machine condition monitoring and predictive maintenance. Sensors in the system collects data on a range of engine parameters, including acceleration (including engine vibration), force, pressure, oil condition and surface temperatures. There is also the Oil Debris Sensor 4212, designed to detect metal wear and particles in the lubricant.

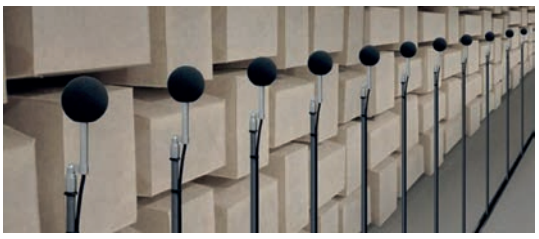
Leveraging Industry 4.0 analysis, information can be used to identify potential issues with the machine in real time. This replaces scheduled maintenance programmes, which might otherwise be unnecessary, supporting maintenance as and when it is needed. This keeps engines running longer, reducing related return on investment.

Eltek hydrogen concentration sensor

Range of sensors from Disynet

Hydrogen has great potential as a new fuel, but the gas needs specialist equipment to support optimal usage. Based in Casale Monferrato, Italy, Eltek will be highlighting its new hydrogen concentration sensor. This is to detect hydrogen fuel concentration levels and alert if the concentration is too high.

The sensor is located in the fuel cell's exhaust gas channel. The exhaust mix is made up of cathode waste gases (humidity) and anode waste gas (hydrogen). Based on catalytic combustion technology, the concentration sensor is not sensitive to humidity or other hydrocarbons, so has high H2 selectivity. The sensor offers a response time of less than 100 ms, in gas speed up to 50 m/sec.



MTG microphone array for noise testing

SOUND SCIENCE

Vehicle noise levels are coming under increasing scrutiny, meaning that OEMs must test to be aware of the related results as they continue with development. Microtech Gefell (MTG), based in the city of the same name, will show an acoustic system developed especially for such testing.

The system comprises weatherproof microphones arranged in lateral rows in permanently installed systems. Together with related measuring systems (such as light barriers, speed sensors, GPS, etc.), the hardware creates a sound level measuring chain for checking standard sound values, together with frequency-related analysis of the driving noise. In addition to these arrays, MTG offers sound measuring room equipment and other related technologies. **dpi**

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Hybrid drive buses

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Brazil attracts new companies due to drivetrain demand

New tech will help cut pollution in South American cities. By **Mauro Belo Schneider**

The market for hybrid and electric propulsion systems in Brazil is just getting started, according to Ian Wilson, Business Development director at BAE Systems Power & Propulsion Solutions. He said that global pressures to reduce emissions and achieve a zero-carbon footprint have made companies in the automotive and transport sectors look for solutions to achieve the desired goals.

It is with this backdrop that BAE Systems, a company with more than 25 years of experience developing hybrid and electric drivetrain solutions, is aiming to enter South American markets, offering solutions already validated in the United States and Europe.

"The company has different options, from hybrid solutions through fully-electric and hydrogen fuel cells," said Wilson.

The objective is to gradually expand operations on the back of anticipated market growth, which Wilson believes could be significant. "Just looking at buses, the regional market represents almost 20% of the world market, with around 55,000 units per year. The city of São Paulo announced that it intends to have around 2600 less-polluting buses powered by renewable fuels by 2024," he stated.


Ian Wilson, BAE Systems Power & Propulsion Solutions

The Power Propulsion Systems division operates within BAE Systems. With sales of £20.9 billion in 2020 the division is active in several sectors, including global defense and security. The first hybrid electric propulsion solution was supplied to the New York City bus fleet in 1998. These technologies were launched on vehicles in London, UK, in 2008, together with other European cities.

In 2010 and '11, the company started development of zero-emission solutions, with a fuel cell and battery system. Currently, the portfolio includes traction motors, motor drives, system controllers, accessory power drives and energy storage systems.

BAE has also announced that it has closed an agreement with Meritor, supplier of electric powertrain technologies, to offer solutions for heavy vehicles and for the defense sector. As part of the collaboration, BAE will deliver systems integration and electronic power expertise for incorporation with Meritor's ePowertrain management systems.

"The collaboration with BAE Systems allows us to demonstrate the performance of the ePowertrain in different markets," commented Jim Keane, industrial vice president at Meritor.

BIG POTENTIAL

Meritor South America has between 8 and 10% of its revenues coming from the aftermarket – a segment that grew 160% from 2015 to 2020. Gerson Backrany, sales manager of aftersales in South America, said that the market was boosted by the crisis, together with the lack of components in Brazil and across the world. "Because of the fear of the lack of parts, distributors prefered to fill their stocks and then guarantee a future capacity," Backrany said.

Meritor, which recently celebrated 65 years of operations in Brazil, has already manufactured more than 8 million axles (3.5 million for commercial vehicles) at plants in Osasco, near Sao Paulo, and Resende, an automotive enclave near Rio de Janeiro. In 2021, the company launched the first 14xe electric powertrain, developed under the Blue Horizon brand. **dpi**


Drivetrains from Meritor

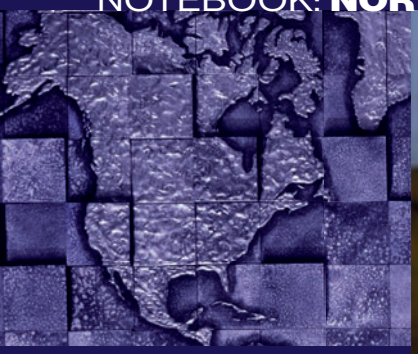

PHOTO: ADOBE

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Straight talk on machine interoperability

Smart machines and components collect volumes of vital data, but OEMs must move from proprietary systems to collaborative integrations. By **Ronnie Wendt**

"Machines are getting smarter, but is anyone listening?" asks Adam Livesay, co-founder and CCO of Elevāt, a US-based company that helps manufacturers connect machine assets to deliver immediate insights. Next up, Livesay asks: "What will it take to make it possible for end users to listen to their data to make smarter and more informed business decisions?"

The answer lies in interoperability – something heavy equipment telematics solutions and machine components have often lacked. Traditionally, OEMs have installed proprietary telematics solutions that didn't play nice with other components or interact with software tools favored by end users.

Livesay reports the tide has changed as machines get smarter and collect more data. Customers demand more integration and OEMS are now willing to provide it.

"The shift is a game changer," he says. "When everyone collaborates on a solution and brings their best strengths to the table, we can deliver the highest value to end users.

Adam Livesay, Elevāt

PICK A PARTNER

The new paradigm pushes OEMs to develop collaborative ecosystems that provide interoperable solutions. OEMs now turn to companies like Elevāt to help them.

Only the top 3% of manufacturers have teams ready to oversee every inoperability challenge, says Livesay. The rest seek partnerships to elevate their software and interoperability efforts, freeing them to focus on producing core products, such as machines, engines and other components.

"Companies now see they don't have to create the entire solution, they can buy solutions to add to theirs," he says. As a SaaS telematics company, Elevāt releases new features weekly to continuously improve. An engine or equipment manufacturer may lack manpower and the needed expertise to do that.

ELEVATED END USER EXPERIENCES

Industry partnerships change relationships over the long-term, ultimately making life better for customers. As machines become more connected and better at sharing data, end users can collect more information about asset utilization, component wear and tear and service needs.

And when a machine goes down, manufacturers, suppliers and end users can collaborate to evaluate and solve the problem. For example, a partnership between Applied Fluid Power and Elevāt helps the fluid power distribution and system integration company aid customers across the globe.

"Before, you'd have to fly three people to the machine," says Livesay. "Now experts for every component can examine data in real time and make recommendations. This strategy leads to better machines, more innovation, improved service and more efficient ways to run your company."

It also reduces downtime, he adds. Whenever a machine isn't working, the biggest concern is getting it back online as downtime costs money. If a Tier 4 diesel engine fails at a remote construction site, it could take days for a service truck to arrive, diagnose the problem and make repairs.

"With interoperable technology components you can look at the engine remotely, talk with engineers and even fix it remotely," he says. "Repairs in hours rather than days, it's a massive savings." **dpi**

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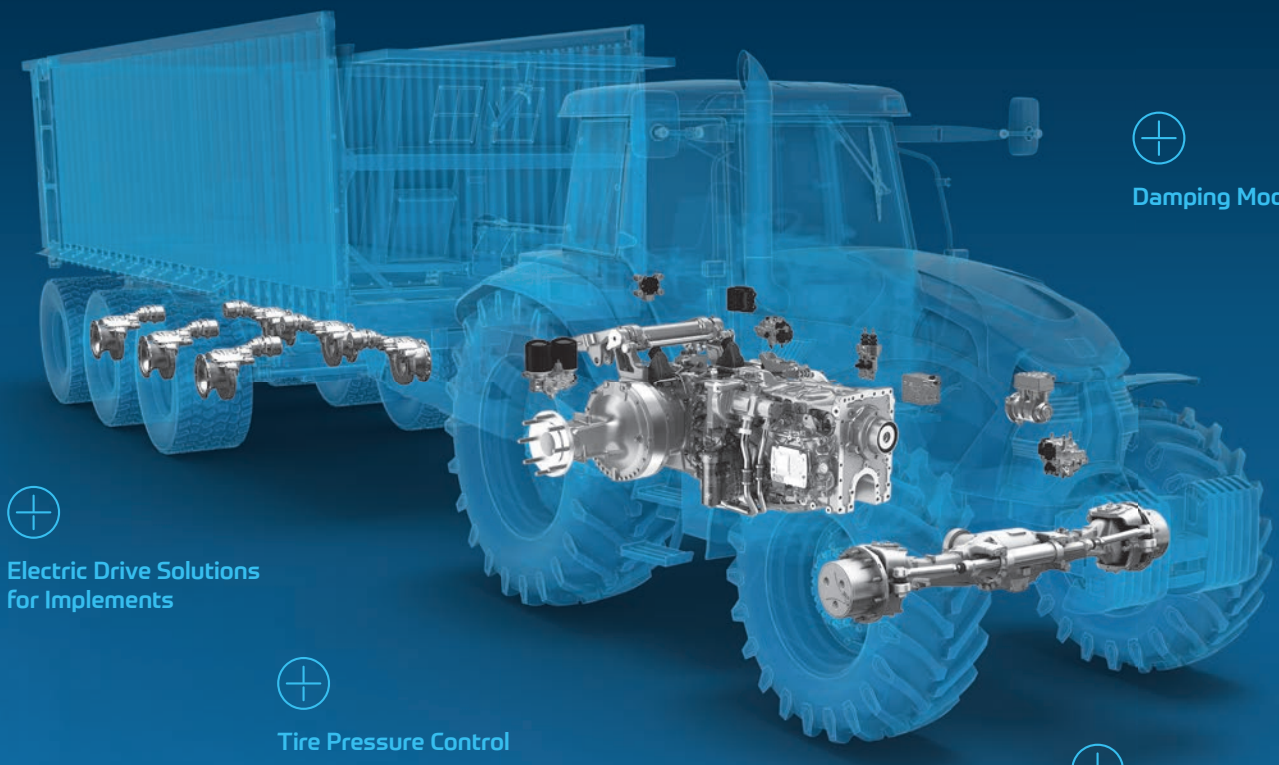

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