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January-February 2022

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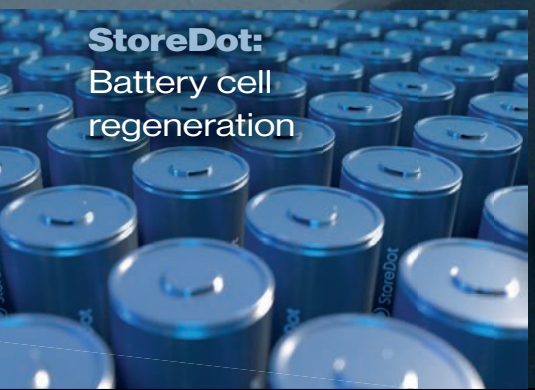
Gen set cooling in the Canadian wilderness

Arctic Star

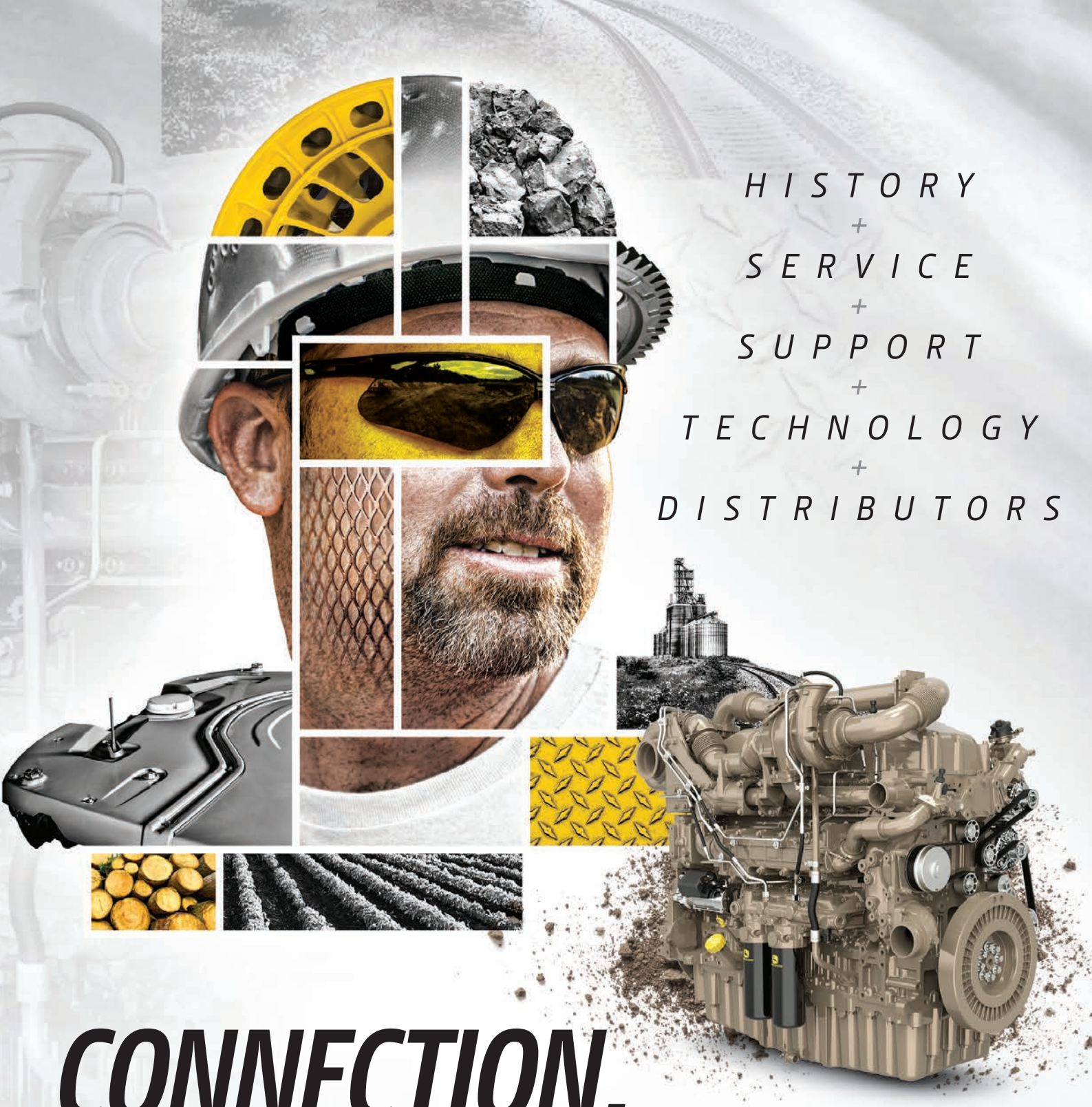


StoreDot: Battery cell regeneration

Dr Frank Hiller: Deutz CEO looks forward to new products

BKT Tyres: Making good tyres better

THE MAGAZINE FOR ENGINE DESIGN, POWER AND COMPONENTS ON A GLOBAL SCALE



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COMMENT

Shows are better in person

Whether you call it a postponement or a cancellation, the move to hold over this year's Agritechnica trade show is indicative of the new world in which we live. Scheduled to be held in late February in Hanover, Germany, the decision to delay the show by a year was made due to rising COVID infection numbers across a series of countries.

The call to hold off the event, made by Agritechnica organisers DLG and their partners, highlights fundamental problems which have been with us since the start of the pandemic. COVID is a fickle beast; waves are an appropriate way to describe how the virus washes over countries and populations.

Even in the planning stages, DLG must have weighed up the possibility that the trade show would need to be called off.

In late 2021, I was more than happy to attend a couple of events, EIMA 2021 in Bologna, Italy and a smaller event organised by engine manufacturer Deutz, which took place near Frankfurt, Germany. Yes, there were complications with travel. In one case I was up until 2am making sure I had the right documentation and test results to get back into the UK. Those official tests didn't come cheap, either.

Visitor numbers were 30% down at EIMA. You can bet complicated travel docs and COVID had a big part to play in that. The halls were surprisingly easy to navigate, which must have been disappointing for exhibitors, considering the related expense. While deals are not really made on stands anymore, meet-and-greets still play a big part in getting deals.

COVID has forced everyone, from trade shows to publishing companies (ahem), to move events online. While there's reduced sponsor appeal, they are cheap to host and attend. But just because it can be done doesn't always mean that it's right. After all, it takes some considerable concentration to last a full day of onscreen presentations.

Due to online alternatives, some are saying that the trade show format is dead. That would be a terrible thing. Online seminars and product reveals are OK, but they are no replacement for seeing machinery and people on a stand. That value goes well beyond dollars and cents.

I was looking forward to my first Agritechnica show and was disappointed when it was cancelled. I'll be looking forward to 2023 when, COVID aside, we'll all be able to meet up in Hanover.

> "I'll be looking forward to 2023 when, COVID aside, we'll all be able to meet up in Hanover."

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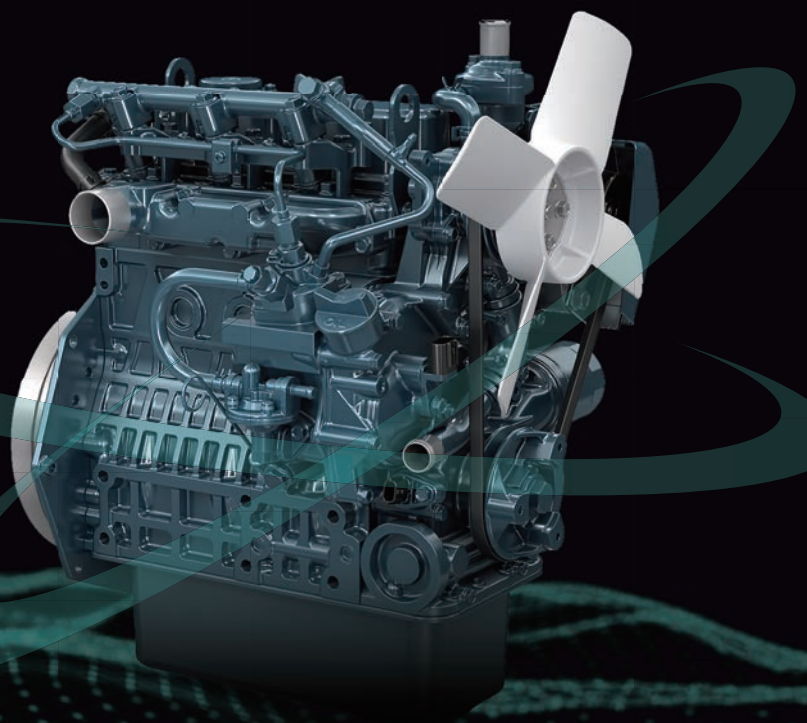

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Kohler goes on company buying spree

Wisconsin-based Kohler has purchased both Heila Technologies and Curtis Instruments. No financial details covering the deals were released.

Founded in 2015 and based in Somerville, Massachusetts, Heila specialises in the integration and operation of distributed energy resources and microgrids. The tech is promoted as having the potential to change the energy industry through the use of batteries, fuel cells, and solar arrays in sustainable grids for communities and businesses.

Just days after announcing the purchase of Heila, Kohler revealed that it had purchased Curtis Instruments. With headquarters in Mount Kisco, New York, Curtis acts as an electrification partner across a broad range of markets, including material handling, recreational vehicles, construction and agriculture.

Products include motor speed controllers, HMIs and instrumentation, power conversion, CAN modules and a range of accessories. These are all supported by related software solutions.

The purchase of both companies by Kohler follows the company's formation of a new Home Energy Management Systems business unit, focused on residential energy storage. In a statement, Kohler said that the acquisitions underline the continued commitment to lead in diversified distributed energy solutions.

Heila Edge supports optimised connection of energy resources

Both Heila and Curtis will operate as standalone entities within the Kohler Power Group. In the case of Heila Technologies, general manager Francisco Morocz will report to Brian Melka, Group president, Power. At Curtis, Stuart Marwell, president, will report to Melka.

Speaking about the new setup, Marwell said: "We were drawn to Kohler because of its nearly 150-year history of strong family leadership and innovation, as well as its commitment to embracing the growing shift to electrification and hybridization."

In a separate statement, Heila's Morocz said: "As a young company, Heila Technologies couldn't be more pleased to now be part of [Kohler's] well-established Power Group and contribute to a shared strategy of power resiliency and sustainability and to accelerate the growth of clean and distributed energy resources globally." **dpi**

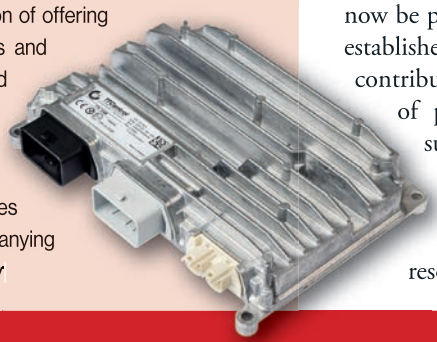
HED, TTControl in joint tech and sales deal

HED (Hydro Electronic Devices) and TTControl, a joint-venture company of TTTech and Hydac International, have agreed a joint technology and sales partnership. No financial details were provided.

HED, which is based in Hartford, Wisconsin, is a designer and manufacturer of vehicle controls and HMI and telematics for mobile equipment. TTControl delivers electronic control systems for off-highway vehicles.

The deal will support both companies as they look to enhance their respective product portfolios; HED will leverage the tie up to build on existing vehicle control systems to include safety-rated controller products.

TTControl TTC 2300 series ECU



"We are very excited to partner with TTControl and implement our strategic vision of offering safety-rated products to our markets," said Steve Magee, vice president of Sales and Marketing at HED. "TTControl/Hydac has an excellent portfolio of hardware and software tools, as well as sensors for creating functional safety control applications for mobile vehicles. We feel confident they will be a long-term partner in supporting our growth strategy."

Safety-certified electronic controllers, displays, sensors, etc. for heavy-duty vehicles remain a challenge for many companies as the ISO 26262 A level standard and accompanying B level standards, such as IEC 61508 and ISO 13849, are applied by region or industry

NEWSBITES

→ **Eaton Cummins Automated Transmission Technologies** has released specifications of its new Endurant XD and XD Pro transmissions.

Designed for on-highway applications up to 75,000 kg (166,000 lb) GCWR, the Endurant XD is rated for 2240 to 2500 Nm (1650 to 1850 lb ft) of maximum torque. The XD Pro has an unlimited GCWR.

The transmissions are designed for heavy on-highway applications and off-road vehicles such as dump and logging trucks.

→ **National Express** has ordered 130 zero-emissions double decker buses. The purchase is part of a £140 million ($189 million) scheme that could see up to 300 buses bought, which would make Coventry the first city in the UK to have a wholly battery-electric bus fleet. The programme further includes bus station upgrades including installation of dedicated charging points.

→ Australian mining company **Fortescue** has bought Williams Advance Engineering (WAE) for £164 million ($222 million).

The battery and tech division related to the Williams F1 team, Fortescue plans to leverage the

Junttan PMx2e electric pile driving rig

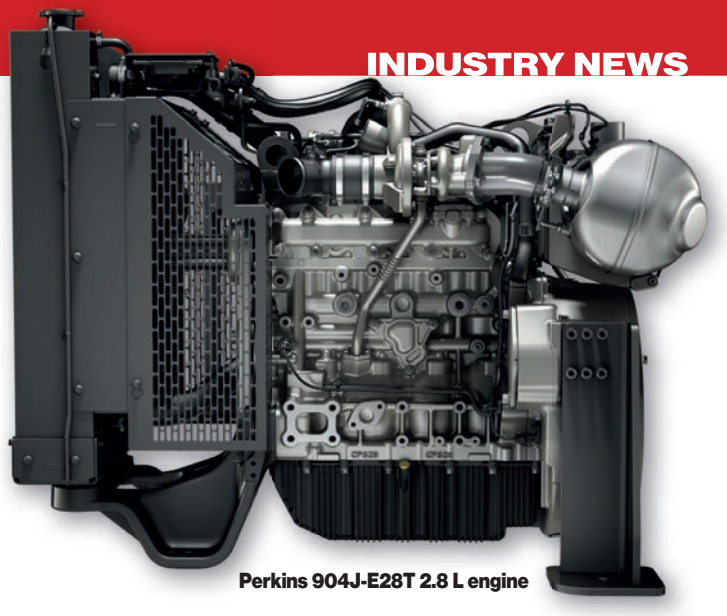
Danfoss' Editron division and Junttan reveal PMx2e

Danfoss' Editron division and Junttan, manufacturer of hydraulic pile driving rigs, have teamed up to deliver the PMx2e, described as being the world's first fully-electric pile driving rig.

The PMx2e is designed to match the operational performance of a diesel-powered rig. According to information from Junttan, the PMx2e pile driver has a hammer winch capacity of 12,000 kg (10,000 kg, pile). Maximum pile length is 20 metres (66 ft).

The PMx2e features an Editron PMI375-T1100 electric motor and an ABB HES880-series invertor. Using less energy per pile than a diesel equivalent, with less noise and zero emissions.

It is expected that the machine will enter series production in 2022.



Perkins 904J-E28T 2.8 L engine

Perkins adds to IOPU engine range

Perkins has expanded its range of Industrial Open Power Units, part of the 904 Series, with the addition of new 2.8- and 3.6-L variants.

The engines are intended to deliver plug-and-play power solutions for the agricultural and industrial sectors that meet the EU Stage 5 and EPA Tier 4 Final emissions standards.

Engines have full aftertreatment mounting, integrated cooling systems, a full wiring harness and mounting for the ECM and fuel filter. There is a 500-hour service interval.

The 2.8 L turbo engine delivers 55 kW and 300 Nm of torque at 1600 rpm. The 3.6 L aftercooled and turbocharged engine has a maximum output of 100 kW and 550 Nm at 1500 rpm. 3.6 L versions can be configured with either 12 or 24 V electrical systems.

The design of these engines means they are ready to use, eliminating the need for extensive machine reengineering. In addition, they are preinstalled with an ECM, aftertreatment sensors and fuel filters compatible with a wide range of machines.

These new engines have been tested in a range of territories to ensure reliable cooling performance, further reducing installation costs. **dpi**

Cummins' Darlington, UK factory reaches production milestone

Engine manufacturer Cummins has announced that its factory in Darlington, UK has manufactured its 1.5 millionth Mid-Range engine. The landmark was reached in January this year.

The site, which produced 66,000 engines in 2021, also manufactures exhaust aftertreatment systems. Opened in 1965, the Darlington plant initially produced the Small Vee family of V6 and V8 diesel engines. In 1985, after a £13.5 million upgrade, production switched to the Mid-Range engines.

The Mid-Range engines are B and C Series products, the forerunners of the ultra-clean, low emissions products manufactured today.

With power outputs ranging from 75 to 430 hp, the engines are used across a broad range of applications, including truck, bus, construction, agriculture, material handling, military, marine and power generation.

Craig Thomas, Darlington plant manager, said: "Our workforce has been through many challenges over the years, none more than the current COVID pandemic. This milestone is a great achievement and a recognition of all of their efforts to keep engine production running and our customers supported."

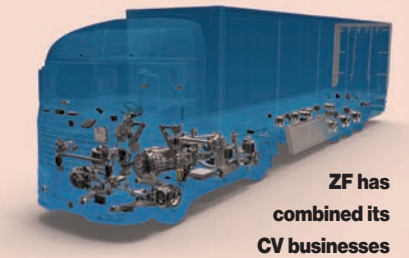
Thomas added that the 1.5 millionth engine would be shipped to Hyundai Construction Equipment in South Korea. **dpi**

Craig Thomas, Ian McMahon and staff with the 1.5 millionth engine

tech to achieve its goal of carbon neutrality by 2030. Top of the agenda is development of a battery-powered freight train.

→ Battery manufacturer **Britishvolt** has received £1.7 billion in funding for a new battery cell gigafactory. Located in NE England on the site of the former Blythe Power Station, the plant will produce enough low-carbon cells for production of 300,000 EVs per year.

This equates to 48 GWh. The SMMT has estimated the UK will need 60 GWh by 2030 to support national EV production, which could reach 1 million units.



ZF has combined its CV businesses

ZF launches Commercial Vehicle Solutions

ZF has announced the launch of its new Commercial Vehicle Solutions (CVS) division.

CVS unites ZF's former Commercial Vehicle Technology and Commercial Vehicle Control Systems divisions, the latter formed after ZF purchased Wabco in May 2020.

"With the new CVS division, ZF is now positioning itself as the world's largest component and system supplier for the commercial vehicle industry," said Wilhelm Rehm, member of the ZF management board with responsibility for the new division.

"Thanks to our broad technological positioning and global market presence, we can offer our customers the key solutions they need to transform their product portfolio from a single source. Leveraging our regional structure, we offer significant advantages for truck, bus and trailer manufacturers, as well as fleet operators, wherever they are in the world."

Tucano combine harvester with 260 kW inline six-cylinder mtu 1000 Series engine

Rolls-Royce and Claas extend engine supply

Rolls-Royce and machine OEM Claas, have extended their supply agreement covering the former's mtu engines.

The deal covers supply of 'several thousand' mtu engines per year from the Series 1000 to 1500. These will feature in the Lexion and Tucano combine harvesters, Jaguar forage harvesters and Xerion large tractors.

Mtu 6R 1000, 6R 1100, 6R 1300 and 6R 1500 are Stage 5-compliant variants based on Daimler's OM 93x an OM 47x utility vehicle engines. Power outputs range from 180 – 480 kW (241 - 643 hp).

"We laid the foundations for continuing our cooperation in the intensive field tests we performed for certification, which primarily took place at Claas. By coordinating with each other closely from a very early stage, we improved our engine platforms, also adding a diesel particulate filter to the SCR system to ensure compliance with the strict emission limits," explained Stefan Rudert, director C&I and Agriculture Business at the Rolls-Royce Power Systems business unit.

The engines have the option of being purchased with dual certification for Tier 4 Final compliance covering the United States and Canada. **dpi**

Daimler Truck reports sales increase

Daimler Truck has 'significantly increased' its group sales over fiscal year 2021. Total sales of 455,000 units represents a year-on-year increase of 20% across truck and bus sales.

The company benefitted from recoveries across all major markets in the first half of the year, with demand remaining strong over the remaining six months.

Daimler Truck was spun off from Daimler AG in December last year

Sales were affected by supply constraints, particularly in the case of semiconductors, which forced a production slowdown and constrained volume growth, especially for heavy-duty vehicles in the US and Europe.

Daimler Truck will release further details in March, together with forecasts for the 2022 fiscal year. **dpi**

NEWSBITES

→ The **CIMAC World Congress** has joined a series of trade shows and other events which have had to be called off due to COVID concerns.

Covering the large engine market, CIMAC was scheduled to be held this June in Busan, South Korea. It will now be held over June 12 – 16, 2023 in the same location.

→ **Lake Shore Systems** has merged with **Trident Maritime Systems** and will now operate under the Trident Maritime Systems – Heavy Equipment Group name.

The two companies are to join forces so as to provide a comprehensive network of integrated services that will better serve their customers worldwide.

→ **Eaton** has completed the acquisition of Royal Power Solutions. The $600 million purchase price represents approx. 13.6 times the company's 2022 EBITDA.

The purchase will extend Eaton's presence in the mobility and electrification markets, through RPS's portfolio of high-precision electrical connectivity components.

→ Mining company **Teck Resources** is to test 30 zero-emissions large haul trucks from Caterpillar. Teck is looking to cut carbon output 33% by 2030.

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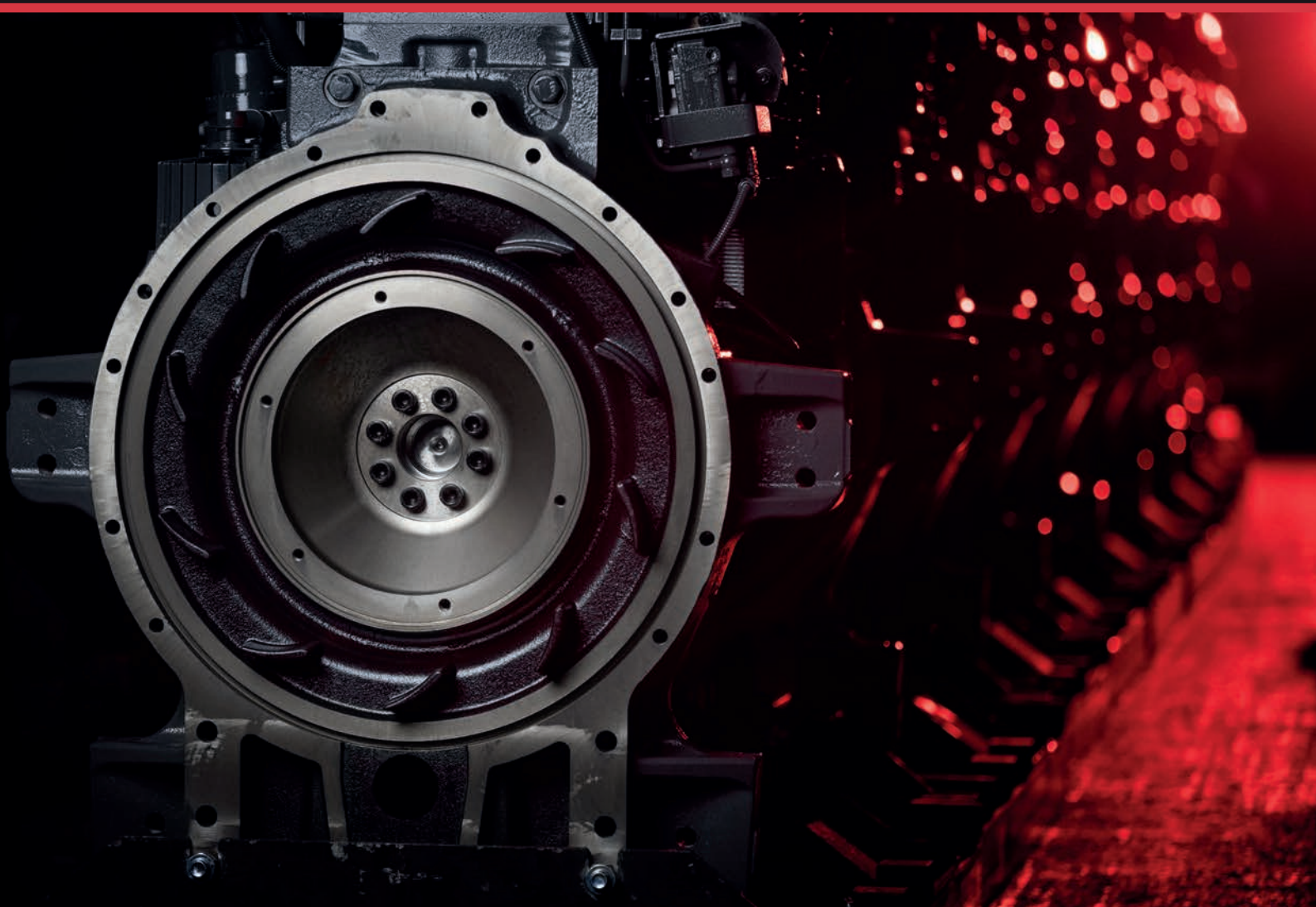


Farrell retirement prompts moves at Thompson Pump

Thompson Pump and Manufacturing Company has reported the retirement **John Farrell (left)**, vice president of Sales and Marketing. His departure has seen the company promote Bobby Zitzka to the position. Pat Broderick has moved into the National Sales Manager role.

Farrell had been with Thompson Pump for 38 years. Starting as a purchasing agent, he went on to become purchasing manager and regional sales manager. In 2002 he was promoted to VP of Sales and Marketing.

Bobby Zitzka (left) has been appointed vice president, Sales and Marketing. Zitka has been with the company since 2002 and most recently was promoted to National Sales manager in 2013. He has worked with Farrell to learn about the distribution network and national accounts and later went on to close the largest sale in company history. He is also part of Thompson Pump's Executive Management team.

Pat Broderick has now taken over as National Sales manager. He has been with the company for 20 years and has held a variety of roles. In 2007 he was promoted to regional manager for the entire Midwest and West Coast regions territory.

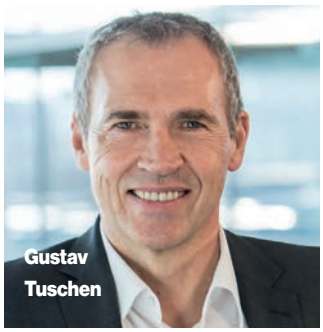
Klein assumes production, engineering roles at Daimler Buses

With the upcoming retirement of the previous head of Product Engineering at Daimler Buses, the division is to merge the two central management areas. Michael Klein will assume overall responsibility for Production and Product Engineering at Daimler Buses on April 1. Gustav Tuschen, who has been in charge of Product Engineering at Daimler Buses since 2013, will retire at the end of March after more than 30 years with the Daimler Group.

"In order to do justice to the transformation in the best possible way, we have decided to combine our Production and Product Engineering management areas under the leadership of the previous head of Production," said Till Oberwörder, head of Daimler Buses.

Michael Klein, Daimler Buses

He went on to thank Tuschen for his service: "We would like to thank Gustav Tuschen for his outstanding commitment, his perseverance in implementing new technologies with a high level of personal commitment. We wish him all the best in his next chapter of life." **dpi**



Gustav Tuschen

Cummins names Wiltrout VP of Corporate Strategy

Cummins has named Jeff Wiltrout vice president, Corporate Strategy, effective immediately. Wiltrout had served in this role on an interim basis since the departure of Thad Ewald in 2021.

"I am thrilled to have Jeff take this role and I'm confident his experience and leadership capabilities make him the ideal leader for this work," said Tom Linebarger, chairman and CEO, Cummins. "During his career at Cummins, Jeff has demonstrated excellence in leading critical strategy projects, while building trust and developing strong teams around him. It is an exciting and pivotal moment in our history given the technology and industry transitions that are taking place and Jeff will help us continue to grow and be successful."

Wiltrout has been with Cummins since 2009. **dpi**

Jeff Wiltrout, Cummins

Sifferlen, Jeanniton, receive new Cummins roles

Cummins has named Mark Sifferlen as the company's first vice president, Chief Risk Officer and leader of Environmental, Social and Governance (ESG) Strategy for the company, effective 1 February.

Mark Sifferlen, Cummins

"I am thrilled to have Mark take this new and important role for our company," said Sharon Barner, chief administrative officer.

The company has also named Schuyla Jeanniton executive director, Ethics and Compliance. Jeanniton will also serve as the chief of staff and quality lead for the chief administrative officer (CAO) organisation.

Jeanniton joined Cummins in 2010 and has held a variety of senior positions. **dpi**

DEALERBITES

→ **Total Energy Systems**, Green Bay, Wisconsin-based supplier of critical power solutions in the upper Midwest region, has been named as an authorised distributor for Gridiron onsite power generation systems.

Products from the company, which is based in Houston, Texas, include the PowerPlant H24 micro combined heat and power (mCHP) unit. This hardware can run on either renewable natural gas, natural gas, or propane. It is designed to simultaneously power space and water heating systems, which helps to eliminate waste through transmission and distribution systems.

→ **CNH Industrial** is to implement a rental and used equipment programme with its Case Construction dealers, focused on North and South America, Europe, South Africa and New Zealand.

Dealers will be encouraged to rent from across the entire portfolio of Case equipment, ranging from skid steers to 35-tonne excavators. They will also look to sell certified used Case machines.

Caterpillar has introduced self-service options for customers preferring to carry out their own routine maintenance.

The kits will cover common repairs across 300 models.

Yanmar develops maritime fuel cell powertrain

The Yanmar hydrogen fuel cell boat near the Rainbow Bridge, Tokyo

Strategies to reduce greenhouse gas (GHG) emissions are being drawn up around the world. As it stands, 123 countries have agreed to target net-zero GHG production by 2050. Hydrogen is expected to play a considerable role in this switch from fossil fuels to sustainable power.

The International Maritime Organization adopted a GHG reduction strategy in 2018 with the aim of achieving zero emissions across international maritime transport at the earliest possible date. Within that, there was a pledge to reduce emissions per unit of transport by at last 40% by 2030, while also reducing total GHG emissions by a minimum 50% by 2050 (both based on 2008 levels).

To help support these goals, Japanese power specialist Yanmar has developed a hydrogen fuel cell technology specifically for maritime applications. The fuel cell project was carried out with the support of various governments, local authorities and private corporations representing the related industries.

PROJECT PREPARATION

Speaking about the project, Takehiro Maruyama, member of the New Power Source Group, Fundamental Technology Research Center, R&D, Innovation and Technology division, had this to say about the development project's background.

"From 2015 to 2017, Yanmar was part of project to research the development of 'Safety Guidelines for Hydrogen Fuel Cell Ships'. Then we joined a project to develop a 'Roadmap for

"Fulcrum bridge supports engine braking and HLAs."

By HILKO SCHMITT, Jacobs Vehicle Systems

Unlock full braking potential

A new technology has been developed for off-highway vehicles which makes it possible for heavy-duty diesel engines to use both engine braking and hydraulic lash adjusters (HLAs, also known as valve lifters), two features which were previously incompatible.

Called a fulcrum bridge, the new feature was developed by Jacobs Vehicle Systems. In addition to the performance benefits, the technology reduces engine servicing requirements, vehicle downtime and total cost of ownership.

Engine brakes give heavy vehicles control while travelling downhill, while also helping to reduce wear on the mechanical braking system. At the same time, HLAs are desirable because they eliminate the need to manually adjust the valvetrain to achieve the required mechanical clearance between the valves and camshaft, known as the lash settings.

HLAs automatically adjust the clearance as it changes due to wear and tear, maintaining zero gap between the cam, rocker and valve. This ensures ideal functionality of the valvetrain and aftertreatment systems, while ensuring optimum performance of the camshaft over the full operating life of the vehicle.

Until recently, engine brakes and HLAs were an either/or choice, due to the way each system manipulates the valvetrain. The engine brake works by turning the power-producing diesel engine into a power-absorbing air compressor with a compression-release mechanism. This decompression device works by opening the exhaust valves near the top of the compression stroke, releasing the highly-compressed air through the exhaust system. Very little energy is returned to the piston, while as the cycle repeats, the kinetic energy of the vehicle's forward motion is dissipated. But when the engine brake valve extends to open the exhaust valve for brake operation it can overextend the HLA, putting valve-to-piston contact at risk.

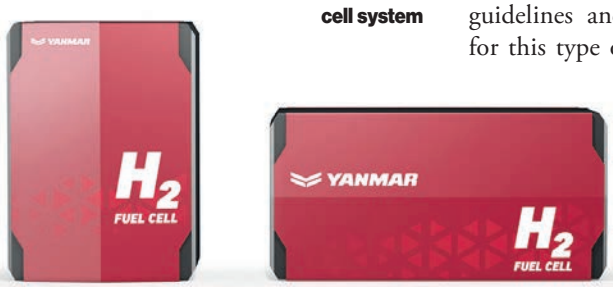
PREVENTS OVEREXTENSION

As a leader in vehicle retarding systems and valve actuation technologies for medium- and heavy-duty commercial engines, Jacobs Vehicle Systems has solved this issue with the new fulcrum bridge, a valve bridge which uses leverage to mechanically prevent the HLA from overextending during engine braking.

Deployment of Hydrogen Fuel Cells for Maritime Applications', funded by the [Japanese] Ministry of the Environment. Building on these experiences, we started a project to develop and test a maritime hydrogen fuel cell system in 2019."

The Yanmar system uses components from a Toyota Mirai fuel cell electric vehicle. But that is only part of the solution, as Maruyama explains: "To build a demonstration test boat, we almost had to develop a whole new boat. We had to develop an electric powertrain that not only included the fuel cell system but also other components, such as lithium-ion batteries, a motor and power management software. We also designed a new hull and the boat required a special hydrogen refuelling facility."

300 kW-class maritime hydrogen fuel cell system



Difficulties with designing the hull included having to take into consideration factors such as operating temperature, weight, vibration characteristics and the intended use of the vessel.

BUILT-IN SAFETY

Another team member, Yukihiko Kimura, Marine Group, Solution Development Division, Yanmar Marine International Asia, explains more about how the project came together.

"The components of the powertrain are quite different from the conventional diesel engine-powered boats, which are designed in a matured and standardised processes. In the case of the fuel cell demonstration boat, there were many components that had to be installed and work together, such as fuel cell systems, motors, inverters, power distribution boxes, battery packs and hydrogen tanks.

"There was no standardised process to design fuel cell-powered boats, but even so, we had to ensure the safety of the boat in any operating conditions in the field."

Continuing, Kimura explains that some of the guidelines and requirements were "not realistic" for this type of boat. He says that it was difficult to install the eight hydrogen fuel tanks within guidelines outlining clearances from the side and bottom of the boat to ensure the tanks were not damaged in a collision. With a laugh, he says that he even considered mounting them on the cabin ceiling.

REFUELLING TEST

With the tanks successfully installed under the deck, the boat received type approval from the Japanese Craft Inspection organisation and testing commenced in March 2021. The 38-foot (11.5 metre) boat achieved speeds of up to 20 knots, all without the noise and related emissions of a diesel engine.

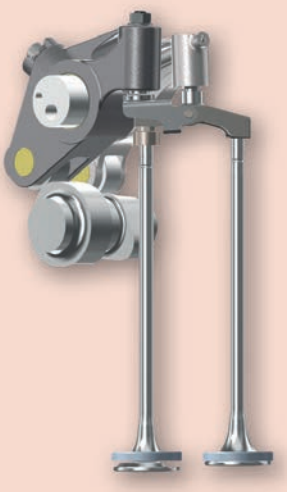
"It's very quiet," explained Kimura. "Acceleration is quite good compared to a diesel powered boat due to the different features of the electric motor. I think passengers will appreciate the comfortable ride."

In October, the team completed the first high-pressure ship refuelling in Osaka Bay, using a 70 MPa high-pressure hydrogen refuelling station, described as the world's first for this type for a maritime application.

Having completed initial tests, the team will now look to reduce the overall weight of the boat by making the fuel cell systems and components lighter and more compact. It is hoped that the 300 kW Maritime hydrogen fuel cell system can be brought to market in 2023. **dpi**

14>

Jacobs Vehicle Systems' fulcrum bridge technology



This is accomplished by actuating the braking valve slightly off its centerline and diverting a portion of the braking load to the HLA via a linkage mechanism. The brake valve tip is used as a fulcrum point to deliver an upward force through the bridge, keeping the HLA in its optimal operating position.

The fulcrum bridge makes it possible for almost any engine brake design to be complemented by HLAs. This offers a series of advantages for off-highway vehicles. For example, if an engine doesn't have HLAs, it can be awkward to manually adjust the lash settings. Further to this, aftertreatment systems, turbochargers, or ancillary components can often obstruct access to the valve cover, adding time to vehicle maintenance and downtime.

Additionally, manual adjustment to these settings is notoriously prone to error, which can negatively affect engine performance. And if this work is done in dirty or dusty environments, there's the risk of introducing dirt into the valvetrain, which can lead to catastrophic engine damage.

By eliminating these problems, fulcrum bridge will allow off-highway vehicles to have the safety of engine braking while also enabling the engine to work better for longer at lower cost, with less time spent in the service bay.

Sensor Technology delivers improved torque measurement

Sensor Technology has extended its range of non-contact torque sensors. The sensors can take readings of between 200 mNm and 13,000 Nm. The units are accurate to +/- 0.1% and have resolution to +/- 0.01% of the transducer's full scale.

Based in Banbury, Oxfordshire, Sensor Technology had been producing wireless torque sensing units based on detection of surface acoustic waves, but the new sensors, designated SGR510 and 520, use a four-element strain gauge bridge design.

"The new sensors have the advantage that they can accurately measure and record sudden spikes in torque load," explained sales manager Mark Ingham. "In the past this data was generally not required by plant and machinery operators, but with the growth in automated continuous monitoring it is becoming more and more important. Any torque spike could have an immediate effect on operations, while a series of them may indicate the beginnings of a problem."

The new design also compensates for any extraneous forces, such as bending, inadvertently applied to the sensor. In addition, the units have improved sensitivity and a wide temperature tolerance. As with continuous monitoring, these are features which have become increasingly desirable, to support sophisticated modelling of operational performance.

Range extension for innovative wireless torque sensing

TORQUE SENSING

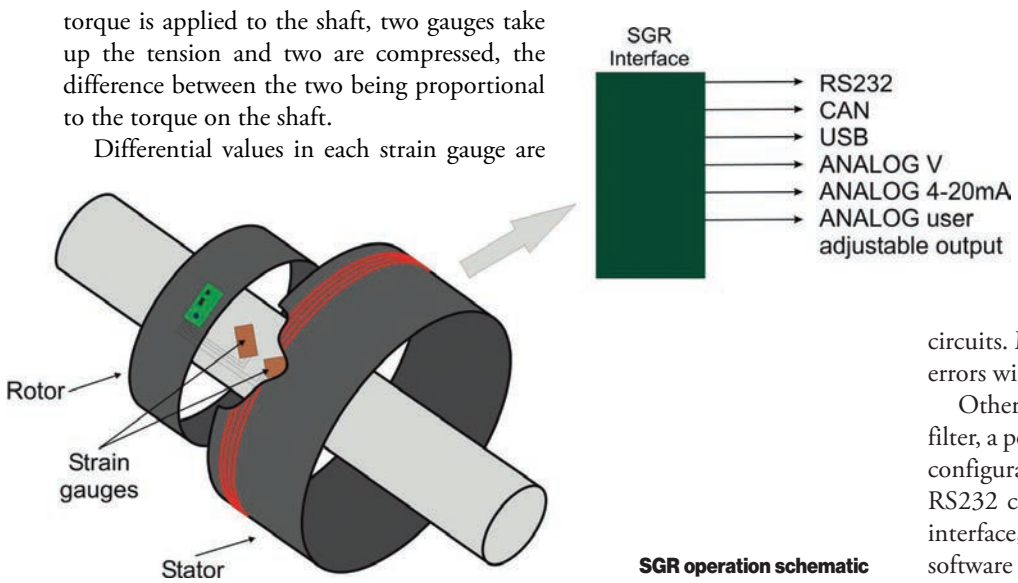
In use, four strain gauges are glued to the shaft which is being monitored. They are set in a square formation at 45° to the axis of rotation. When torque is applied to the shaft, two gauges take up the tension and two are compressed, the difference between the two being proportional to the torque on the shaft.

Differential values in each strain gauge are measured by an ultra-miniature microcontroller mounted on a rotor. Powered by an inductive coil, it relays results to the stator via the same coil. Strain gauge signal conditioning techniques are used to convert the raw digital data into torque value measurements. The setup provides high bandwidth, over range and overload tolerances.

Further advantages of this design include elimination of noise pickup and signal corruption associated with slip ring and other analogue data transfer methods. The over range capacity means true values are taken, instead of 'maxing-out' at the hardware's upper limit. The 400% mechanical overload limit is unlikely to be breached in the majority of applications.

Ingham: "External noise pickup into the wiring is virtually eliminated due to the short distance between the strain gauges and the rotor's measuring circuits. Multipoint calibration reduces any linearity errors within the sensor."

Other features include adjustable moving average filter, a power supply ranging (12 to 32 V DC), user-configurable analogue output voltages, a choice of RS232 communications, USB interface, CAN bus interface, external Ethernet gateway, TorqueView software and LabView virtual instruments. **dpi**



SGR operation schematic

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TURKISH START-UP MODÜLER MAKINA HAS UNVEILED ENOCH, A NEW MACHINE CAPABLE OF COMPLETING A RANGE OF TASKS. BY **ROBERTA PRANDI**

The Swiss Army knife of off-road vehicles

ENOCH (which stands for electric, next-generation, operational, commodity handler) is a multipurpose battery-electric or hybrid off-highway machine that can transform into seven or more different vehicle types through the addition of modules and peripheral equipment. Standardised couplings allow the hardware to be quickly fitted to the main platform.

Mansuri Çaynak, founder of Modüler Makina, the startup behind the ENOCH concept, explains that his company was established in 2017 with the aim of developing this new concept.

innovations delivered from the headquarters in Teknopark Istanbul, Turkey, has already won industry recognition, including the Seal of Excellence from the European Commission in 2019, a gold medal from the Istanbul International Inventions Fair in 2021, and another gold medal from the Zagreb International Exhibition of Inventions in 2021.

"ENOCH delivers a disruptive solution that will revolutionize the way in which off-highway machinery is built, stocked and used," says Çaynak.

PLATFORM PLUS

The machine is based around a four-wheel drive platform which serves as the remote-controlled heart of the unit. Modules can be added to this platform, including a cab, a gen set, a hydraulic pack and additional batteries.

The platform's powertrain is based around a Dana TM4 – HV1200 electric traction motor delivering 100 kW (160 kW peak power) and 520 Nm continuous torque (1200 Nm peak torque). The motor is connected via a cardan shaft to a Dana 360 two-speed transmission which delivers drive to a pair of Dana 212 steering axles with limited slip differentials.

The removable Imecar LFP 600 V li-ion battery pack has 65 kWh of energy storage. A removable tray holds all the power electronics: Dana TM4 inverter for the electric traction motor; 22 kW onboard charger; DC-DC converter from 600 to 24 V; an Imecar battery power distribution unit; and an Arcon T7 remote system.

Electro-hydraulics rated at 24 V are also mounted using a removable tray, allowing easy assembly and servicing. This drives the safety critical components, including steering and brakes. An 8 kW Schabmueller powerpack feeds the system, while the main steering valves are Danfoss EHI PVED-CLS. In addition to powering the dozer blade or outrigger, the system will kick in if there is a failure in the high-voltage battery circuit; using this power source the safety-critical hydraulics can operate for up to two hours.

A separate 600 V hydraulic module is also available to supply oil to the hydraulic equipment mounted on the platform. It uses the same TM4 traction motor (limited to 70 kW) with a cast-iron Hema QS5 helical gear pump. The variable flow system operates at 250 bar with a 170 L/pm flow rate. The equipment features AKON SPV 120 CAN bus load-sensing sectional valves.

"In battery-electric mode and on a medium-duty working cycle, ENOCH can operate for up to a day," says Çaynak. "When the vehicle is used for high-duty cycles, for example as an agricultural tractor, and is operating in a remote location without possibility of recharging the battery, ENOCH can be used in serial hybrid mode, thanks to a gen set module powered by a Perkins 404-D 22T diesel engine with 44 kW power output. When used in hybrid

Modüler Makina remote control

Modüler Makina's ENOCH, with various attachments

ENOCH platform can support a variety of hardware attachments

mode, the vehicle saves up to 50% on fuel."

EASY ASSEMBLY

With an operating weight of six tonnes, ENOCH can travel at speeds up to 12 or 40 km/h (dependent on power source). It is suitable for all terrains, having a high ground clearance and three different steering modes. In addition, the machine has a range of interchangeable implements for completing different jobs: a telehandler boom, a wheel loader bucket, a tractor lift, a crane, a sweeper and an aerial platform. All can be operated hydraulically or electrically.

"Assembly of the machine is pretty easy as each module and additional implement is placed and attached to the platform using quick couplings," says Çaynak. "The electronic control unit automatically recognizes the attached components and performs the correct set up to ready the machine for operation." He adds ENOCH can be transformed from an unmanned to a manned vehicle by installing the cab.

There are three main places to mount the equipment: on top of the platform, which is more suitable for truck-mounted equipment; in the front mounting section, after removing front cover, which is more suitable for loaders, tractors and similar machines; and in the back of the platform, after removing the back cover, which is the location for telehandlers and crane attachments.

Çaynak points out that the optional equipment for the basic machines (loader, tractor and telehandler) have been designed by Modüler Makina. Other truck-mounted components can be sourced from external suppliers and fitted with small modifications. This supports the possibility of creating an almost endless variety of vehicles. "Our solution is not seven separate machines, or more, but a single platform that can be turned into different machine types without compromising power and working capacity," he says.

ENOCH uses drive-by-wire technology with no mechanical or hydraulic link between controls and equipment. This drive architecture enables remote control of the machine, which is offered as standard, or autonomous operation, which is especially attractive for agriculture or even hazardous disaster zones.

According to Çaynak, ENOCH addresses several challenges related to the purchase and operation of off-highway mobile machinery, including high production, stock and logistic costs, the need for skilled operators, and the reduction of exhaust emissions and noise. "The future is in the simplification of machinery," he says. "ENOCH is multi-functional, like Swiss Army knives."

Logistics and storage costs are also lower thanks to in-built modularity. Customers need only buy the components and implements that are needed, which can be shipped as separate modules.

Calculations by Modüler Makina highlight the potential for reduced operational and maintenance costs. For example, a telehandler runs an average 1900 hours per year, using 13,300 L of diesel valued at about €20,000, plus €5000 for maintenance. Taking advantage of ENOCH's serial hybrid configuration, both fuel and maintenance costs can be reduced by up to 50%, delivering an annual saving of about €12,500.

"ENOCH's true modularity, with the use of independent modules, will support short lead times, a major benefit for machine dealers and rental companies," comments Çaynak.

RESPONSIVE SOLUTION

The ENOCH concept has been through several tests, including powertrain specifications and calculations. Digital Twin was used for realistic powertrain simulations, together with electro-hydraulic steering, brakes, batteries and their control systems. Human-machine interface tech was integrated into the control unit, while realistic field conditions covered temperature, load, gravity force and slope combinations.

All the control algorithms are developed by Moduler Makina, with a brand-independent design. All selected components have already been field tested. Hardware- and software-in-the-loop tests have been completed to ensure the various components and control algorithms work in harmony. Dynamic responses were also analyzed.

Çaynak reports that a prototype of ENOCH has undergone remote-control tests. Further field tests are currently in progress.

"Independent modules will allow a new level of responsiveness to customers, with unprecedented short lead times for clients, dealers and rental firms," he says. NPP

Cell regeneration

BATTERY CELL MANUFACTURER STOREDOT HAS DEVELOPED A PROCESS FOR EXTENDING CELL LIFE. **JULIAN BUCKLEY** SPEAKS WITH COMPANY CEO **DORON MYERSDORF** TO FIND OUT HOW IT'S DONE

As battery-electric vehicles (BEVs) gain greater penetration across global markets, questions about battery pack longevity remain. Issues include how much the maximum charge of a lithium-ion pack (and the available working hours) will decline year-on-year and how that will affect vehicle resale values are just two points.

Such concerns are well placed. Not only do battery-electric vehicles represent a greater level of capital investment than a diesel equivalent, but the battery pack is far more expensive than any single component in a vehicle using internal combustion.

While not in the commercial or off-road sector, in late 2021 a series of media outlets reported that an owner of a second-hand Tesla Model S had been quoted $22,500 for an OEM replacement battery pack (85 kWh) after the car had gone out of warranty. This represents about 25% of the car's original sale price.

There are some basic recommendations to maintaining a li-ion battery pack. These include operating the vehicle at optimal temperatures; like many people, packs perform best at an ambient air temperature of about 20°C. It is also recommended that packs are not drained to zero and are plugged in for a recharge at no less than 10% capacity. But even when such guidelines are followed, li-ion battery cells can still have problems due to the fundamental chemistry.

That is where new technology developed by StoreDot comes in. Based in Tel Aviv, Israel, the company has devised a system which can refurbish one or more battery cells in a fully-automated process.

"After about 1,000 or 1,500 charging cycles, a battery cell will naturally drop to about 80% of its original capacity," says Dr Doron Myersdorf, CEO of StoreDot. "But some show problems even earlier, with excess heat, a loss of capacity or increased resistance being the red flags."

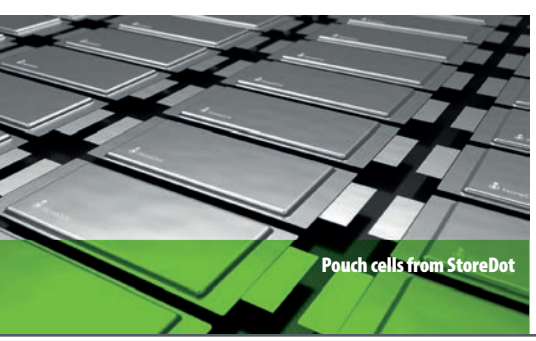
He goes on to explain that information covering cell condition is already stored in the battery management system (BMS). A proprietary StoreDot module coded into the BMS allows the system to access that data and identify a cell (or a string of cells) demonstrating an issue. The system algorithm then decides which cells should be taken offline to undergo the patented refurbishment process.

BATTERY REFORMATION

Myersdorf explains more about the process. "First, there is a deep discharge of the cell. At the same time any lithium in the silicon anode is extracted and stored in the cathode. Then over several hours the battery is slowly recharged in a process similar to reformation. This reconditioning brings the cell back to a like-new state. This can be done to one cell or a string of cells, dependent on the configuration and architecture of the pack. It just requires a dedicated circuit which allows us to bypass the cell or string while the formation process is ongoing."

The regeneration process can be carried out while the vehicle is in motion or parked and charging. Further, the driver will not notice the process as power output from good cells can be increased to compensate for those taken offline.

Myersdorf says the process does not damage the cell but acts more as a refresh that ultimately results in optimal balance of the battery pack. In general, any battery chemistry can benefit from the process.



Pouch cells from StoreDot

Dr Doron Myersdorf, StoreDot

NEW CELL PRODUCTION

While StoreDot is behind development of the individual cell maintenance process, the company's core business is production of individual cells used to assemble complete battery packs. Acting as a Tier 2 supplier, the company is creating a network of production sites around the world, including one in China (in cooperation with EVE, one of the top 10 battery producers in the country), together with other locations in Italy, the UK and the US.

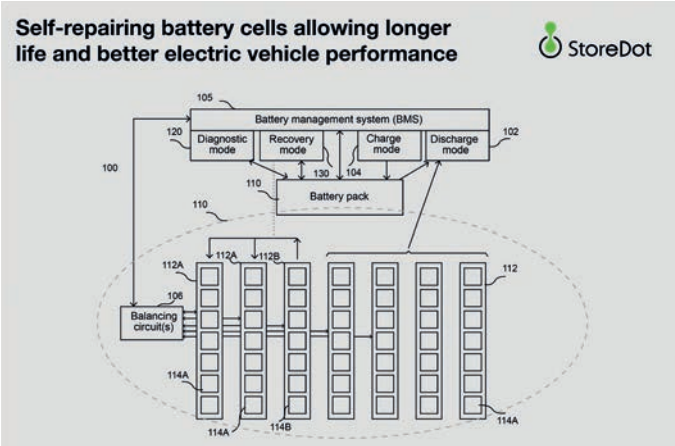
"We're trying to get cell production joint-ventures in areas where vehicles are being made so it's cost-effective to move the cells," says StoreDot CEO Dr Doron Myersdorf.

In the role of specialist cell manufacturers, StoreDot has also developed new battery cell chemistries. In one case, they have replaced standard graphite anodes with nano silicon, the reworked element being better able to support superfast charging.

Myersdorf picks up the story: "In a standard cell, a silicon particle will become inflated with ions. It grows like a balloon and then may detach from the anode structure. That's both an energy drain and a safety concern."

StoreDot cylindrical cells

He says that the StoreDot anode structure allows the particles to inflate but, using a proprietary organic compound and carbon for stability, the particles remain within the anode structure. This prevents energy drain, while the greater surface area of the nano-sized particles supports an increased rate of recharge.



Schematic of self-repairing battery cell process

In addition to improving overall vehicle performance, reconditioning of the battery cells can be considered a safety feature. Myersdorf says that increasing resistance in the cell creates heat and that can be a fire risk. He adds that the patented reformation process improves the safety margin by reconditioning the higher-resistance cells.

The system then monitors cells which have completed the regeneration process. If they undergo the process three or four times without any significant performance improvement, that cell can then be permanently taken offline, effectively removing the hazard.

COST ADDS UP

Doron Myersdorf says that StoreDot can currently produce cells at $80 per kilowatt hour (kWh). The additional wiring in the battery pack to support the regeneration process adds approximately 50% to the cost of the original loom. In total, this adds between 2 or 3% to the cost of a standard battery pack.

"But the regeneration process can add a further 20% to the pack life," he points out. "The real cost has to be worked out using total cost of ownership. If you extend the energy throughput of the battery pack, then that additional cost is easily amortised in the price. Then you have to consider the reduced frequency of replacement and the related environmental benefits."

Further benefitting the environment is that the cells do not use any rare earth metals. Asked if he is concerned about the rising cost of lithium, Myersdorf says that it's just a problem waiting to be solved.

"Lithium cost is an issue, but overall it's a small fraction of the entire cost of the cell. Cobalt, which has significant supply chain issues, has almost been eliminated from advanced chemistries. Costs of elements will go up and down, but I'd be more concerned with the cost of metals, nickel and manganese."

The regeneration process is not limited by pack size, so could be applied to larger packs used to power commercial vehicles or even battery generator sets. But Myersdorf says he thinks battery pack weight considerations will see the sectors use a mix of battery and hydrogen power, dependent on application.

Will the regeneration process be made redundant with the advent of solid state batteries? "I don't believe so," says Myersdorf. "There are still issues with degradation and cycle life in solid state. Moreover, current solid state technologies require precise pressure and temperature control in the pack, resulting in possible non-uniform cell behaviour. Reformation can help optimise the balance of the cells, resulting in a similar energy throughput increase." NPP

Preparing for the

OEMS AND TIER COMPANIES ARE PARTNERING UP WITH SPECIALISTS TO ENSURE THEIR PRESENCE IN AN INCREASINGLY ELECTRIFIED MACHINE MARKET

At the end of last year and in the first month of this, a series of OEMs and Tier suppliers announced investments in battery suppliers and related specialists. The following is a roundup of these stories, as published on the Diesel Progress and New Power Progress sites.

At the end of November last year, diesel engine manufacturer Cummins announced that it had entered into an agreement with Sion Power that would see the Tucson, Arizona-based company using its Licerion technology in cells delivered for electrified applications. As part of the deal, Cummins would take a minority stake in Sion, although no figures were released.

Cummins put forward that the large-format battery cells would go into packs destined for integration into its commercial vehicle powertrains. The related statement added that the cells would play an important role in Cummins' future roadmap to electrifying its commercial vehicle portfolio.

In December, Deere & Company, the brand behind John Deere machines, signed an agreement which would see it acquire a majority stake in Kriesel Electric. The Austrian battery technology provider is a specialist developer of high-density, high-durability battery packs and modules.

John Deere put forward that the move came on the back of a growing demand for batteries across the company's hybrid and battery-electric off-highway products. A range of machines produced by Deere feature pure electric powertrains, including compact utility tractors, small tractors, compact construction and some road building equipment.

Also in December, German engine OEM Deutz revealed that, after completing its related due diligence, the company would be making the first of two planned share purchases in Danish fuel cell specialist Blue World Technologies. While fuel cells use a hydrogen/oxygen reaction to deliver electrical energy, that power is generally transferred to a battery pack before being delivered to the end equipment – in this case, Deutz plans to develop the fuel cells for gen set applications.

NEW YEAR, NEW BUYS

The pre-Christmas electrical specialist buying spree continued after the holiday break when in January, German engine technology provider BorgWarner revealed that it was the lead investor in a Series-C capital raising initiative by California-based Qnovo.

From its headquarters in Silicon Valley, Qnovo delivers software and controls related to measuring battery health (charge rate,

INCREASING COMMODITY PRICES MAKE BATTERY RECYCLING VIABLE

The Financial Times has reported that prices for lithium carbonate, the ore which delivers the pure lithium metal used in production of li-ion batteries, have undergone a dramatic increase. At the close of 2021, the per-tonne price of the material had reached a record $41,000. This is five times the price of just 12 months earlier.

Prices of materials used in battery cathodes have also been rising. Cobalt values have doubled since last January to about $70,000 per tonne, while nickel prices have increased approximately 15% to $20,000.

Lithium-ion battery cells are used across a variety of tech. But electric vehicles pack the most cells into a single unit. Using a lithium iron phosphate chemistry, a battery pack – or Energy Storage System - in a Tesla Model 3 has 2,976 individual cells.

It is estimated that an average 70 kWh battery pack requires about 63 kg of lithium carbonate, which translates to about 12 kg of lithium metal across all of the cells.

The prices of battery cells had been steadily dropping over the past decade, primarily due to volume production by such companies as Tesla, LG Chem and Panasonic. But the increasing cost of raw materials will likely see cell prices start to trend upwards.

With the increasing volume of EVs, this is unlikely to be a temporary blip in commodity prices. According to S&P Global Markets, demand for lithium carbonate reached 497,000 tonnes in 2021. Demand over 2022

is forecast to reach 641,000 tonnes. Supply has been further complicated by the closing of some lithium mines in Australia in 2020, ironically due to low prices, while companies in China have had problems with staffing due

electric future

Iveco Bus Crossway LE Electric will use Microvast technology

capacity, etc.) and hardware to support fast charging. The investment would see BorgWarner extend its available range of battery solutions for OEM customers, with the target of improving battery management and with that the related appeal of electrified powertrains.

January saw a further direct OEM investment in a battery manufacturer when Italy's FPT Industrial, powertrain supplier to Iveco Group, partnered with Microvast Holdings, a provider of battery technologies for commercial and specialty vehicles.

FPT stated that it would lead development of mechanical and thermal integration of packs produced using cells and modules delivered by Texas-headquartered Microvast, with those packs being applied to such vehicles as its Crossway buses and the Iveco e-Daily CV. The e-Daily, which is expected to launch at the end of this year, will use a modular battery format using between one and three packs.

Speaking about the deal, Sylvain Blaise, president, Powertrain Business Unit of Iveco Group, said: "This collaboration with Microvast underlines our commitment to become a multi-power technological leader and provides us with competitive advantages in the market."

That statement effectively sums up the strategy in play across all these acquisitions. While battery-electric applications currently comprise a very small percentage of all customer purchases, these companies see where we are now as just the starting point in a market which will become increasingly electrified.

While not completely foregoing legacy products related to internal combustion, these companies appear to be preparing for a new future where you're either delivering electrically-powered products, or you're losing market share.


Dismantling an EV battery pack at Stena Recycling plant

to COVID and energy shortages.

Beyond personal transportation, this is bad news for a those manufacturers looking to launch commercial vehicles and buses using battery-electric drivetrains.

A series of companies are now planning to launch battery recycling centres. In the UK, French resource management company Veolia will open one such facility which it says will be able to process approximately 20% of the country's end-of-life batteries by 2024.

Located in the West Midlands, near Birmingham, the plant will dismantle batteries in advance of a chemical recycling process to separate out the reclaimed materials.

MOST ADVANCED FACILITY

In another case, Sweden's Stena Recycling has invested SEK250 million ($27 million) in what is described as 'Sweden's and Europe's most advanced battery recycling facility'. Located in Halmstad, the plant will recycle batteries from EVs as well as consumer goods. The site is expected to be operational in the first quarter of 2023.

"Battery recycling is a fast-growing challenge in society and there is stricter legislation coming from the EU. In a few years this is likely to be a significant part of our business," commented Kristofer Sundsgård, CEO with responsibility for Stena Recycling's operations in seven European countries.

"With our size, infrastructure, customer base and expertise, we have all the prerequisites to become one of Europe's leading players in battery recycling so that the materials in used batteries can become circular raw materials for the production of new ones," he added.

The issue with recycling has always been whether it was financially viable. In the case of plastics, chemical and mechanical recycling of plastics creates a virtuous circle, but in most cases the cost of recycled product is higher than that of virgin material.

Increasing raw material values, ballooning OEM demand and the environmental impact of mining and shipping lithium carbonate means we will soon hit that sweet spot where battery recycling and reclaimed material starts to make financial sense.

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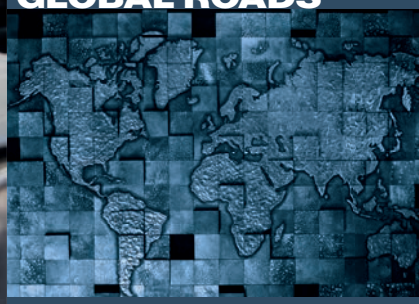
Could anything be possible now Daimler Truck is an independent company?



ABOUT THE AUTHOR

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Expect the unexpected

With the spinoff of Daimler Truck and Iveco Group, our correspondent believes that nothing is impossible.

By **Oliver Dixon**

Conglomerates occupy an interesting place in the automotive story. Historically, auto manufacturing began as a national endeavor and so national organizations developed to produce a wide range of vehicles; from passenger cars, through to vans, through to buses, through to heavy trucks. Heavily-verticalized organizations focused on a clearly defined national marketplace with its own national regulatory standards made a lot of sense.

National then begat regional, at which point in our trek through history things began to change. A demand for mass mobility added scale to passenger car production, leading to significant marketplace consolidation – albeit consolidation at a regional rather than a global scale. Mergers and acquisitions acted as a type of natural selection, further shaping these new auto industry iterations.

At this point things started to get rather more interesting. That which had been a fundamental assumption underpinning much of the strategic thinking behind the auto industry began to be questioned. Up until then, road-going vehicles had been seen as different sides of the same coin; different sizes and different applications for sure, but with wheels and an engine they were more alike than different. This made conglomerate manufacturing that much more attractive. But as markets got more sophisticated and regulations more onerous, so this illusion of similarity started to fade.

VALUE CYCLE

And so we move into the era of pure play manufacture where, with just a few exceptions, an organization either makes heavy or light vehicles. Here is the growing acceptance that the 'value cycle' is fundamentally different between the two operational types, while the trading cycle is likewise not amenable to comparison. Despite both possessing wheels and an engine, that is more coincidence than a compelling strategic driver.

With the listing of both Daimler Trucks and Iveco Group, the move towards pure play truck and bus has moved still further ahead.

It's entirely reasonable to argue that at least some of the momentum behind deconglomeration within automotive has been derived from extraneous considerations. But in reality, much of that momentum has come from within. That which was unthinkable within the industry only a decade ago is now not merely thinkable but also likely. Today is a future that consists of much that not so many years ago would have been regarded as heresy.

So perhaps now is a good time to contemplate a few more heresies. Change (electrification and decarbonization are two obvious examples) takes a while to arrive in the automotive segment. Now that change has arrived, the opportunity to wallow in a bit of long-term thinking shouldn't be lightly discarded. So perhaps it's a good opportunity to address a couple of fundamental issues. Where is the financial and the societal value to be found in today's truck manufacturer? Do these two values coincide or are they distinct and, ultimately, how best should they be optimized?

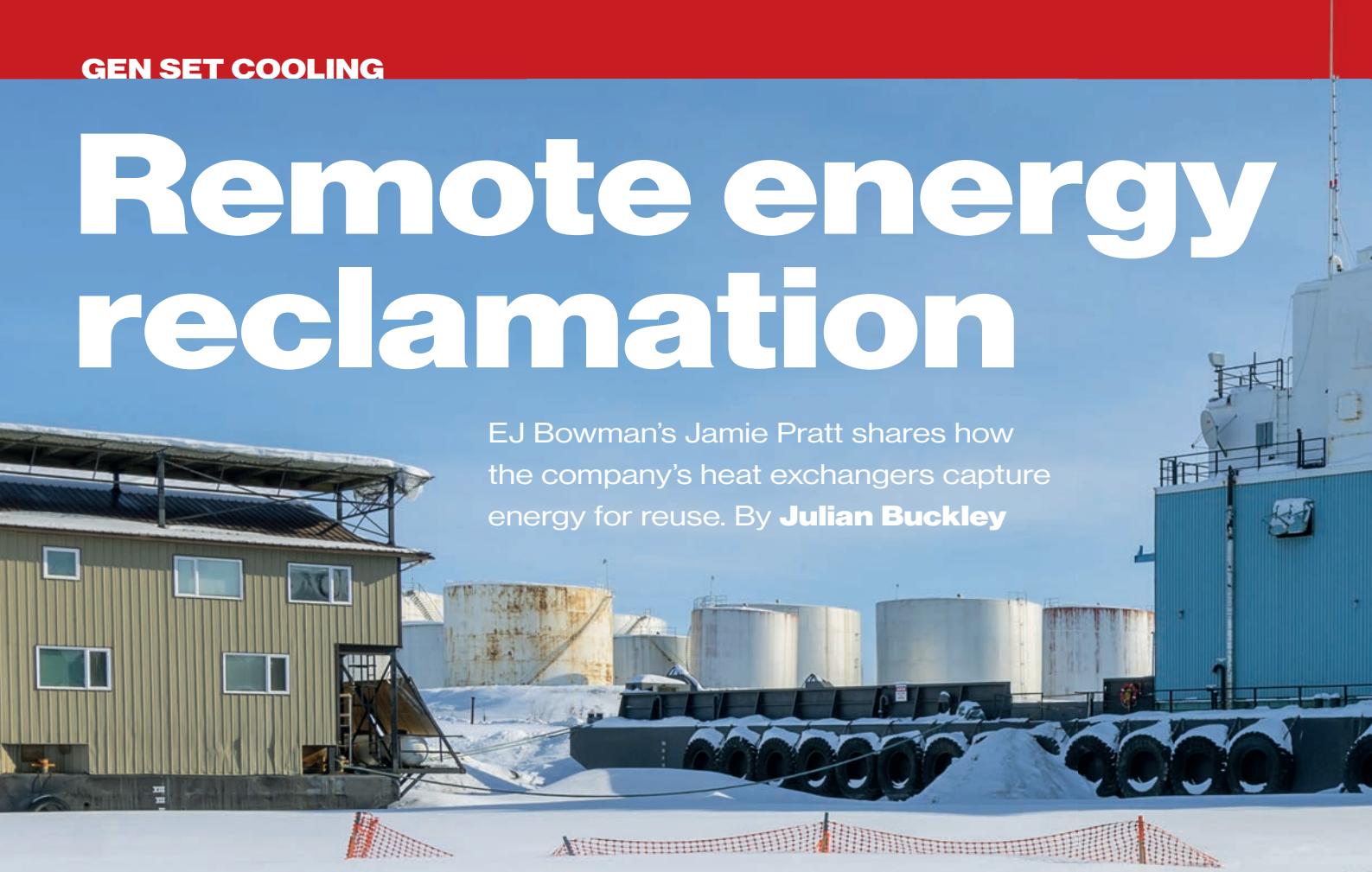
DISRUPTION AHEAD

Ultimately a truck's utility – and thus its value – lies not in what it is but what it does. Where value is a means of delivering freight and thus enabling commerce.

This seems to be a good starting point for further analysis. Should truck manufacturers regard their future as one where, instead of manufacturing the means to enable commerce, they take on the role of commerce provider? This scenario, where truck manufacturers effectively go into competition with a significant portion of their customer base, may seem radical in the early months of 2022. But a lot of what would have been – sorry, was – deemed impossible in 2002 has now proved to be entirely possible. The degree of disruption that now pervades our every day existence suggests that we would be wise not to discount any eventuality. **dpi**

Remote energy reclamation

EJ Bowman's Jamie Pratt shares how the company's heat exchangers capture energy for reuse. By **Julian Buckley**



As the short autumn turns to winter, the barges are frozen in place on the Mackenzie River. Located in Canada's Northwest Territories, the flotilla serves as the base for an oil and gas exploration crew operated by Horizon Marine. The camp, which can serve as home for up to 88 people, is hundreds of kilometres from the nearest town; in winter, access is only possible by helicopter or via trucks running over ice-covered lakes.

With temperatures dropping to -40°C, the working days are long, very dark and very cold. The Arctic Star camp is the team's only refuge and as such, power and heat are vital resources. The base is served by three 150 kW (270 hp) John Deere generator sets. These operate in parallel, with automatic controls starting and stopping the individual engines in response to demand.

EJ Bowman, a UK-based specialist in manufacturing heat exchangers, was commissioned to provide related hardware for the gen sets. The company delivered three header tank heat exchangers to cool and recover heat from the engine water jackets, plus three exhaust gas heat exchangers to recover waste heat from the exhaust stream.

MONEY MATTERS

Removing heat serves to cool the gen sets and keep them operating efficiently. That heat energy is then piped around the base to provide heating and hot water. It's a reliable solution which has been in operation for more than 12 years, or about 25,000 hours. Over that time, fuel costs at the Arctic Star camp have been reduced by about 33%, thanks in part to the combined heat and power (CHP) system.

Jamie Pratt, commercial director at EJ Bowman, says that while there are a range of strategies for cooling gen sets, the company provides solutions intended to make the most of all available energy. "It is possible to install cooling fans for a stationary gen set, but they would have to run almost constantly to cool the radiator. That means using power to drive the fans, while the heat energy is lost to the atmosphere. We try and recover that heat energy for another use."

He puts forward that for every £100 of fuel used in a gen set, about 30% of the total energy value goes towards generating electrical energy. Heat and hot air produced by the engines represents a further 50%, while 20% is due to other mechanical losses.

"An exhaust gas unit might recover around 55%

"There might be a large initial outlay, but under the right circumstances payback would be vey quick."

JAMIE PRATT, EJ Bowman

John Deere gen set with Bowman exhaust gas heat exchanger

The Arctic Star base camp, frozen in the Mackenzie River

[of the lost fuel value]. Header tank or shell-and-tube heat exchangers recover heat from jacket water, that's another 24%. Then you have turbocharger air and oil cooling, which might get you a further 21%." He adds that capturing the heat from moving engine parts will also serve to cool the engine, while reclaiming another £50 in otherwise lost energy.

In designing a CHP package, Pratt says that the goal is to recover as much of the waste heat as possible. That recovered energy can then be used in other applications.

"If you put heat exchangers on each part of the gen set that generates thermal energy (or losses), you can recover that energy and turn it into something valuable," says Pratt.

A high-efficiency CHP system comes at a cost, but Pratt says that has to be balanced with the performance and savings. Clearly the gen set needs cooling, whether that's with a heat exchanger or fan-cooled radiator. He says that an issue is whether there are enough uses for the reclaimed heat. In the case of the Arctic Star, winter heating requires all that energy. In summer, while the exchangers continue to cool the engines, heat recovery may be reduced or eliminated via bypass valves.

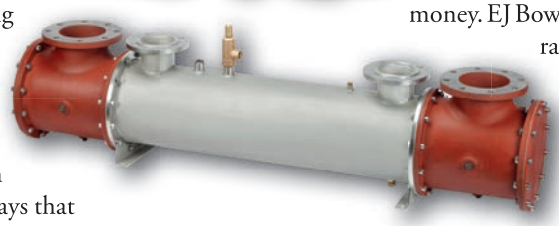
"If all the heat energy is not required all of the time, you might use just one exchanger instead of four," he explains. "Even with a full package there might be a large initial outlay, but under the right circumstances payback would be very quick." That decision should also consider the Capex for dedicated heating sources and the fuel needed to operate the traditional heating systems.

Asked if the heat exchangers bleed any power out of the system, Pratt notes that any losses would be minimal, almost too small to calculate.

"We calculate how the solution will affect the setup, ensuring that the units we supply for water/glycol, charge air, lubrication oil and exhaust gas all work together to provide maximum heat recovery, whilst also considering the flow rates, temperatures and pressure drop limitations of the engine. We have in-house selection software and experienced heat transfer engineers to help choose the right products for the complete system."

The exchangers themselves are effectively passive units, but dependent on system requirements the internal design can be changed to restrict flow or move fluid in a given direction to optimise performance.

KH300-4269-4 header tank heat exchanger



Bowman 1MW exhaust gas heat exchanger

MATERIAL PERFORMANCE

As might be suspected, material choice can alter the performance of the heat exchangers. "Traditionally, we have used copper, cupro-nickel or stainless steel, dependent on application. There's also titanium, which is less susceptible to wear, but it's more expensive. Material choice is dependent on application and required life expectancy of the unit."

The trend of engine downsizing has had minimal impact on the product range offered by EJ Bowman. "A smaller engine might mean that you change the size of the heat exchanger," says Pratt. "But whatever the engine size, we'll have something for it."

Being cost effective is key to the company USP, both in terms of products, efficiency and saving money. EJ Bowman offers heat exchangers for engines rated from 10 kW to 1 MW. Installed as part of a well-designed CHP package, the exchangers should last the lifetime of the engine. There are related environmental benefits, too.

"In the case of the Arctic Star, the heat exchangers support using smaller engines. That has helped reduce emissions," says Pratt. "Additionally, the exchangers allowed the base to stop using gas for heat, so that was an instant emissions reduction. While we don't directly reduce emissions, we support the packages creating solutions which reduce emissions."

Pratt says that beyond diesel, the company has been expanding its reach. "We're involved with electric and hybrid applications, particularly in the marine industry. We can cool batteries, chargers, electrical control equipment and motors, all the elements needed to power marine vessels." **dpi**

Tim Bound, Transtherm

Gen set coolers with header tanks

Cooling as required

Julian Buckley speaks with Transtherm's **Tim Bound** about fan-based gen set cooling

"When we first started the business over three decades ago, we would to sell anything to anybody," says Tim Bound, director of Group Sales and Marketing at Transtherm. "But we realised that was a flawed business model. We decided to sell only what we were manufacturing, the air blast coolers of different types, the dry coolers, adiabatic coolers, free coolers, together with pump sets."

Having successfully narrowed down the company product portfolio, Coventry, UK-based Transtherm now supplies closed-circuit, remote-mounted flatbed coolers, which can be mounted either horizontally or vertically to suit the application, and also V-coolers. The company delivers to OEMs and dealers (who create packaged solutions), and to various industries, including pharmaceutical, food and beverage, and aerospace. Unusually – but with unspoken necessity – the company also works with cremation firms.

Transtherm has also done a lot of work with data centres. These installations use a colossal amount of power, usually taken directly from the grid; such is the draw that they would sometimes need a dedicated substation. The grid supply would have been backed up with diesel gen sets, but Bound says that there has been a move to gas-fired gen sets as a primary energy source to take advantage of the efficiency and environmental benefits.

"An installation might have 10 gen sets as the main power source. Depending on the set up, that would require anywhere from one to a full 10 units as backup. Then those are backed up by the grid. Using the gen sets can fulfil related stipulations for using renewable energy, so it's attractive to the customer. In all areas, we're getting switched on to being green," says Bound.

COOLING SOLUTIONS

Transtherm is a specialist manufacturer of gen set coolers and pump sets. The company can package that hardware with a control system which is prewired and preprogramed to customer specifications. If a pump set is also being delivered, the system can be set up to use a single control panel.

"The idea is single lift, single power supply and single water connection," says Bound.

The type of gen set being used will define the cooling set up, whether that's a single, double or triple bank cooler. Bound explains more: "In areas where the grid is a bit weak, a gas-fired gen set could be used to support the power supply. In that instance all that matters is the power, it's a boost. They're not taking advantage of the heat, it's really just a safety net. So a double-bank cooler is fine."

Switching to a combined heat and power (CHP) installation can require a modified set up, says Bound. "If the jacket water heat is being recovered and put to use, there won't be any heat going to the jacket water heat exchange coil in the cooler. However, if we're still dragging air across those coils to cool the intercooler circuit, it will be massively overcooling the jacket circuit. In cases like this it's preferable to go to two single-bank coolers with completely independent controls."

Essentially, the best solutions deliver cooling as cooling is required. This is particularly important when dealing with larger gen sets, where net electrical output should be as high as possible with minimal parasitic draw from the cooling fans. To reduce this effect, Transtherm now exclusively offers variable-speed fans.

Bound says that these fans offer a series of benefits, including the ability to speed up and down independently or as a unit. He says that power draw is relative to the cube of fan speed. To put this in perspective, if traditional fixed speed fans were being used and half of them were being run at full speed the power draw is 50%.

"However, when using variable speed fans all of

Variable-speed fan set

them would be operating at circa 50%. If we cube 50%, that's 12.5% power usage. In cases of fixed speed fans that are on a stage control, 50% of the area won't be getting any direct cooling, it's redundant and an efficiency reduction. Drawing half of the air over the whole coil is much more efficient, meaning we can operate the variable speed fans at circa 45% rather than 50% to get the same cooling effect."

LOAD PROFILE

Bound says that the company uses other information to develop the most efficient cooling system. Local weather data, with a particular focus on high and low temperatures, is factored into the installation criteria to determine power draw at each degree of ambient air temperature. Those are multiplied by the frequency of ambient temperature to return an annual power consumption profile.

He says that the difference in load profile between fixed and variable fans is "staggering". And although Transtherm might not offer the cheapest solutions, Bound says that the company wins a considerable amount of business by delivering basic operational value.

"Depending on the tech, we will either look at the ROI in terms of how long it will take to pay off the difference in cost between our solution and that of a competitor, or in some cases we will just outline how long it will take to pay off the entire cost of our equipment. Often, that can be less than a year," he says.

The hardware supplied by Transtherm also supports flexibility in terms of gen set location, particularly when looking at diesel installations. Focusing on external remote cooling, the hardware can make or break plans to locate a unit within a limited space.

Coil access panels and leg mesh

"If a gen set has to go into a basement in central London because there's no other space, an engine-mounted radiator won't work. Instead, our coolers can be put on the building roof," says Bound.

In other cases, when mounted on the gen set container roof, space comes at a premium. If the gen set has a lot of hardware at one end, Transtherm can supply V coolers (single or double bank), which offer a much greater cooling density, allowing for a smaller footprint. These are of particular interest when there are fixed boundaries (walls, etc.) around the gen set.

Awkward site locations could see the external air temperatures increase by as much as 10°C above ambient and this information should be used when calculating cooler size.

Noise is another factor which can be added into the calculations. "The quietest equipment is no louder than room air conditioning, you might need to check if the machine is running," says Bound.

But he points out that while higher fan speeds can mean a greater amount of moving air, this also means a reduced amount of heat exchanger surface material is needed.

"There are a heap of factors determining how much heat you can remove, but the main two are material quantity and volume of air. Reduce the amount of air, you must increase the amount of metal. Some engine applications have a daytime and night-time noise requirements and that's another advantage of variable-speed fans, lower noise at reduced speeds - the noise drop off as the fan speed goes down is significant."

The biggest factor in successful cooling, says Bound, is getting the correct ratio of air flow and heat exchange material. "Taking into account fan speeds, the heat exchange coil for the high-temperature circuit has to be sized correctly. If there's not enough material, the engine will likely derate and possibly even trip." **dpi**

Pump sets

Any water-cooled system needs a pump set, as without the related water flow there is limited cooling effect. Compensating for pressure changes is critical to successful cooling, as Tim Bound explains: "We use pumps rated for flow and any pressure loss in the system. As water flows through the system, we need to allow for the cooler pressure drop, which is typically up to 1 bar, and the system pressure drop which is generally up to 6 bar."

In some cases the gen set will have its own built-in pumps. While these can reduce parasitic load, the generally low performance of these units requires a cooling system with a very low pressure drop. Alternatively, Transtherm can supply an external pump set which can offer higher performance, in turn allowing for higher pressure drop coolers that could save footprint and/or cost.

"Deciding which hardware to use comes under our consultative approach," says Bound.

Engineers at Transtherm will help and advise customers as much as possible, using their knowledge and experience, but Bound says that the company rule is to stop short of saying 'yes' when we should be saying 'no'. "This could include the need for customers to use experts in computational fluid dynamics, modelling water and air flow, if there are serious concerns about warm air recirculation."

New-tech wins at Agritechnica

Despite the cancellation of this year's Agritechnica trade show, which was scheduled to be held at the end of February in Hanover, Germany (the event will now be held 27 February – 5 March, 2023), the related Agritechnica Innovation Awards 2022 still went ahead.

Judges picked one gold medal winner, while 16 innovations received silver medals. The following roundup highlights some of those entries which took home commendations for their agricultural machinery.

AUTONOMOUS CARRIER

The gold medal winner at the Innovation Awards was the Nexat System tractor. This machine serves as a carrier vehicle which can be used for all crop production work, from tillage and sowing to crop protection and harvesting. Instead of hauling implements with a tractor, tillage and cultivation tools are carried, helping to improve overall efficiency.

The Nexat is designed as an autonomous machine, supported by a peripheral monitoring system. A cab which rotates 270° is available for process monitoring. The implements are mounted between four electrically-driven track units which can be rotated by 90° for road journeys. Power is supplied by two independent 400 kW (545 hp) diesel engines and related generators. The vehicle is also designed to accommodate alternative drives, such as fuel cells.

Gold medal winner - Nexat System tractor

Using the 14-metre version of the Nexat, 95% of the total field area will never be compressed by tyres, resulting in improved yield potential and good soil protection.

Fitted with the NexCo combine harvester module, the machine achieves grain throughputs of between 130 and 200 t/h. The flow of harvested material is directed into the rotor at a tangent to achieve improved energy efficiency, while a 5.8 metre axial rotor mounts transversely to the direction of travel to thresh the collected crop. This is said to enable approximately twice the threshing performance of conventional machines.

Schematic of the AGCO Fendt Vario air filter

ENGINE FILTER CLEANER

Agricultural machinery can sometimes work in very dusty environments, making it essential that engines are fitted with high-performance filtration systems. These need to offer high separation rates and an extended service life.

Fendt received a silver medal from the Innovation Awards for its Vario filter system. The Vario is essentially a smart filter; it can recognise the soiling level during operation and clean itself automatically without it having to be removed from the housing. With two pressure pulses on the inner side of the filter, a vacuum is created and the collected debris is ejected from the capture unit.

Amazone direct injector spray system

The vacuum is produced upstream of the hydrostatically-driven cooling fan, the speed of which is temporarily increased during cleaning. The pressure pulse comes from a separate compressed air reservoir filled at 12 bar. The automatic cleaning is triggered when the vacuum in the intake system falls below a pre-set limit. To support optimal cleaning, system operation is not impacted by engine load.

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Fasterholt DL 66 Pro irrigator

CROP SPRAYER

Another Agritechnica Innovation Awards silver medal winner was the Amzonen-Werke Direct Injection system. According to the company, the need to apply a variety of crop protection formulations has prevented these systems from becoming more widespread across agricultural businesses.

To address these issues, the system leverages direct injection to deliver the necessary product; the system can switch between liquid and granulated agents. This flexibility means that no additional lines are needed. Unused product is returned to the related container, eliminating any risk of pre-mixed residual product.

The system is operated via an ISOBUS system. If maps of the application area are available, spot spraying can be completed with even higher accuracy.


Muething CoverSeeder in action

MOBILE IRRIGATION

Another silver medal winner was the DL 66 Pro irrigation machine from Fasterholt. This is a mobile irrigation solution which features a mounted nozzle carriage consisting of a telescoping and foldable 66-metre boom, effectively combing the advantages of a self-propelled vehicle with a nozzle carriage.

This machine is said to offer a series of advantages over larger cannon sprinklers. For example, it is more resource efficient at a low pressure (approximately 1 or 2 bar, dependent on the nozzle head). In addition, they are close to the ground, which allows precise application of the product. The low pressure uses less energy, while fewer smaller droplets can reduce evaporation. In addition, the low working height reduces sensitivity to wind.

Disadvantages of other systems include the significantly higher tensile force of the extended pipe. This can limit the maximum field size to about 600 metres. With the DL 66 Pro, the self-propelled vehicle has a maximum pipe length of up to 1000 metres; the machine can pick up and wind the hose as it travels across the area.

INTERCROP SOWING SYSTEM

The Muething CoverSeeder also took a silver medal. This machine combines a series of familiar components to create a new intercrop sowing system which incorporates all related steps.

According to Muething, sowing intercrops (where two or more crops are grown in close proximity), has been relatively inaccurate. This results in haphazard coverage. To deliver improved results, the CoverSeeder features a front-mounted harrow to ensure fine soil and straw distribution. A trailing flail mulcher shreds the straw and stubble, removing harvesting residues close to the seed bed. The resulting mix is conveyed over a seed rail, which then places grain in the exposed bed. Seeds placed on the cleared surface are covered with processed organic material and a prism roller ensures soil contact for good germination.

This combination delivers a full covering layer of biomass, reducing evaporation and erosion, while supporting germination even in very dry conditions.

Compared to conventional methods, the CoverSeeder can reduce labour and energy consumption by combining all related processes. Field hygiene is also improved due to the shredding of all surface material. Since tillage is skipped, with the exception of harrow tines, the natural soil structure is also preserved. This helps to support access, even after recent rain. **dpi**

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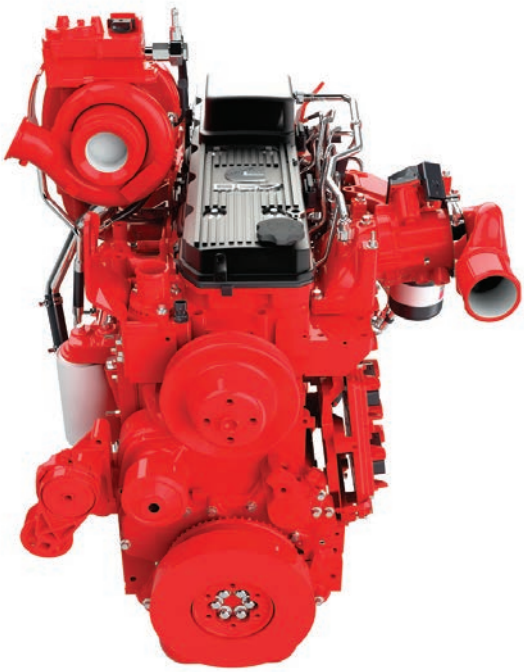

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Looking to "Reinvent the Drivetrain"

Dr Frank Hiller (centre) at the Deutz Days 21 event

Dr Frank Hiller, Deutz CEO, talks about how new technologies will take the company into the future. By **Julian Buckley**

The Deutz Days 21 event was held late last year at the Coreum exhibition and trade centre in Stockstadt Am Rhein. The Cologne-headquartered engine manufacturer used the event to showcase new power technologies it was planning to bring to market. In addition to a series of low-emissions diesel engines, the OEM displayed electric powertrains for a variety of machine and marine applications, plus a prototype of the hydrogen-fuelled internal combustion engine the company is planning to launch in 2024.

Diesel Progress International was invited to the one-day event and took the opportunity to speak with Frank Hiller, Deutz CEO, about the event and about how future product plans were likely to impact the engine manufacturer and the wider engine market.

What's the goal of Deutz Days 21?

It's all about sustainability. We started this journey in 2017 with electrification because we were sure that something would come up besides combustion engines, they would not be the solution for the next 20, 30 years. I think we were quite early with this approach.

It's all about being dynamic, very much like the auto industry. When you look back five years there was just the BMW i3 and Tesla Model S on the road. Now, every OEM has an electric model. I think the same will happen in our industry. It might be a little slower, but the pressure will be there, driven by regulations. What we're showing here today is our approach to electrification and hydrogen. You can see already that we already have a lot of electric products in the market. We also see a big potential in the hydrogen engine.

> "I think we will see a lot of regulations, so we want to be prepared. We want to have the products in place as customer demand increases."
>
> **FRANK HILLER,** Deutz CEO

Torqeedo electric marine powertrain from Deutz

Do you think electrification and hydrogen internal combustion engines mark the beginning of the end for diesel in the machine market?

I think that you could say that, but it will take considerable time. Much more than in the automotive space.

Is that fair, though, considering the advances made, DPFs and SCR treatments? Is diesel being unfairly demonised?

On the emissions side, I think the industry already has done a fantastic job, reducing particulates and CO_2. But as an industry, we must continue to address the CO_2 topic. We need to keep the global temperature increase below 2C. That's not a reduction, but keeping the increase to a minimum. I think there's a social responsibility to act, but it will also be enforced through regulation.

I think we will see a lot of regulations, so we want to be prepared. We want to have the products in place as customer demand increases.

On the other side, I think there will be great pressure on the supply side. Today we use the same suppliers as the car and truck OEMs. As these companies shift towards electrification the supply base for components for combustion engine, will shrink and will become more expensive. The competitiveness of alternative drives in comparison to combustion engines will thus increase.

Can you leverage your global reach to off-set supply side issues? Can you draw on South America or Asia?

To be honest, Asia has great potential. With our JV partner Sany we have set up local capacities for

production and therefore we had to localise part sourcing, too. This automatically gives us a second source for the European market.

So it's regionalisation; instead of bringing parts across from Europe you'll source within? It's almost a globalisation backlash, where regional production is now favoured.

I think it will become more difficult to work together internationally, between certain regions, but overall globalisation is here to stay. But right now, there are political restrictions making life more difficult.

In what way?

The trade war between the US and China is an issue. Europe is somewhere in the middle, being forced to decide which side it supports. It's a challenge for international companies.

Do you think Deutz will separate into different divisions to support the different power technologies?

Our reporting segmentation was previously based on smaller and bigger engines. Now it's really a separation between green solutions and classic solutions. Classic still makes up 96% of our turnover today, but within 10 years we expect the green segment to be more than 50% of turnover across the group. A change is going on.

Evidently, Deutz has moved on several top executives. Is that to allow the implementation of these new sustainability strategies?

We said that we must "reinvent the drivetrain" to be successful in the future. For this we need new skill- and mindsets. So we brought additional people in with special skills in electrification and software. These are the topics where we are focusing. You will see [at Deutz Days 21] that we have some interesting solutions in these areas.

Part of this transformation is our work on

> "It's all about being dynamic, very much like the auto industry. When you look back five years there was just the BMW i3 and Tesla Model S on the road. Now, every OEM has an electric model."
>
> **FRANK HILLER, Deutz CEO**

Modular battery kit at Deutz Days 21. The company is advancing its electrification program

fuel cells with the Danish company Blue World Technologies (BWT). It's a smart combination. It was clear to us that in a first step we should not directly enter the fuel cell value chain. Today, our skills and resources don't support that. But now we have the exclusive right to sell these technologies for our gen-set solutions, so it fits well together. BWT will continue with development work and we will focus on marketing and worldwide sales.

Are you a little concerned that the hydrogen internal combustion engine will only come out in 2024 when your competitors could bring them to market earlier than this?

Not really. We were one of the first to announce the hydrogen engine. Since then, a lot of companies have also announced that they will be introducing the same. We don't want to be first for the sake of being the first. Only when you have a broad product offering this technology will succeed. The technology also needs the hydrogen infrastructure. With more companies going in the same direction, there will be a greater need and pressure to build up the hydrogen infrastructure.

Do you think electric motors will be a stop-gap between diesel and hydrogen internal combustion engines?

I think there will be different technologies competing against each other. Over the next decade there will not be a one-size fits all technology like diesel gave us in the past. Instead of electrification being a basic stepping stone, I could see them being used even more. Over the next 20 or 30 years, I think electrification will become more powerful, fulfil more applications. But for now, I think there will be a mix of technologies.

Our competitors are seeing the market in the same way. Now is not the time to focus on just one technology. You have to have the technology mix.

Deutz has almost a burden of heritage in diesel engine production. Now, that core competence is getting sidelined. Does that concern you?

No, not at all. Look at our combustion engines today. They are already certified for biofuel and will be ready for efuels, too. The combustion engine will still be around for a long time in our industry. It's just the fuel you put in which will change. And our engines are ready for this. **dpi**

Every day is a school day

Julian Buckley visits the JCB R&D centre to find out more about the hydrogen internal combustion engine now under development

JCB hydrogen engine test cell (from left) Ryan Ballard, Engineering Director, Powertrain, Paul McCarthy, Lord Bamford, Tim Burnhope

In late 2021, UK-based engine and off-road machine manufacturer JCB made a series of announcements which caught the eye of the national media. At one such press call, British Prime Minister Boris Johnson was pictured with JCB chairman, Lord Anthony Bamford, as the UK leader refuelled a JCB backhoe fitted with a hydrogen engine.

The event served as the official reveal for JCB's £100 million ($134 million) investment to support development and production of a new hydrogen-fuel internal combustion engines. Speaking at the event, Lord Bamford said: "We are investing in hydrogen as we don't see electric being the all-round solution, particularly not for our industry because it can only be used to power smaller machines."

Fundamental benefits of the hydrogen internal combustion engine (ICE) include a high transient response when compared to an electric drive (together with rapid refuelling), while they are more rugged than an equivalent hydrogen electric fuel cell. Emissions from the hydrogen ICE are water and trace levels of CO_2 and NOx, both of which are far lower than those of an EU Stage 5-compliant diesel.

FUEL CELL PROTOTYPE

Following the media event, DPI was invited to visit the JCB factory and development centre in Staffordshire, UK, to get more technical details about how the company has devised and developed the new hydrogen ICE.

"We looked at our 'Road to Zero' and tried to understand what's needed to achieve that goal," says Tim Burnhope, chief Innovation and Growth officer. "We have battery-electric machines and where there is an energy demand similar to a car, then that technology is a good fit. But 85% of our product range goes above that energy demand in terms of working hours."

Prime Minister Boris Johnson (right) and JCB chairman Lord Bamford at H2 engine investment announcement

Continuing, he says that the team turned from battery packs to fuel cells. "[Hydrogen] is a fantastic mobile fuel, it can be taken to the site, refuel the machines and they keep working." JCB went on to develop a fuel cell excavator prototype. Burnhope says that in terms of the power unit, it stands as the most technological piece of machinery the company has produced to date.

"But fuel cells are a little immature for our industry, too complicated and too expensive. With the high transient responses of our machines, they're not the best energy source," he adds.

FUEL DYNAMICS

At a presentation in mid-2020, it was put forward that a hydrogen-fuel ICE would serve as the best all-round solution for JCB machines. Seven months later, in December, the team successfully completed the first demonstration of a hydrogen-powered engine.

The hydrogen ICE is based on the proven JCB Dieselmax 448 four-cylinder engine block, with the addition of such features as additional venting to support purging of any excess hydrogen fuel at shutdown. Unlike the block, the head unit has undergone some significant reengineering to support hydrogen as a fuel.

"We've got about 100 engineers working in the R&D section," says Paul McCarthy, chief engineer for hydrogen engines. "They're working on a series of projects, focused on development of the hydrogen engine."

According to McCarthy, there were about 77 unsuccessful hydrogen engine development projects documented in technical journals prior to the JCB programme. The team examined each of these to uncover what had prevented those experiments from progressing, which helped to determine the

JCB ABH2 hydrogen ICE won the Dewar Trophy in 2021 for outstanding technical achievement

JCB backhoe fitted with hydrogen internal combustion engine

best route to achieve successful hydrogen internal combustion.

One of the issues was dealing with gas as a fuel. "H2 is an intriguing gas, it's very light, very low density. It disperses very well, but because of the low density and tiny molecules, getting it to mix in a cylinder can be problematic. Getting the hydrogen exactly where we want it in the cylinder has been a key focus."

The goal here is to improve the combustion efficiency to reduce any emissions. But McCarthy explains that hydrogen generally doesn't go where it's expected. "If you open a drink can of hydrogen at 1 bar and 25°C, the horizontal diffusion velocity is 2 cm/second – quite slow. On the other hand, the vertical buoyancy velocity is 9 m/second, it shoots up out of the can. It also warms up as it expands, instead of cooling, so you have a strange mixture of properties."

HYDROGEN FLOW

JCB has in-house computational fluid dynamics (CFD) capability and between this function and a partner team at Aachen University in Germany, the flow rate of hydrogen has been modelled successfully. "The majority of projects that came before us were trying to do conversions, using CFD rates for helium, nitrogen, but never hydrogen. We proved the flow rate of hydrogen, which was a major step forward," observes Burnhope.

The first prototype engines used injectors developed for use with natural gas, but while OK for testing, these are not suitable for production models. JCB has been working with an injector supplier to develop a proprietary solution.

Getting hydrogen into the combustion chamber is an issue, but getting sufficient air is also a problem. "Hydrogen needs far more air than diesel, it's stoichiometric combustion," says McCarthy. "That made us focus on our turbo solutions, the way air is forced into the cylinder. We need that mass of air to carry momentum and overcome the low weight of the hydrogen gas to make a good mix."

He adds that while the temperatures and pressures are "a bit different", it's still only fundamental turbocharging that can force sufficient air into the combustion chamber. "Instead of exhaust, we're working with steam to drive the turbo," he adds.

Water content in the exhaust has to be carefully managed to prevent that fluid combining with the oil. Together with another partner, JCB is working to develop a hydrophobic engine oil that uses additives to prevent emulsions from forming in the coolant. The development team is now working with prototype oils infused with additives to ensure those products are not drawn out of the coolant.

Unlike most JCB diesel engines which use compression ignition, the hydrogen engine requires a spark. McCarthy says that creates new issues related to over-sparking or double sparking. "It has to be very clean, very clear, which dictates how the flame front propagates combustion of the mix," he points out.

With LPG and natural gas engines already on the market, it would seem like a simple step to produce an internal combustion engine that uses hydrogen. It might be less complex than a hydrogen fuel cell, but as the various projects which have come before the JCB project highlight, it's far from a simple solution. While most engine hardware comes from standard ICE models, there's hardly anything that's not had some form of adaptation.

"There are so many things that are counterintuitive with hydrogen, every day is a school day," says McCarthy. dpi

> "We are investing in hydrogen as we don't see electric being the all-round solution."
>
> **LORD ANTHONY BAMFORD, JCB**

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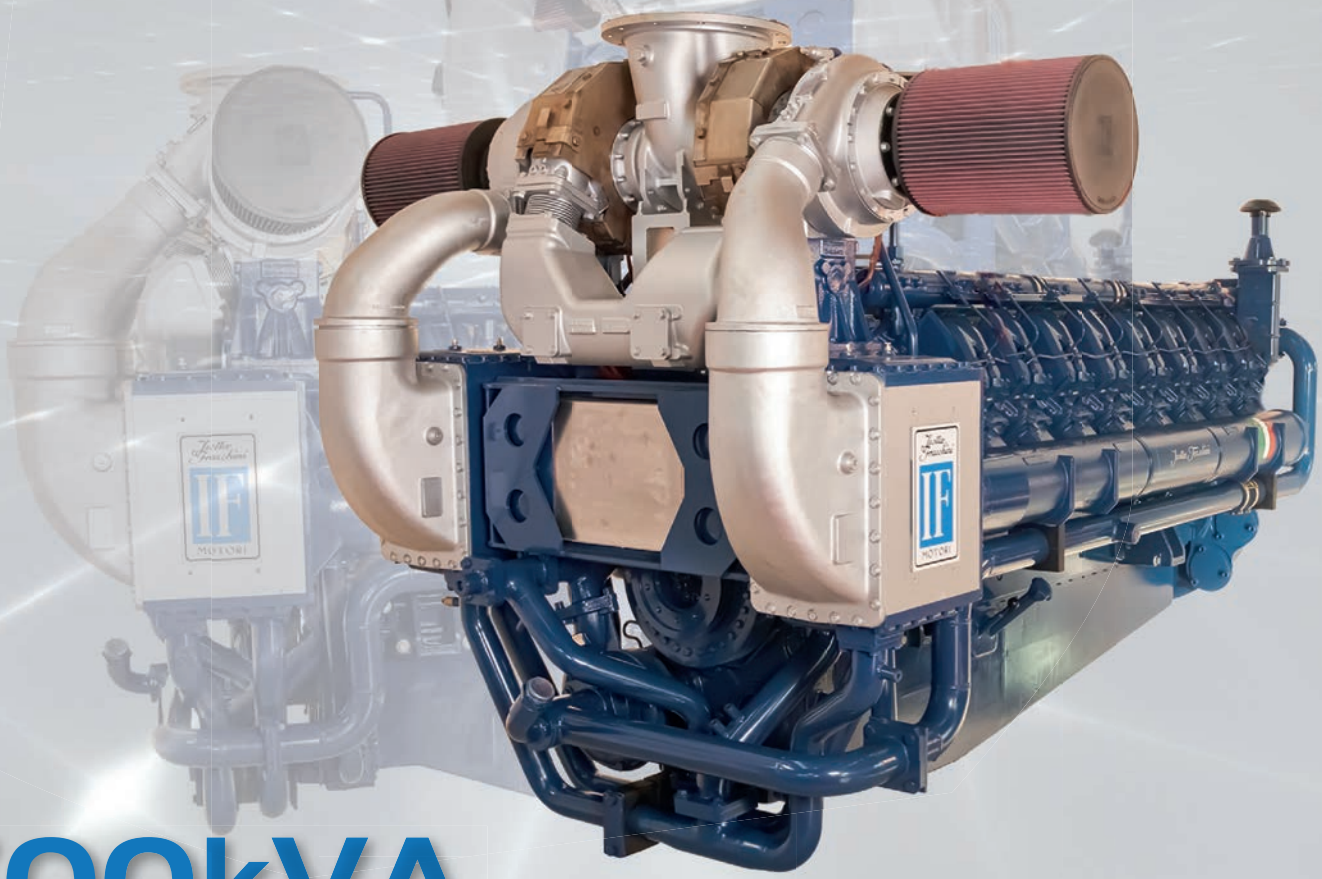

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DISCOVER THE POWERS

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BKT Ridemax IT 697 MS tyres are designed for different surfaces in cold conditions

Under pressure

How BKT is adapting tyre tech to suit new applications

By **Julian Buckley**

To find out how demands from the agricultural market have affected tyre manufacturers, DPI spoke with Denis Piccolo, product manager, Agricultural Tires, at BKT Europe. He says that avoiding soil compaction is a trend that has driven manufacturers to launch new ranges of low-pressure tyres using IF (increased flexion) and VF (very increased flexion) technologies.

"A VF tire is designed to transport 40% more weight at the same air pressure as a standard tire," says Piccolo. "That means the air pressure could be reduced by 40% and carry the same weight as a standard tire."

Where these VF tyres were originally introduced for tractors, similar products offering the same VF rating have been launched for equipment needing better floatation, including dump trailers, spreaders and tankers. Using these tyres means the support hardware has a similar tyre footprint to the tractor, reducing soil compaction as the full rig travels across the land.

FROM FIELD TO ROAD

While reduced soil compaction is taking the headlines, Piccolo says that customers continue to request tyres with improved quality and durability. This includes the capability to move problem-free between field and road without any loss in grip or driving comfort.

"An optimised balance between investment and durability is still one of the main customer requirements. Customers need a tyre which offers optimal traction across all surface types and that is a real challenge," says Piccolo. "They expect optimal traction, self-cleaning and flotation properties, combined with good roadholding and reduced noise, all without having to change tyre pressures as the equipment moves between surfaces."

Such demands have led to a considerable change in the BKT product range. Piccolo says that over the last few years the company has focused on introducing several new tyre sizes, with both IF and VF technologies, to equip high and very high-powered tractors.

These changes have also meant that BKT has been continuing to work on new tyre compounds. While improving puncture resistance and longevity, these formulations also help to support wider distribution; BKT now markets products in 160 countries around the world.

"We have to adapt our tyres to the regional and local conditions and environments," says Piccolo. "These include producing tyres for difficult applications, such as sugar cane production. On the other hand, we have to support rice farmers, while also working in stony silex soils such as in France and Northern Africa."

Denis Piccolo, BKT Europe

BKT uses a both natural (NR) and synthetic rubbers (styrene butadiene, or SBR and polybutadiene, or BR), the properties of each supporting specific applications (see table).

TREAD PATTERNS

New compounds come hand-in-hand with new tread designs, intended to deliver better traction in different soil types and also on the road. This has also impacted carcass structure. "Agriculture is a global industry, but every farm is unique and so are its needs," observes Piccolo.

He continues by saying that tread patterns reflect the purpose for which the different tyre types were intended. For example, agricultural tyres will use a classic lug (chevron) pattern, as seen on the Agrimax range. If road and transport are required, the pattern will change to ensure better ride comfort and road holding, together with reduced rolling resistance to improve fuel economy. According to Piccolo, a great example of this is the new Ridemax IT 697 (M+S), developed to maintain grip on different surfaces in cold weather.

Piccolo says that while tread styles are based on use, tyre construction changes due to application, with bias, radial or bias belted the most common types. Even the mounting axle can dictate the material, tread or construction.

Summing up, he adds: "What we do at BKT is create products and solutions to answer specific needs based on real feedback and requests." **dpi**

PROPERTIES	NATURAL RUBBER (NR)	SYNTHETIC RUBBER (SR)	SYNTHETIC RUBBER (BR)
Tear resistance	Very good	Good	Good
Elastic re-bound	Best	Good	Very good
Fatigue resistance	Very good	Very good	Very good

PEMD advances are Driving The Electric Revolution

Companies challenged to put forward Power Electronics, Motors and Drives projects. By **Julian Buckley**

UK Research and Innovation (UKRI) is currently funding a challenge under the headline banner Driving the Electric Revolution, a programme intended to support, grow and strengthen the national supply chain as it helps with development of new technologies within the Power Electronics, Motors and Drives (PEMD) space.

The challenge has seen a wide variety of projects put forward, from specialised semi-conductors for use in switching high power connections, through to development of recycling techniques for electric motors and development of in-wheel motors for small agricultural machines.

Professor Will Drury of UKRI, who is also a Fellow of the Institute of Engineering and Technology and director of Driving the Electric Revolution, says that the entries are all related to PEMD projects. "[PEMD] is what allows us to convert electricity from one form to another and then into mechanical energy. It's how the electronics allow energy to be taken out of the battery and turned into something we can use. In the case of a digger, that has gone from hydraulic to electro-hydraulic, through to only electric."

SUBMIT ENTRIES

Companies have been invited to submit applications with details of their project plans, which go on to be reviewed by an assessment panel made up of a team of independent adjudicators. The best entries receive a portion of the £80 million in UK government funding behind the project.

Drury says that the challenge has received entries from a wide range of different organisations. "Just 15% of R&D awards announced to date have gone to larger companies. SMEs and micro businesses have made up 61%, with the remainder coming from academia and research groups." In addition, those business are predominantly based in Wales, Scotland, the West and East Midlands and North East England, areas which are already heavily involved in PEMD development.

Drury says that instead of each project focusing on a core area of application, the project spans various different industries. Where a 15 MW wind turbine and an off-road vehicle are clearly from different sectors, both require motors delivering very high torque at very low speed. As Drury puts forward, it might be a different architecture but it's still a motor.

The goal is for these companies and organisations to deliver next-gen hardware, software and the related supply chain, helping the UK achieve its net-zero 2050 target. Drury: "A phone charger delivers five volts – it's not magic, it's clever power electronics in action. Like this, we want to develop hardware which is more efficient. If we can reduce energy usage by 5%, I've immediately reduced CO_2 output by 5%."

> "If we can reduce energy usage by 5%, I've immediately reduced CO_2 output by 5%."
>
> **WILL DRURY, UK Research and Innovation**

BUILDING TALENT FOR THE FUTURE

The UK already has strong aerospace and automotive industries and Drury wants to see other sectors learn from them, bringing that know-how into an ecosystem where companies in similar fields can grow together through knowledge sharing.

Another part of the Driving the Electric Revolution programme is a competition named Building Talent for the Future 2 (following on from round 1). This is a drive to get mechanical engineers interested in electrical conversion, with the aim of improving skill sets at smaller companies. In total, almost £5 million was put aside to support companies with plans in this area, including training courses.

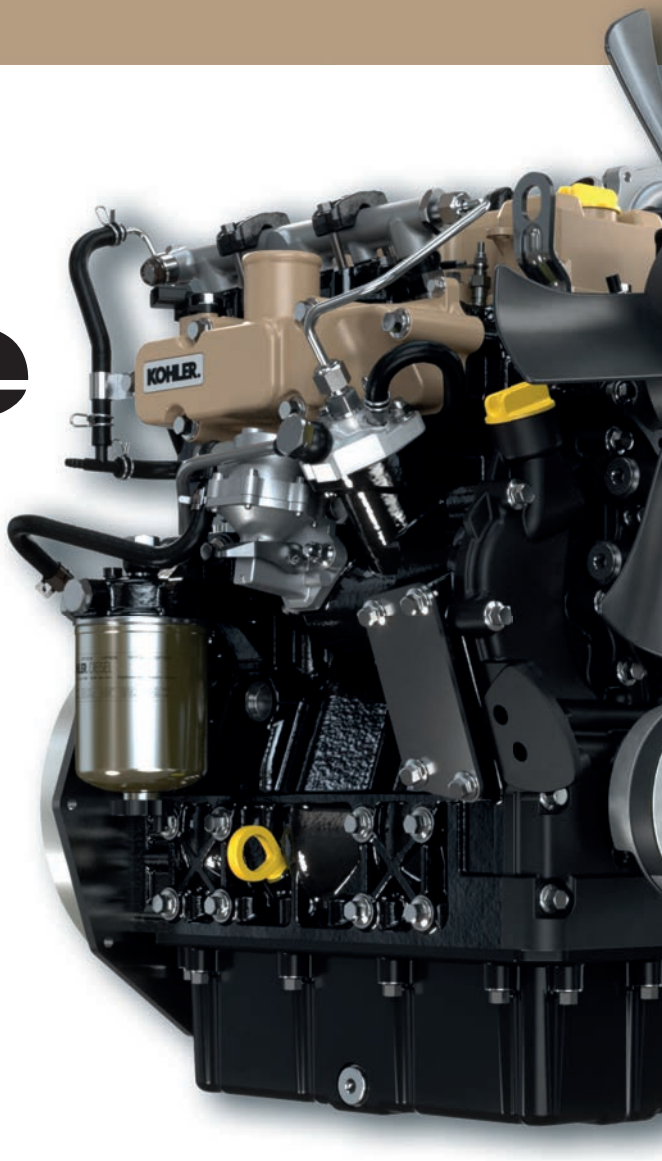
Recycling is also being addressed within the Driving the Electric Revolution. Drury says that examples include a company looking to reclaim gallium from LEDs for use in next-gen, low-resistance power switches. Another is looking at how to efficiently recover magnets from audio equipment to reclaim the neodymium and praseodymium rare earth metals.

"It's important that we figure out how to get these materials back into the supply chain," says Drury.

There is ongoing monitoring of each challenge project to measure investment success. But Drury says that such success is only part of the win. "We'll need more programmes like this to secure the supply chain and achieve net-zero goals. People working together, figuring out new solutions, adding value. To me, that's exciting!"

Driving the Electric Revolution will run through March 2025. **dpi**

Kohler's big move in small engines



New KSD diesel family targets global applications under 25 hp. By **Mike Brezonick**

Kohler is making a big move in the global market for small diesel engines.

Aiming to provide flexibility for both mobile and stationary applications, the company has unveiled a new range of compact diesels that will be offered in naturally aspirated, turbocharged and turbocharged charge-air cooled versions to meet exhaust emissions regulations in the US and EU, as well as new emissions standards in India (Bharat Stage 5 in 2024), China (Stage 4/Stage 5), Japan and Korea.

The new Kohler Small Displacement (KSD) are the company's most significant engine development since the launch of the Kohler Direct Injection Diesels in 2017 and comes in one of the most competitive segments of the global engine market.

"Choosing the right engine for any equipment, from gen sets to specialty machines, requires time and significant investment," says Vincenzo Perrone, president of Kohler Engines. "We at Kohler are convinced that a global product must be conceived and designed with a global approach suitable for all regions compliant with all norms worldwide, compatible with all kinds of machines.

> "We at Kohler are convinced that a global product must be conceived and designed with a global approach suitable for all regions compliant with all norms worldwide, compatible with all kinds of machines."
>
> **VINCENZO PERRONE, Kohler Engines**

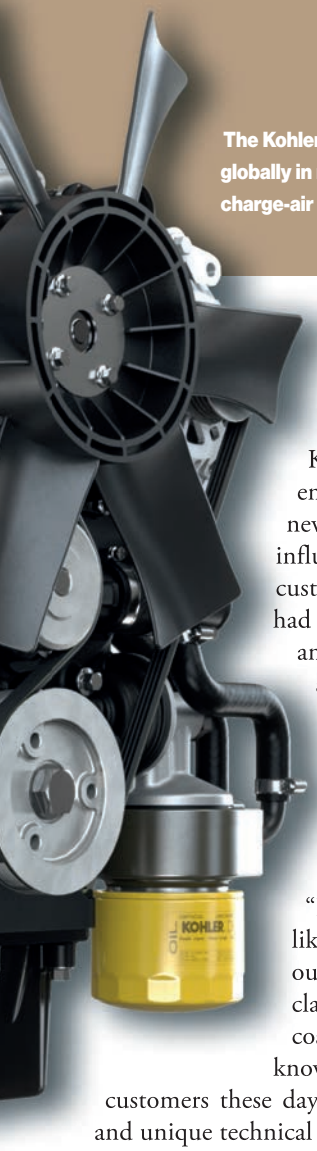
"With the KSD we are bringing the level of technology available on larger platforms to compact engines. We are offering the latest technology to deliver the best performance for every new or existing machine worldwide."

The three-cyclinder KSD engines have bore and stroke dimensions of 81 x 90 mm and an overall displacement of 1.391 L. The naturally-aspirated models will offer ratings of 24.6 hp (18.4 kW) at 2200 rpm, with maximum torque of 66 lb. ft. (90 Nm) at 1800 rpm.

The turbocharged engines will have the same maximum horsepower, with torque rising to 77 lb. ft. (105 Nm) at 1500 rpm while the turbocharged and charge-air cooled engines will see torque top out at 88.5 lb. ft. (120 Nm) at 1400 rpm.

The KSD will also be available at launch with EU Stage 5 and EPA Tier 4 Final generator set ratings. For the 50 Hz markets, standby power ratings will be 17.4 hp (13 kW), 22.1 hp (16.5 kW) and 25.2 hp (18.8 kW), while prime power ratings are 15.6 hp (11.7 kW), 19.9 hp (14.9 kW) and 22.9 hp (17.1 kW). All 50 Hz ratings are at 1500 rpm.

For the 60 Hz markets, standby ratings are 22.7 and 24.6 hp (17 and 18.4 kW), while prime ratings are 21.8, 22.7 and 24.6 hp (16.3, 16.7 and 18.4 kW), all at 1800 rpm.



The Kohler Small Displacement (KSD) engines will be available globally in naturally aspirated, turbocharged and turbocharged charge-air cooled versions to meet local exhaust regulations

ALL-NEW DESIGN

The new KSD engines are intended to eventually succeed the existing Kohler KDW series engines. The engines are a completely new design that was heavily influenced by Kohler's OEM customers. "With this engine, we had a lot of early conversations and we partnered with some of our OEMs and got input from them even before the design," says Jeff Wilke, Industry Channel Manager, Engines at Kohler. "It's a clean sheet design like the KDI engines and our targets were best-in-class performance, total cost of ownership – we know that's a focus for our customers these days – heavy-duty design and unique technical solutions.

"The people who have given us input have seen the result of that input in this engine," he adds.

The KSD engines incorporate an electronically controlled indirect injection (IDI) system in which fuel is delivered into a pre-chamber where it is mixed with air and ignited before passing into the combustion chamber where the combustion cycle is completed. The system uses low pressure (250 bar/3600 psi) fuel injectors based on gasoline direct injection (GDI) technology.

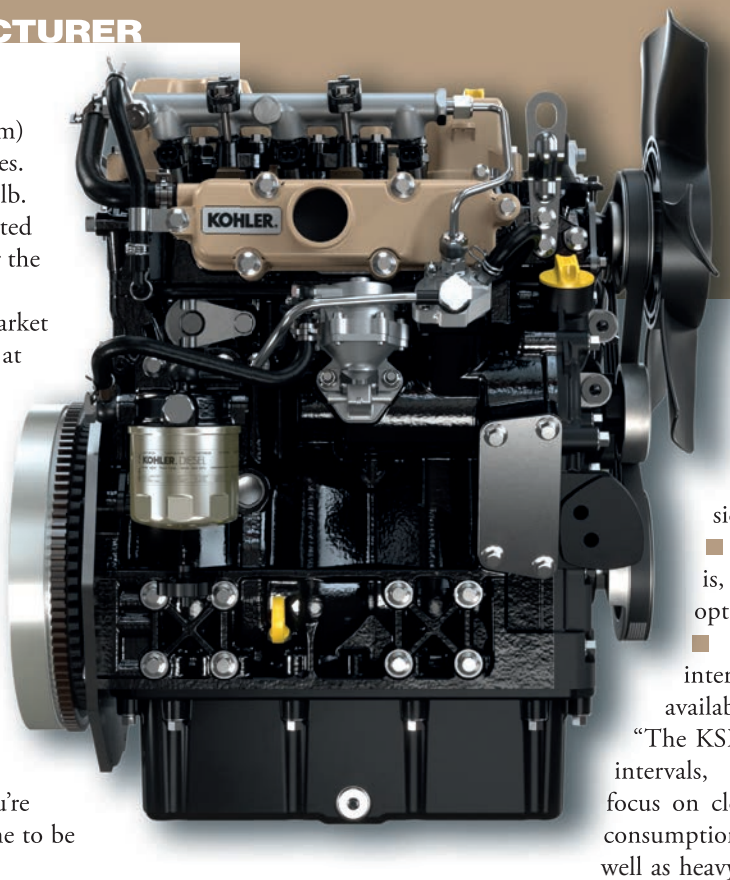
The fuel system is designed to provide precise fuel metering and strong load response, along with good performance at altitude. The control electronics also allow for prognostics, diagnostics, and remote monitoring, as well as integration with other machine systems through CAN J1939 communications networks.

"It is a state-of-the-art indirect injection system but has the specific electronic management typical of direct injection engines," says Massimiliano Bonanni, general manager, Product Strategy for Kohler Engines. "Major benefits are the engine performance is maximized in any operating conditions and environments, at sea level as well as in high altitude. And responsiveness is outstanding, as the system offers a very limited speed droop, as well as isochronous control if required, like in bigger displacement common rail engines."

COMPACT SIZE

Kohler said the KSD engine is designed to fit in the same application envelope where 1.1 L engines are currently used - thus providing a drop-in replacement to competitor's engines - while still delivering the horsepower and torque performance of a 1.7 L engine.

"It's almost 1.4 L, however, it's in the package size of a 1.1 L engine," says Wilke. "It's very compact," with length, width and height dimensions of 19.88 x 16.1 x 23.8 in. (505 x 409 x 605 mm) for the naturally aspirated engines and 19.88 x 17.7 x 42>



The naturally-aspirated KSD engines will offer ratings of 18.4 kW (24.6 hp) at 2200 rpm, with maximum torque of 90 Nm (66 lb. ft.) at 1800 rpm

25.6 in. (505 x 450 x 652 mm) for the turbocharged engines. The weight ranges from 209.4 lb. (95 kg) for the naturally aspirated engines to 233.7 lb. (106 kg) for the turbocharged models.

"When you look at this market now at 19 kW and you look at the engine displacements, they range from 900 cc to 1.7 L that have all been pushed all into this same area," Wilke says. "So our idea is we went more in the middle with 1.4 L, while providing all kinds of torque and performance.

"When you look at most engines in this range, they've got to be pretty large displacement before they can even get close to 120 Nm torque. In most cases, you're looking at close to a 1.7 L engine to be able to do that."

Even with its compact dimensions, Wilke describes the KSD "is a heavy-duty design."

"Our KDW engine wasn't perceived as a heavy-duty engine because it has an overhead cam that was belt-driven," Wilke says. "People just saw that it had a belt and that's just not seen as heavy-duty.

"This engine goes back to the in-block cam design that is very robust. It also has large bearings to handle the higher loads of applications where larger displacement engine were used and now can be replaced with the KSD due to the robust design."

DROP-IN FEATURES

Kohler has said the drop-in capability of the KSD engines is enabled by a range of features that includes:

- A fully-adjustable cooling fan mount, allowing three different fan positions and eliminating any radiator repositioning in the application. "You don't need to reposition the radiator because the cooling fan is fully adjustable," says Bonanni. "We put it where you need it."
- A dual side service capability. "The oil filter, oil dipstick and fuel filter can be located on the preferred service side," Bonanni adds.
- A third power-takeoff (PTO) is, available, as well as a non-PTO option.
- Standard 500-hour oil change interval, with 1000-hour intervals available for select applications. "The KSD provides extended oil service intervals, Bonanni says. "In fact, the focus on clean combustion drives low oil consumption and avoids oil dilution as well as heavy sooty oil contamination. This is thanks to its unique piston design, a dedicated in-house honing machining process and a specific crankcase ventilation system with a cutting-edge design."

Kohler plans to begin production of the KSD engines at its Aurangabad, India, facility at the end of 2022.

"We are building a new portion of our Aurangabad plant," says Nino De Giglio, director, Marketing Communication and Channel Management for Kohler in Italy. "And it's not just building a new building, the processes of the assembly line will be very innovative."

The company also has plans to develop spark-ignited versions of the KSD engine that will be capable of operating on gasoline, natural gas and LPG. Those engines, currently expected to launch in the 2025 timeframe, will also be available in naturally aspirated (23.2 to 27.6 kW/31 to 37 hp) and turbocharged (35 to 37 kW/47 to 49.6 hp) models. **dpi**

KOHLER SMALL DISPLACEMENT DIESEL SPECS

ENGINE	KSD NA	KSD TURBO	KSD TURBO CAC	KSG	KSG TURBO
Maximum hp (kW) @ rpm	24.6 (18.4) @ 2000-3000	24.6 (18.4) @ 1800-3000	24.6 (18.4) @ 1800-3000	31 (23.2) @ 3000 35 (26.2) @ 3000 37 (27.6) @ 3000	47 (35) @ 3000 49.6 @ (37) 3000
Maximum Torque Lb. ft. (Nm) @ rpm	66 (90) at 1800	77 (105) @ 1500	88.5 (120) @ 1400	60 (82) @ 2400 64 (87) @ 2400 66 (90) @ 2400	88.5 (120) @2400 84.8 (115) @ 2400
Fuel	Diesel	Diesel	Diesel	Gasoline/LPG/NG	Gasoline/LPG/NG
L x W x H in. (mm)	19.88 x 16.1 x 23.8 (505 x 409 x 605)	19.88 x 17.7 x 25.6 (505 x 450 x 652)	19.88 x 17.7 x 25.6 (505 x 450 x 652)	19.88 x 16.1 x 23.8 (505 x 409 x 605)	19.88 x 17.7 x 25.6 (505 x 450 x 652)
Weight Lb. (kg)	209.4 (95)	233.7 (106)	233.7 (106)	209.4 (95)	233.7 (106)
Emissions Compliance	EPA Tier 4 Final EU Stage 5	EPA Tier 4 Final EU Stage 5	EPA Tier 4 Final EU Stage 5	EPA Tier 4 Final EU Stage 5	EPA Tier 4 Final EU Stage 5

Information from the manufacturer

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Power generation adopts Stage 5 standards

In 2021, FPT Industrial supplied the gen sets for a wakeboard event in Milan, Italy

DPI talks to FPT Industrial about the dynamics and trends across the highly-regulated power generation markets.

By **Roberta Prandi**

Fabio Rigon, FPT Industrial

FPT Industrial offers a choice of Stage 5 engines for power generation applications, ranging from 37 to 378 kW for standby power and 34 to 342 kW for prime power at 50 Hz. This includes engines across a series of FPT platforms, including F34, F36, NEF67, Cursor 9 and Cursor 13.

All engines, with the exception of the F34, use FPT Industrial's proprietary, second-generation HI-eSCR2 aftertreatment technology, which cuts NOx output by 95%, together with bringing particulate emissions within Stage 5 limits.

Fabio Rigon, vice president EMEA Commercial Operation and Power Generation at FPT Industrial, tells DPI that the current market situation is quite fluid, with unusual dynamics being brought to the forefront by the COVID pandemic.

"The power generation segment for FPT Industrial is divided into two main areas of application, stationary standby power for emergency use and prime power for situations where a main grid is not available or not adequate, as is often the case in areas such as the events industry," he says.

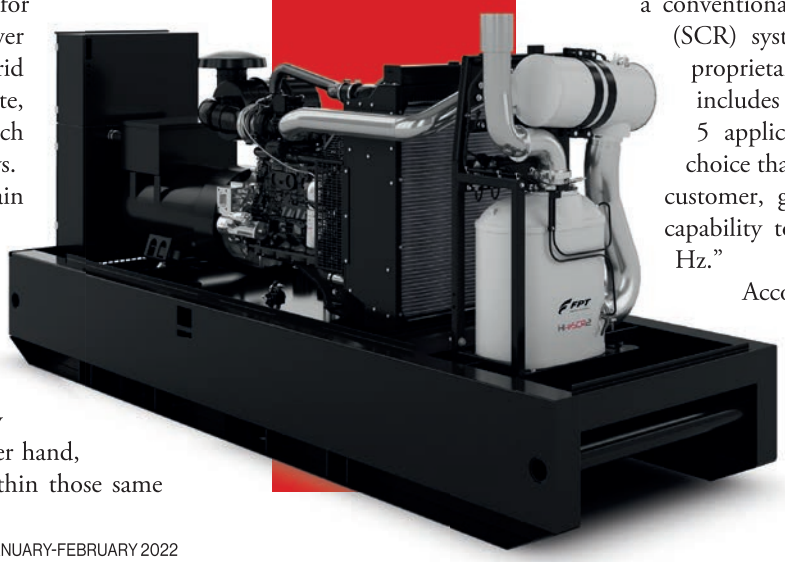
Within these two main segments there are different emissions standards depending on geographic region. For example, in Europe, stationary back-up power is not subject to the latest EU Stage 5 regulatory emissions limits. On the other hand, mobile prime power falls within those same regulations. Tier 4 Final in the US adopts a similar approach to Europe, with some small differences.

"The EU Stage 5 standard is more restrictive than US Tier 4 Final because it includes a limit on particulate matter dimension, which is why [European] engines have to use a diesel particulate filter (DPF) but can do without in the USA," says Rigon.

"In this case, FPT Industrial offers engines with a conventional selective catalytic reduction (SCR) system for the US market, the proprietary HI-eSCR2 – which also includes a compact DPF for Stage 5 applications in Europe. This is a choice that brings advantages to the end customer, going hand-in-hand with the capability to switch between 50 and 60 Hz."

According to Rigon, voltage switching capability is an important aspect for maximum flexibility in gen set applications, but also for optimal logistic management. It means that

The FPT NEF67 200 kVA is available in an aftertreatment pack solution



customers don't need to stock two different engines to cover markets with different voltages.

The rest of the world is basically non-regulated; this includes most of the Middle East. Elsewhere, South America is trending towards medium emissions limits in big cities (Tier 3a equivalent). In Asia, India is heading towards emissions limits similar to Tier 4 Final, while China is adopting China 3 at the same time as moving towards China 4 standards similar to those for off-road mobile machinery applications.

PREMIUM APPLICATIONS

"Another advantage that FPT Industrial engines can offer is the user-friendly approach that allows customers to purchase pre-assembled solutions. That's a definite plus on sophisticated engines such as the Stage 5 examples, it's a way to make the shift from Stage 3a to 5 as smooth as possible," says Rigon.

Rigon explains that Stage 5 engines are often used in premium applications, including those that demand superior performance in difficult conditions. In a world that is profoundly different, the demand for prime power is also changing: "One example is the events industry. A big opportunity for the rental business and a market that is evolving more and more into localized, temporary events, rather than huge stadium venues, where the main grid is usually not capable of handling the required high peaks of demand.

"Another example is telecommunications. Since the launch of 5G networks, electricity consumption has doubled compared to 4G. It's a real challenge for the main grid, but also for the providers of back-up power." The same is true for electromobility and the increasing demand for power to recharge electric cars, which often peaks at night.

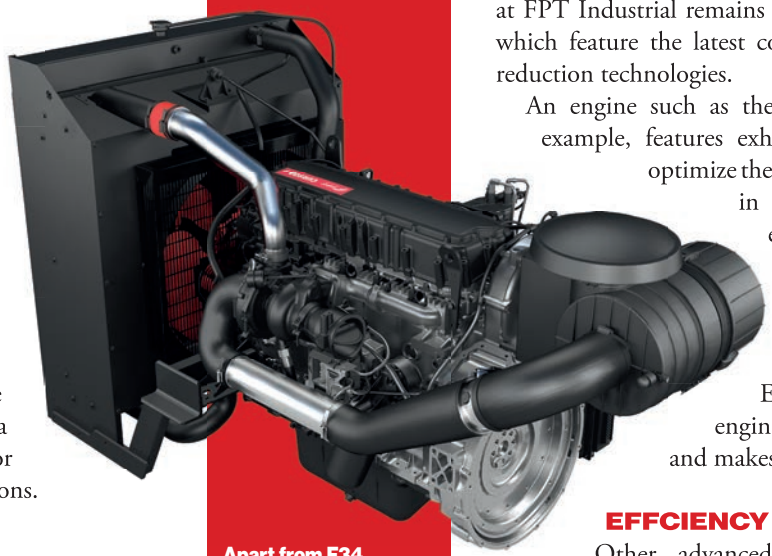
Another key point when looking at the future of energy production is the related environmental impact and the need to introduce renewable electricity sources with efficient storage systems. "The move towards renewables brings major changes in the energy demand pattern, creating disruptions that have to be addressed to re-establish a balance between demand and offer," says Rigon.

"To address these disruptions, we see an enormous number of start-ups, as well as existing players, working to offer innovative solutions with CO_2 neutrality in mind."

FPT Industrial is working to further reduce emissions from its engines, looking especially at the two load ends (low and high) and at developing solutions with alternative fuels, including natural gas and biogas, which are expected to join the engine ranges for power generation at some point. But these two topics, says Rigon, are for a future article.

For the moment, the focus for power generation at FPT Industrial remains with its Stage 5 engines, which feature the latest combustion and emission reduction technologies.

An engine such as the NEF67 200 kVA, for example, features exhaust flap technology to optimize thermal management, which in turn maximizes SCR efficiency and minimizes the post-injection cycle. Furthermore, the engine doesn't need an air inlet valve and EGR, which means the engine requires less cooling and makes for a leaner unit.



Apart from F34 models, all engines use FPT Industrial's second-gen HI-eSCR2 aftertreatment

EFFCIENCY IMPROVEMENTS

Other advanced technologies on this engine include a fixed-geometry wastegate turbocharger and common rail injection system with up to 1600 bar pressure that delivers high-frequency stability output for critical applications. FPT Industrial calculated that the fuel efficiency of its Stage 5 engines is about 5.7% better than Stage 3a versions (EU Stage 5 regulations have focused on particulate reduction rather than overall fuel efficiency).

The oil system on this engine supports maintenance intervals of up to 600 hours, with a capacity of just 17.5 L. Based on yearly usage of 2500 hours and after typical fuel, AdBlue, oil and oil filter costs, the annual total cost of ownership for the NEF67 200 kVA Stage 5 is about 2.4% less than the equivalent Stage 3a engine.

As mentioned earlier, the NEF67 200 kVA Stage 5, as with other Stage 5 models from FPT Industrial, is available as an aftertreatment pack solution, pre-assembled (from 12 components to one), pre-cabled and pre-validated for easy installation and sign off. **dpi**

Sweet deals

A look at the drivers behind the recent success of Yanmar Europe. By **Roberta Prandi**

As it was for most engine manufacturers, 2021 proved to be a record sales year for Yanmar. But Carlo Giudici, Sales and Marketing director, admits there were problems that could last a while longer.

"Our OEM customers have been producing machines at full speed to cope with the demand, even to the point of assembling vehicles that have sat uncompleted in yards while waiting for the missing components to appear," says Giudici. "But this approach is not sustainable for longer periods and some customers even had to stop production for extended holidays at the end of 2021."

According to Giudici, the component shortage now being experienced by manufacturers is a complicated matter and it is hard to predict when it will ease up; he candidly admits that it involves suppliers which have historically influenced the market with a monopoly-type control of their components. Shipping is also a major hiccup, with delays and prices spiralling out of control.

Carlo Giudici, Yanmar

WARRANTY WINS

Moving on to merrier topics, Giudici turns to the new Yanmar five-year warranty program: a free extended warranty that applies to all Yanmar TN Series diesel engines in Europe.

"This is a major regional initiative we have been working on for a couple of years. It applies to engines sold in Europe and on machines operating in European territory." The free five-year extended warranty applies on condition that maintenance is carried out within the official Yanmar service network using original parts.

"When approaching this initiative, we considered that for the automotive industry this warranty period is already a standard, if not longer. We are convinced this is a trend that will be seen in the off-road market as well. We are proud to be the first to offer this for off-highway engines, at least to our knowledge," says Giudici.

Keeping total cost of ownership reduction targets in mind, he says two main factors influenced the introduction of this new offer. On the one side, the willingness to bring forward a strong promotion to highlight the quality of Yanmar engines; on the other, the necessity of creating a stronger bond with end-user customers, particularly in aftersales.

"In all truth, our engines do not require many service interventions, which is a nice situation for our service teams. But at the same time this means we don't have much direct feedback from our field network. We hope this initiative will help us to gather intelligence from the market about our engine population."

> "Customers even had to stop production for extended holidays at the end of 2021."
>
> **CARLO GIUDICI, Yanmar**

REDUCED EMISSIONS

Another recent success story from Yanmar covers market penetration of its Stage 5-compliant engine series: "Our technology for EU Stage 5 regulations has been available to our customers since 2012,

Yanmar engines sold in Europe now have a free, 5-year extended warranty

Yanmar common rail injection system

Enhanced generators

Yanmar has released a series of Stage 5-compliant engines, but some of the latest feature in the updated YDG Series generators.

Powered by the air-cooled L-Series engines, the range includes the YDG3700, which offers four variants with outputs from 3.3 to 3.7 kVA and the YDG5500 which also has four variants ranging from 5.1 to 5.6 kVA.

These industrial-grade portable units were previously made in Japan but are now being produced in Italy. Yanmar states that this should help to improve lead times for customers in Europe, the Middle East and Africa.

Speaking about the new introductions, Carlo Giudici said: "These upgraded and precision engineered models are brand new entrants into the European market. They are established yet meticulously advanced generators which meet all global emissions standards and incorporate cutting edge components."

He added that the new generators are especially quiet, while offering a series of outputs to suit various power requirements. Due to the very low fuel consumption, the generators can be operated at full capacity for up to 10.5 hours.

Servicing of the new generators in Europe will be backed up by a 'comprehensive' parts centre based in Amsterdam, The Netherlands, which will offer a wider range of components sourced in Europe.

Yanmar YDG3700 diesel generator

with the introduction of our Tier 4 Final solutions," says Giudici. "Therefore, our engines with diesel particulate filters have been on the market for quite a few years without hiccups; sales are now beyond 700,000 units. The two latest TNV Stage 5 models we launched more recently utilize that same aftertreatment technology."

Giudici reports that Yanmar's latest Stage 5 engines are gaining market share with customers of all sizes. "We are not only gaining in construction applications, where we are already one of the leading suppliers, but also in material handling and power generation, a segment we approached more recently and is now growing significantly for our brand." He adds that the strategy is to move in steps, from one application where Yanmar is successful to the next and most similar segment.

LOCAL DRESSING

A few years ago, Yanmar also introduced a new production approach called Local Dressing, which Giudici explains has been a very successful initiative for customers. "Local Dressing means that we receive 'lighter' engines from our parent company in Japan and we dress them later for the various applications. This operation step is carried out in our Italian plant which is historically known as the production centre of our L-Series, air-cooled engines."

This initiative started with small numbers but gained popularity among customers and now is available across Europe.

"Local Dressing gives us significant advantages in flexibility, especially with small/medium customers that have different dynamics and timing requirements in comparison with bigger companies," explains Giudici. "The process of moving from sample to mass-production, which is usually very time consuming, can be drastically shortened by taking advantage of the leaner and more customer-focused Local Dressing procedure."

Yanmar 4TN101 - the company has sold 700,000 Stage 5 engines in Europe

Giudici adds that there have been cases where a project was first launched with the Local Dressing setup and later moved into a more conventional procedure. Every case is dealt with according with the best solution available.

"Local Dressing is available for all Yanmar electronic common rail engines and we are extending it to the new, larger engines with 3.8 and 4.6 L displacements. We believe this approach will be even more appreciated by our customers."

Finally, Giudici says that having started in Italy, Yanmar's European organization is gradually being strengthened to better respond to growing demand and increased workload. **dpi**

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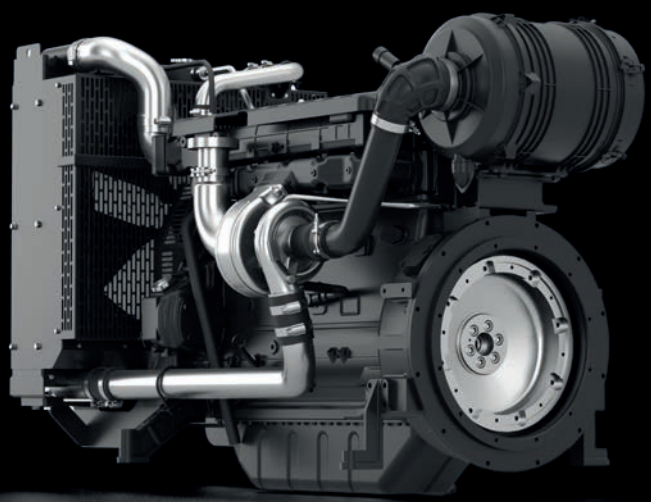

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South America's agricultural industry dodges COVID

While COVID has impacted large swathes of the economy, our reporter finds that regional agrimachine manufacturers are performing well. By **Mauro Belo Schneider**

Agribusiness in South America has demonstrated some extreme resilience during the COVID pandemic. In many cases, the sector became stronger, as international contracts and commitments were fulfilled without disruption.

This is the view of Eduardo Nunes, director of Marketing at Massey Ferguson. He says exports by AGCO South America, owner of the agricultrual machine manufacturer, grew 61% due to tractor sales. Products made in Brazil have been shipped to all countries in and around South America, with the hottest destinations being the Dominican Republic, Argentina, and Ecuador.

The Brazilian market for agricultural machinery and equipment continues to trend upwards. Forecasts are pointing to double-digit growth (around 30%) across the sector, according to data from the Association of Equipment Manufacturers.

"Good commodity prices and the positive impact of the exchange rate make farmers invest in machinery and equipment to gain more efficiency and productivity. We see this movement in South America, especially in Brazil. This scenario has had a positive impact on the brand performance in the Brazilian market," stated Nunes.

With more money to spend as a result of increasing year-on-year output, Brazilian farmers have invested in agricultural machinery to build on those numbers. Today, farmers are looking for equipment designed to support precision farming, with built-in guidance, telemetry, and monitoring systems. At Massey, for example, the MF 8225 sprayer was launched in 2021. Designed for medium and large farms, the sprayer combines low fuel consumption with high traction power and operational comfort.

Marcelo Lopes, John Deere Brazil

Marcelo Lopes, sales director at John Deere Brazil, agrees that while COVID has meant restrictions on many activities, others have been boosted. Since the start of the pandemic, John Deere dealers have been aiming to improve virtual connections with customers. This has resulted in more than 85% of service calls being resolved remotely. The online support has meant less down time and more productivity - and the service was implemented without the need for massive investment.

STRONG DEMAND

John Deere is continuing to export products developed in Brazil to countries around the region and also some African countries. That's in addition to the major global markets where demand for technologically-advanced machines, such as the CH950 sugarcane harvester, remains strong.

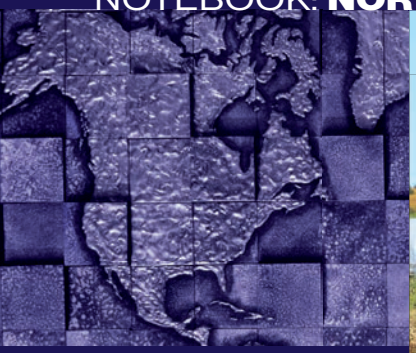
John Deere's annual report shows a 69% increase in net income in Q4 of fiscal year 2021, reaching $1.28 billion.

John Deere CH950 sugarcane harvester

Across the last fiscal year, growth was 117% above the same period in 2020. Sales in South America are forecast to increase a further 5% in 2022.

"Here in Brazil, demand for new and used machines is heated, the producer is more capitalized and understands the return on investment," explained Lopes.

He continued: "The lack of subsidized credit has an impact, mainly on small customers. Large and medium-sized producers get resources at slightly higher rates, but they do get them. We need to better understand the country's macroeconomic standing at one of the most challenging times of the last century and particularly over the last two years." **dpi**



Solectrac E70N battery-electric tractor

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Automation and robotics deliver World Ag solutions

Autonomous vehicles and robotics take center stage in the 2022 World Ag Expo Top 10 New Product Winners. By **Ronnie Wendt**

Farmers across the country are embracing the benefits of robotic machinery. These machines can improve safety, efficiency and work consistency; with higher speeds and closer tolerances, they operate with fewer errors. They can reduce pesticide use by up to 80% by spraying weeds and pests only where needed. They replace human operators who can then focus on other jobs. And they tackle repetitive tasks that can affect human health.

The trend toward autonomous vehicles and robotics was highlighted in the 2022 World Ag Expo Top 10 New Product Winners. The top machines, exhibited and demonstrated in February at the show in Tulare, California, ranged from simple solutions to autonomous robots and EVs.

Mini Guss is a downsized version of earlier award winner

"Every year the contest seems to have a different flavor," says Jennifer Fawkes, marketing manager of the International Agri-Center. "This year, entries have focused on autonomous equipment, technology solutions and EVs."

Fawkes attributes the shift to government regulations zeroing in on EVs and related reductions in greenhouse gas emissions; the technologies that make it possible and a willingness among farmers and ranchers to embrace innovative solutions.

This year's contest entries address key concerns related to battery life, repairs and operation, she says. "We've seen demonstration tractors from Case and other manufacturers in the past, but we haven't seen ones that are out in the field consistently [until now]."

One winning example is the Solectrac E70N, a battery-electric tractor designed for use in vineyards, orchards and similar commercial farming operations. The 70 hp motor offers the power of a similarly sized diesel, while delivering instant torque and no noise or exhaust emissions.

To demonstrate its work potential, the tractor will pull a tram carrying show visitors at this year's World Ag Expo. Overnight charging will be completed with a 220 volt (50 amp) charge, or in six hours with an 8 kW solar array. The battery pack has an anticipated lifespan of 10 years, dependent on operating cycles and depth of discharge.

Autonomous agricultural equipment manufacturer Guss Automation first made the top 10 list in 2018 with the Guss autonomous sprayer. The company's second win was for the mini Guss, a compact version of the earlier machine that allows vineyards, hop growers and other high-density fruit farmers to realize the benefits of an autonomous sprayer.

"Guss was the first company we saw that was ready to go to market with autonomous machines," Fawkes says. "The mini Guss can run 24/7."

WORKER BENEFIT

Entries also trended toward robotics that make jobs easier for human workers, says Fawkes. She highlights the IT Rover by Insight Trac, a robot which kills pests as it travels down orchard rows, while also collecting data about crop performance.

The award-winning Burro offers similar capabilities. The collaborative robots help people work more productively, while building a base platform for more automation. Burros use computer vision, high-precision GPS and artificial intelligence to navigate autonomously, supporting workers as they scout crops or carry produce and tools.

"It's a wonderful use of assistive technology to reduce repetitive tasks and keep workers healthier," Fawkes says. "It doesn't take jobs away from workers but makes their jobs better." **dpi**

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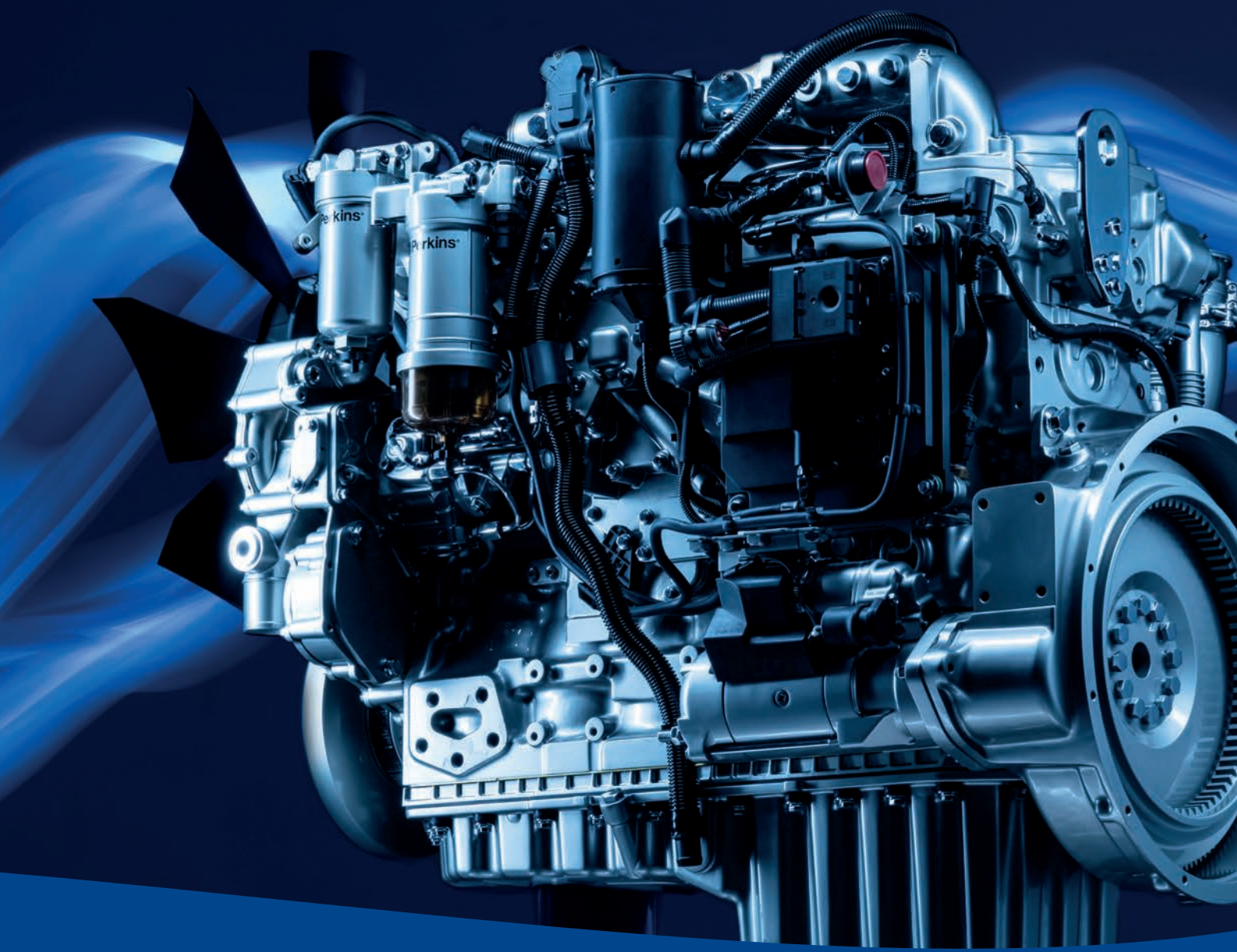

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