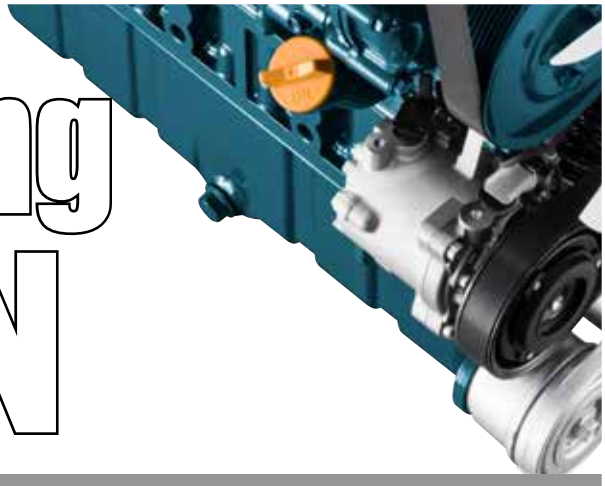
DIESEL
INTERNATIONAL

Rising SUN



2019 DIESEL OF THE YEAR KUBOTA V5009

Kubota V5009 is the Diesel of the year 2019

Cummins 100 years - MEE & BAUMA - DRiV - MTU - FPT

Comparisons: 1.5-1.7 liters and 4 liters - H as Hydrogen

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April 2019

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DIESEL INTERNATIONAL

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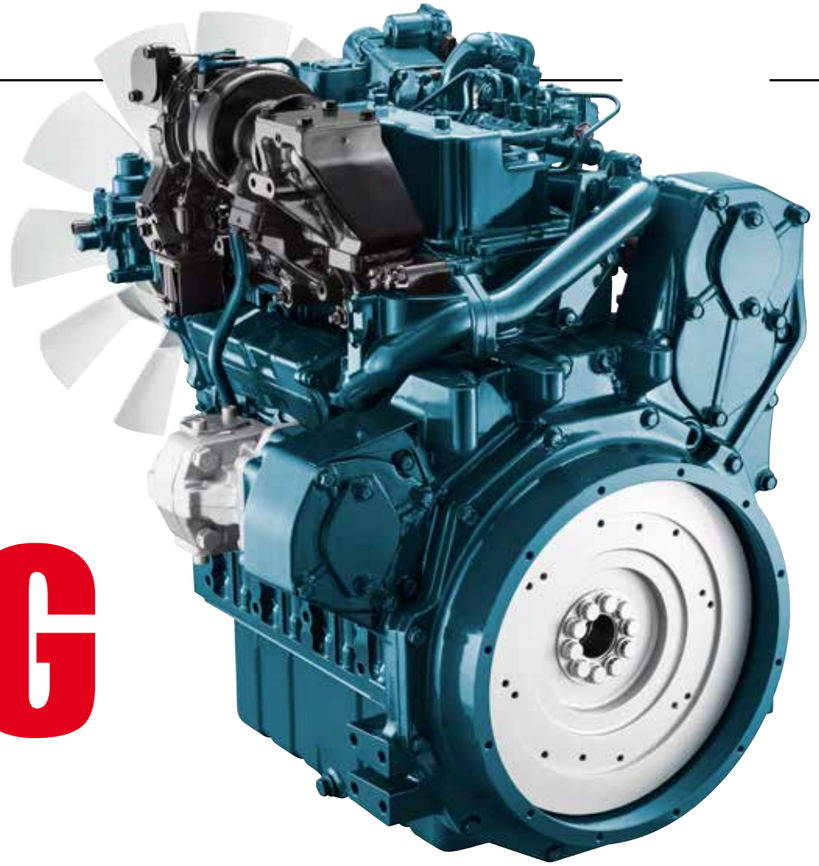
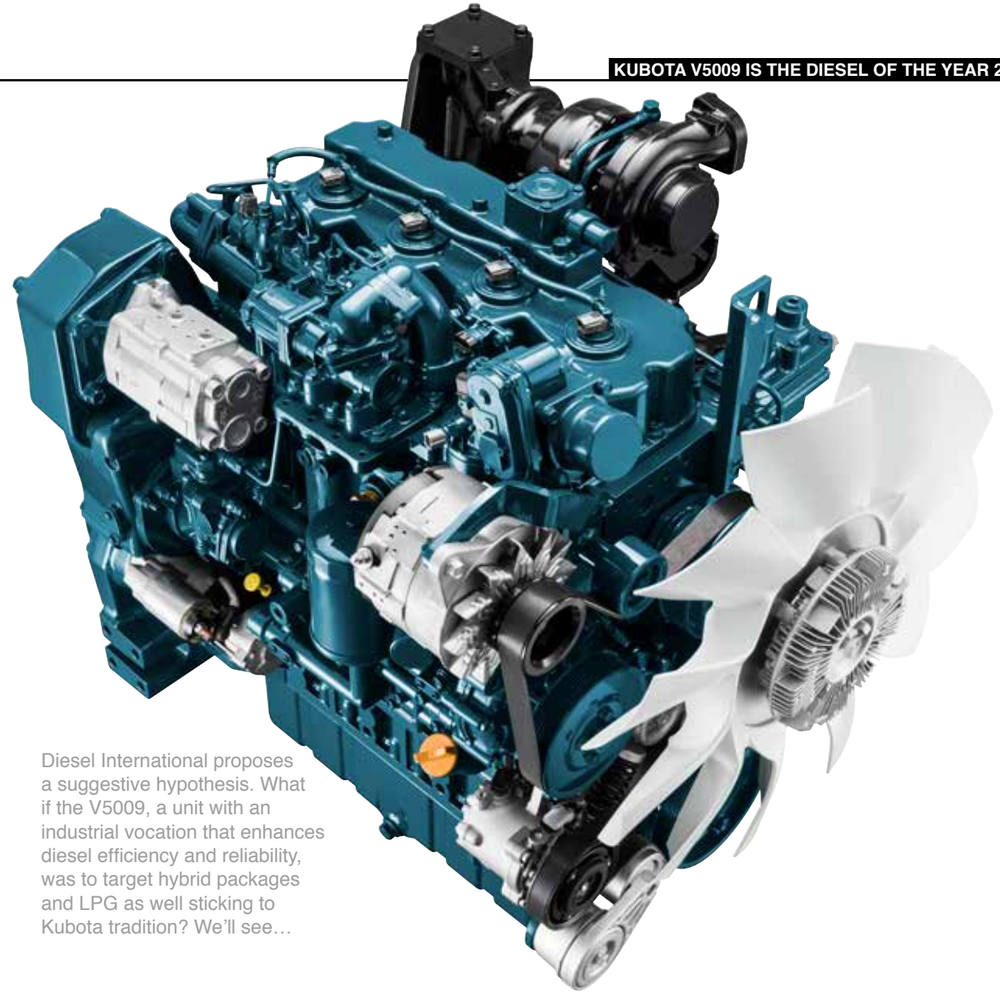
Klaus Dittrich, CEO of Messe München
«We've taken account of the rise in demand and expanded our site in eastern Munich to 614,000 square meters»

KUBOTA V5009

RISING SUN FLAG





Diesel International proposes a suggestive hypothesis. What if the V5009, a unit with an industrial vocation that enhances diesel efficiency and reliability, was to target hybrid packages and LPG as well sticking to Kubota tradition? We'll see…

2019 DIESEL OF THE YEAR KUBOTA V5009

Monday April 8th at 11.00 am
Kubota stand A 4.239 Bauma Munich

Daniel **Grant,** marketing manager, Kubota Business Unit Engine Europe, said: «*This award recognises Kubota's customer commitment to drive continuous development in new, innovative and highly-efficient industrial engines that meets the market's needs*»

The Kubota V5009 is the Diesel of the year 2019. This is a story that starts from afar. For the general public the first milestone was in Las Vegas, March 7, 2017. In the Nevada desert Kubota is "guilty" of a double heresy: the 5 liters shuffles the cards by raising the bar of the traditional Japanese segmentation and dispelling a myth at the same time: for the first time, the brand from Osaka announces an engine that will be launched in 2020, that is three years later. 2020 is now near, the V5009 has premiered on the European catwalk in 2018 at the Intermat in Paris and is about to make its debut at Bauma, where it will complete the transoceanic parade in the sanctuaries of earthmoving machines in a complete different light, that of the first non-European or American engine to win the Diesel of the year prize. Why? On our January issue you read about the Osaka double, which has won the final prize rush in an unprecedented face-to-face challenge. Kubota and Yanmar share the Japanese passport, the accurate attention to details, the priority given to reliability and testing, the confidence in regeneration, the refusal to excessive sophistication. Nothing in common with automotive, no double stage for supercharging, no unnecessary complications, but here the differences begin. Although having both a clearly industrial soul Yanmar has always dared more, being among the first to feature EGR under 56 kW, DOC on single cylinder engines (the only one so far), relying almost entirely on common rail to deal with Tier 4 Final and using double stage right on another candidate for DOTY 2019, the 4TN107. Kubota for its part faced bravely an historic transition, clearly identifying a key figure in the 5-liter displacement and challenging several competitors, including Deutz who is about to move its four cylinders from 5 to 5.2 liters, Isuzu, JCB, MTU, Agco Power and Volvo Penta. Although being Osaka very discreet about the subject, we are convinced that this displacement is very suitable for the hybridization of various mobile and semi-stationary applications. The impatience in announcing this engine at a very early stage, a heresy for Kubota's rigorous policies, testifies the confidence of the Japanese in this target. The 4.3 – 5 liter combination, moreover, broadens the potential of Kubota 3.8 liters for OEMs, one of its best sellers, opening new horizons in terms of application. In this way the Japanese are likely to cover applications that were out of reach before. From 10 to 157 kW there is space to meet the requirements of material handling, specialized and farm tractors, multi-purpose, drilling, low and medium power excavators. The V5009 proves to be substantially aligned with specific Yanmar curves; maximum torque however takes off, due to the increased cylinder compared to the 4.6 liters TN107. Its small footprint is particularly noticeable and meets one of the most demanding requirements of the market, the lack of space in engine compartments. What most intrigues us are the studies on the reliability of the engine block and the resistance to thermal, environmental and mechanical stresses. Here Kubota brings again on medium and heavy duty machines its family feeling that made the brand a protagonist in the mechanization of mobile applications. Osaka engineering isn't certainly fond of the "surgical" approach to mean effective pressure. Let's quote the management of the European division from the interview published in our January issue: «*The central philosophy of Kubota is to achieve a perfect balance between performance, quality and cost*». Another starting point for interesting interpretations is the following: «*We must also consider the steady improvement of transmission lines that could enhance the five liters compared to the classic six cylinders, also due to the consolidated trend towards downsizing, the reduction of fuel consumption and TCO*». **Fabio Butturi**

The Kubota V5009 is the Diesel of the year 2019. This is a displacement that opens the doors to downsizing and hybridization. This new high-end engine opens a new era for the Japanese revamping the reliability of diesel on industrial applications

DANA OERLIKON

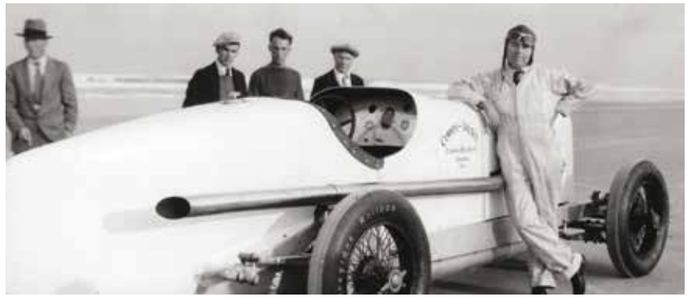
FEELING WITH ITALY

> “We will now concentrate in sustaining the growth of our surface solutions and manmade fibers businesses” Roland **Fischer**, CEO of Oerlikon Group

Dana pushes on shopping, especially in Italy, where, after taking over Brevini, it raises the flag on Graziano facilities, which have become part of the Dana galaxy together with Oerlikon Fairfield. This acquisition expands the company’s capabilities in electrification and strengthens its manufacturing presence in key growing markets. In particular, the addition of the Drive System segment has opened for Dana different growth prospects for the future. First of all, the expansion of the current technology portfolio. Particularly in the field of high precision helical gears for light and commercial vehicles, as well as planetary gearboxes for wheeled and tracked vehicles in the off-highway market. Secondly, an increase in know-how in electronic control systems for transmissions and drivelines. There is also a clear prospect of enhancing Dana’s global presence, to get closer to markets such as China, India and the US. Finally, James Kamsickas, President and CEO of Dana, said: «*The acquisition by Dana of the Drive Systems segment of Oerlikon allows us to support the passage of customers towards electrification. In particular on almost all the architectures of light, commercial and off-highway vehicles segments. The highly talented team of Drive Systems is also already in a strategic position on the market. The goal is to offer our customers access to critical manufacturing capabilities in key growing markets, such as India, China and the US*». Dana has also completed the acquisition of the SME Group, based between Verona and Venice. SME Group designs, engineers, and manufactures low-voltage AC induction and synchronous reluctance motors, inverters, and controls for a wide range of off-highway electric vehicle applications. ■

WALVOIL CED1200S

With Hardware Category 2, the Walvoil CED1200S can be used in applications up to Performance Level D / SIL 2. It is programmable according to the IEC 61131-3 standard with PHC Studio Integrated Development Environment. This unit is completely sealed and protected against water and dust ingress (IP67/IPx9K). There are 24 general purpose inputs, 2 CAN bus ports and a 5V sensors supply output.



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CATERPILLAR C9.3B STAGE V

Productivity, energy efficiency, and power density are the keywords ruling Cat's industrial engines. Jeff **Moore**, product director, research and development for 7.2 to 18 liters engines, commented C9.3B Stage V certification: «*End users will see this refinement pay off with increased performance, up to 3 percent less fuel consumption and exceptional starting capability in cold climate. Design is 39 percent smaller and 55 percent lighter than the EU Stage IV/Tier 4 Final*».

HATZ STAGE V

KBA CERTIFIED EU STAGE V THE FULL LINE OF THE GERMAN ENGINE SPECIALIST

Hatz can apply the Stage V mark to the full range. At Ruhstorf they have received official certification for its EU Stage V-compliant engines for mobile machines from the German Federal Motor Transport Authority (KBA). The certification applies to air-cooled engines of the B-, D-, G-, L- and M-series with a power output of less than 19 kilowatts. Focused on ultra-compact engines, Hatz is now able to supply diesel engines for the European market outside the H-Series. Obviously the 3H50TICD and 4H50TICD as well are now available with an official EU Stage V certificate. The three-cylinder and four-cylinder engines are equipped with a separable – and therefore very maintenance-friendly – combination of DOC and DPF. Compared to the Bauma audience, the certification opens up interesting opportunities in the mature and competitive target of German and European manufacturers, where Hatz boasts references among vibratory plates, rollers, skid steer loaders and other compact construction machines.

Johan Van Der Boot

BIMOTOR AND THE 4.0 WAREHOUSE

At Bimotor's headquarters you can breathe an effervescent air for the countdown to the inauguration of the automatic warehouse. The warehouse, with a storage capacity of 1,240 engines, is under construction and will also be used for stockpilling. Bimotor is the FPT Industrial distributor for Northern Italy, Slovenia, Croatia, France (and Overseas Territories), Spain and Portugal. In 2018 it sold about 6,540 engines.

PATRINI T63W

T63W is the new metal rubber anti-vibration support by Patrini Giacomo & C. In fact, it aims to isolate the vibrations that disturb the heat engines. In particular, it has an internal geometry specifically designed to support high loads, thanks to the amount of rubber inside. The every-day job of the T63W concerns working in close contact with static or towed motor pumps in the various heavy applications of construction sites. In fact, it has a threaded central hole in M10 or M12 with an anti-tear safety system that can withstand plastic deformation up to 2g dynamic shocks.

CUMMINS@MEE DUBAI

NATURALLY NATURAL GAS

"The HSK78G models are suitable for a diverse set of industries„ said Craig **Wilkins**, Director of Cummins Prime Power Segment

March is the debut of a new season in every sense. That's the message launched by Cummins at Middle East Electricity (MEE) with the debut of the HSK78G natural gas generator series, which includes a package of gas generator capabilities and innovative gas technology for prime and peaking power applications. Delivering power densities up to 2.0MW from a 78 liters engine, the HSK78G generator series has been designed with reliability in mind regardless of the natural gas source or the climate, including extreme heat and altitudes, and it's a challenge launched by Cummins to the gas market thanks to a solution that is meant to deliver efficiency, transient performance and gas variation beyond former natural gas generators. According to Craig **Wilkins**, Director of Cummins Prime Power Segment and Global Sales Support, «*the new generator series have been designed to achieve better performance and a low TCO. A high electrical efficiency of up to 44.2 percent (50Hz) and 43.5 percent (60Hz) is achieved on a wide range of pipeline natural gas down to 70 methane number (MN) without impacting power output and efficiency. The fuel flexibility of the HSK78G enables the utilization of low-cost, low-BTU and free fuel sources, that would otherwise be considered waste products, delivering robust power even with very aggressive fuels with minimal derating. By eliminating the need and the space required for gas-cleaning systems customers can optimize their capital and operational expenditures*». The efficiency of the HSK78G is maintained by automatic engine adjustments, which account for fuel quality changes and quick load-step performance, without the need to calibrate or switch off the engine. In the case of a grid failure, the HSK78G can also switch to island mode offering more reliability. **F.B.**

OREFICE GENERATORS AND BAUDOUIN

Orefice Generators and Baudouin, a case history from Sardinia. Andrea Orefice said: «*We appreciated the same level of power in both turbo and aspirated versions. For some applications, such as standby, we prefer naturally aspirated, which require a different sizing. This cooperation began with the naturally aspirated, from 30 to 100 kVA. Then we went up to 1,000 kVA*».

PERKINS PG

STAGE V, 1706 A-E93TAG2 AND MY ENGINEAPP IN THE SPOTLIGHT

Perkins brought the Stage V range ready also for power generation applications under the Dubai sun. The 9.3 litre upgrades were made focusing on power density, as you can read in the MEE report on page 18. «*The 1706 delivers the highest power capability in its class*», said Jaz **Gill**, Vice President global sales, marketing, service and parts. «*We have leveraged state-of-the-art technologies to give customers an engine that provides customers with world-class levels of performance*». The full engine range will cover the range between 0.5 and 18 litre and from 4 to 560 kVA. The Perkins family is designed to ideally suit to a range of mobile electric power (EP) applications including light towers and rental equipment. The range is being built in Peterborough, UK; Seguin, Texas, USA; and Wuxi, China. Perkins updated My EngineApp, available for mobile and stationary applications as well. Italian and Turkish have also been added to English, French, German, Portuguese, Spanish and Chinese. **Joao Carvalho**

JOHN DEERE FOR BREDENOORD

John Deere PowerTech 4.5L and 6.8L help to supply energy without a break, and they accomplish their mission together with Bredenoord. Through NPS dealer, John Deere has powered the Bredenoord 80-, 100-, and 125-kVA rental gensets by 4.5L, fitted by a variable speed fan, created by NPS. The larger 6.8 gensets are poweed by 6.8L. Who is Bredenoord? To make an example, the Dutch company was been able to provide 7 MW backup installation within 12 hours.

VOLVO @ MEE

STAGE V IS ALSO A PURE REALITY IN GÖTEBÖRG. D16 IS TIP OF THE ICEBERG

«*The D16 is just tip of the iceberg. We are currently working on a full range of Stage V-compliant engines for mobile gensets*» is a statement by Kristian **Vekas**, product manager for genset engines at Volvo Penta. The 16 litre is the top of the range of Swedish industrial series and is the only one that is not coupled to IPS for pleasure boats. If and when it does, then there will be no limits for the Volvo's pod. The dual speed engine, switchable between 1,500 rpm (50 Hz) and 1,800 rpm (60 Hz), delivers 570 kWm and 596 kWm respectively. The Swedes are thus able to meet the demands of gensets between 500 and 600 kVA, which is becoming increasingly strong from the market. D16 approaches the SCR only technology, without any EGR and DPF. «*Being an independent supplier allows us to support our customers all the way, from the design stage to installation and aftermarket service through our worldwide network of Volvo Penta dealers*», says Giorgio **Paris**, head of the industrial segment at Volvo Penta. **John Fanti**

MAN ENERGY SOLUTIONS AND STORAGE

Developed jointly with ABB, it is called Power-to-X, and is MAN Energy Solutions' answer to ETES, acronym for Electro-Thermal Energy Storage. Uwe Lauber, CEO of MAN Energy Solutions, said: «*The use of storage technologies with different capacities is essential for the future success of the energy transition. It will only be possible to reduce CO2 emissions if renewable energy is also available outside of the grid*».

MERCEDES BENZ ENERGY

There is a new star that shines in the firmament of energy production, that of Daimler. According to Mercedes-Benz Energy R&D Automobile battery storage systems can take over tasks from large-scale power plants and make a significant contribution towards power grid stabilisation and system recovery. The prototype of a battery storage system made up of automotive batteries with a total connected load of approx. 1 megawatt (MW) and a storage capacity of 750 kilowatt hours (kWh) was installed at the test centre in Kamenz.

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HATZ DIESEL

DIESEL GATE AND THE EUROPEAN COURT

PROBLEM SOLVED? MAYBE

The European Court of Auditors document reads as follows: «The EU legislation on vehicle emissions has improved, but some issues remain; manufacturers may find ways to evade the new testing systems and third party independent tests may be limited due to substantial costs».

«*In Germany*» the document states «*Volkswagen has agreed to pay 1 billion Euros to Lower Saxony and Audi, and 800 million Euros to Bavaria for obtaining undue benefits and for failing to adopt the appropriate surveillance measures. In Italy, the competition and market authorities have fined the Volkswagen group for 5 millions*».

Compared to the pre-dieselgate the current situation has dramatically changed (for the better):

New tests have been introduced to fill the gap between the levels of CO2 emissions measured in laboratories and on the road. The WLTP-World Harmonized Light Vehicle Test Procedure has been adopted worldwide as the new standard for the homologation of pollutant emissions, and all newly registered vehicles will need to comply to its requirements from the 1st September 2018. The WLTP replaces the NEDC.

The new RDE-Real Driving Emissions has been introduced to measure NOx emissions in real driving conditions.

Some issues addressed by the European Court of Auditors:

Manufacturers may optimise vehicles for the RDE test;

A maximum limit of 128 mg/km for NOx, which was initially suggested, would have been preferable to that of 168 mg/km. In the US the limit for NOx emissions is 40 mg/km;

- The RDE test is addressed to cover normal driving conditions, ruling out, for example, temperatures below-7 °C or an aggressive driving style. **Davide Canevari**

The European Court of Auditors and the Commission itself have pointed out several flaws in the European system for vehicle emissions detection. The accusations go further: «*Manufacturers may find ways to evade the new testing systems*». These are the main issues

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MTU. LARS KRÄFT

IN THE NAME OF EARTH

Lars Kräft, MTU Vice President Industrial Business: «EGR is a well-established technology at MTU. For Stage V we added diesel particulate filter and the diesel oxidation catalyst»

MTU and the earthmoving, Munich, so close at home. We ask for guidance straight to Friedrichshafen. Lars **Kräft** is the MTU Vice President Industrial Business.

A typical example of a hybrid application is the dumper truck. On the one hand the competition from CAT and Cummins, on the other a face as new as it is illustrious as that of Liebherr. Is the Chinese market the new frontier, as shown by XCMG and NHL?

MTU has a strong position in Europe and invests in global expansion to satisfy customer needs. OEM's outside Europe, e.g. in Russia, nowadays focus on product quality which empowers them to sell their machinery in Europe. Technological advancement in these markets is a key success factor for MTU as we are known for high quality, reliability and outstanding performance. We have a strategic focus on the German market, Europe in general and the US market. In the construction application we are focusing on mobile cranes and excavators, especially in Asia.

> "Regarding electrification and hybridization we are focusing on marine, rail and powergen applications for the moment. We are now working on pre-studies and see possible applications e.g. in port facilities and underground mining"

By focusing on the market as a whole, does construction confirm the positive trend?

Yes, we see a positive growth in the construction business. For us especially Asia is very interesting with China and Japan. The prospects of the BRIC countries remain exciting.

Mannheim is still the plant that produces for both MTU and Daimler. Will there be further developments and synergies between the two companies in transferring future truck technology into construction machinery?

We benefit from the Daimler kit and its further developments. We are in a steady exchange to develop our portfolio. Global emission regulations demand for certifications. Hybrid solutions may also be interesting one time.

In conclusion, what news should we expect at Bauma and what's going in the near future?

For visitors interested in our C & I portfolio we will present our MTU Series 1000, 1100, 1300 and 1500 which have been available on the market as production Stage V engines for customers since June 2018. MTU is also showing its one-box SCR solution for exhaust gas aftertreatment. This system is both compact and robust as well as being easy to use, install and clean, thus ensuring it complies fully with the requirements of vehicle manufacturers and operators alike. For visitors interested in our Mining products we will show new digital service solutions. Digitalization is a central theme for us: It enables us to connect our customer service, our product development and our international network to meet our customers' needs in the best possible way. In the near future we see a new market in microgrids. With regard to cost efficiency and to environment protection, electricity derived from renewable energies is more and more demanded on construction and mining sites. Decentralized microgrids, combining classical electric power sources i.e. diesel generators, CHP, batteries, capacitors and fuel cells with renewable energies such as photovoltaic, wind or water power will more and more complement and replace central power plants. Microgrids can be installed in remote areas and next to where the power demand occurs. MTU is now adding turnkey microgrids to its current portfolio. In addition to the diesel and gas gensets MTU now offers battery containers, include renewable power generation plants, and combine that with intelligent control.

Fabio Butturi

A STRONG RELATIONSHIP WITH DIESEL

Diesel International: Do you think that diesel will still be the dominant propulsion system for the whole of the next decade?

MTU: «*In the near future, diesel engines will remain an important power source for construction applications but are more and more accompanied by, combined with or even replaced by other power sources, depending on the field of application and the infrastructure in the area of operation. The high power density of diesel oil cannot yet be replaced by other power sources such as batteries used for E-drives. Hybrid drive solutions based on diesel as primary energy source are in increasingly interesting alternative wherever repetitive movements with acceleration and deceleration phases invite for energy recuperation either electric or hydraulic, i.e. in loading equipment. Gas engines will increasingly find their way into mobile machinery in the off-highway sector as they did in stationary applications i.e. as CHP plants*»

MIDDLE EAST ELECTRICITY DUBAI

DOING BIGGER IS BETTER

MIDDLE EAST ELECTRICITY
ENERGISING THE INDUSTRY
6 – 8 MARCH 2018
DUBAI WORLD TRADE CENTRE, UAE

The event suffered the absence of MTU, Caterpillar and Himoinsa and of Indian builders, such as Mahindra Powerol and Kirloskar, and also of many OEMs like Bruno Generators to make another European example. The event followed a double trajectory: the promotion of gas and the top segmentation of displacements. Based on what PSI showed at the PowerGen in Orlando, the competitors reacted by crowding the large displacement audience. The first signal, loud and clear, came from **Cummins**, with a 78-liter engine, capable of delivering up to 2 megawatts and a thermal efficiency of 47.1 percent. The name is HSK78G, a supercharged 12-cylinder engine, with a compression ratio of 13:1 and an electrical efficiency of 44.2% for 50Hz and 43.5% for the 60Hz models. The HSK78G does not fear thermal excursion: it doesn't weaken at 50 degrees at an altitude of 500 meters and 25 degrees at an altitude of 1,500.

Baudouin was present, having played a leading role in the sector over a two-year period. The big bang of the 16M55 research and development dates back to four years ago, a 16-cylinder engine with a 5.5-liter barrel that for 50 Hz applications is able to deliver from 3,000 to 3,750 kVA. It is the pioneer of the family that by 2022 will also include a 20-cylinder engine. Among the new faces, also the 4M11, with variable revolutions.

Middle East Electricity is still the most important event for power generation. Baudouin and Cummins unveiled large engine displacements. The main themes: gas engines and Stage V

At **Perkin**s booth the 1706A improved its power density by over 22 percent. A result due to an overall recalibration of combustion, piston bowl geometry and injection. The starting point is good: the 9.3 liters is in fact best in class in its category for mobile applications, according to the Diesel Index. The news, however, concern the officialization of the Stage V approval for the entire EP (Electric Power) range. Perkins brought the benefits of modularity of the after-treatment package from off-road to stationary engines. Jaz Gill, Vice President of global sales, marketing, service and parts, said: «*We have made a significant investment across our Stage V engine range to provide power dense and efficient engines, ensuring low consumption of Diesel exhaust fluid*».

Scania is also focusing on gas, continuing on the "road" of the truck sector, where it shares the scene of LNG with Iveco, also involving the bus sector. The protagonist is the V8, presented as a world premiere for biogas engines, derated compared to its diesel parent, with a redesigned software mapping and a different compression ratio: from 364 to 455 kVA at 50 Hz in PRP and 360 in COP (respectively 409 - 477 kVA and 383 kVA at 60 Hz).

The common denominator is the Stage V stamp, with a reduction of 5 percent in terms of consumption and sharing spare parts, diagnostics and assistance network with its street parents. **Doosan** was also present and unveiled the pioneers of electronically controlled G-drives. Bosch injection, DOC, DPF and SCR for the highly regulated emission versions, from October they will be available in two sizes. The DX12 is a 6-cylinder in-line engine, 11.1 liters, 414 kW at 1,500 rpm, 448 kW at 1,800 rpm, while the DX22 is a 21.9-liter 12-cylinder V-engine, with 875 kW at 1,500 rpm, 995 kW at 1,800 rpm. The compact engines of the G2 Stage V family (D18, D24 and D34) were also on display.

John Deere has exhibited, among others, the EWS, made in Saran, the 4.5-liter G-Drive complete with after-treatment system but without EGR, to promote a better thermal balance. Deere also showed the whole Stage V family. Compared to mobile applications we can see the same recipe (DOC, DPF and SCR), but there was a change in the setting of the software, optimized for stationary loads. Icing on the cake: the certificate of compliance with RoHS2 regulations.

FPT Industrial has brought the 55 kVA F34, which recovers the recirculation, here named ecEGR, which had been banned from the NEF and Cursor series. The exhibition also included the 'revival' of the protagonists of the last two editions, the 600 kVA Cursor 16, the S8000 and the N67.

Recorded presence also for KDI engines at the **Kohler SDMO** booth. ■

MADE IN INDIA AND CHINA

India was represented by **Coper**, featuring Bosch injection for the 20 kVA 2 cylinders together with 4 and 6 cylinders. Among the Chinese manufacturers, **Yuchai** displayed its 4.2 and 19.6-liter G-Drives and the **Raywin** brand, which features a 3 cylinders, one liter engine and a 4 cylinders, 2.45 liters in the power generation, both aspirated or supercharged. The **Lovol** 1100 series features the 1 liter cylinder, a 6-cylinders engine block for 6 liters, 129 and 142 kW in prime and stand-by and Bosch electronic control. **VMan** featured besides the displacement derived from Man (BxS 128x142 mm) a larger displacement - from 27.6 to 97.6 liters, **Beinei**, which covers medium-low powers, and **Lambert**, focused on 9.7, 11.6 and 12.6 liters.

MENA Power Industry Outlook 2019: «*The GCC countries' grid inter-connectivity is expected to generate USD33 billion in investments, economic and energy savings over the next 25 years a pragmatic and multi-level approach*».

BAUMA PREVIEW

PUSHING ON INNOVATION

bauma
APRIL 8-14, 2019, MUNICH

Let's get the ball rolling! Bauma 2019, two brand new halls, a total of 614 thousand sqm, 200 thousand indoor. Exhibitors will be one hundred more than in 2016, despite JCB absence. Electrification of operating machines is going to be a hot topic. And what's the answer of the champions of Diesel cycle?

Kubota replies with its V5009, Diesel of the year 2019, and the segmentation from 1 to 2 liters, playing the dual fuel card. **Yanmar** equipped the 2.2 and 3.3 liters with three-way catalyst for LPG: 4TN88G and 4TN98G, delivering 45 kW at 2,600 rpm and 175 Nm at 1,800, 63 kW at 2,500 rpm and 264 Nm at 1,200. The 3.8 and 4.6 liters introduced at Intermat will also be displayed, and the Stage V approved LV series.

Speaking of single cylinder, **Hatz** will have a lot to say. With its E1 technology, Hatz enables applications such as mobile lighting towers or generators to be propelled into the era of the Internet of Things. According to Bernhard Richter-Schützeneder, Director of Sales and Marketing: «*With our new E1 technology, Hatz offers the platform for the next logical step, for the first time integrating machines with small engines into the advancing world of digitisation*».

The ICE answer to electrification hype? Two LPG by Yanmar, Kubota brings in dual fuel, Hatz its single cylinder Stage V, Man D1556 and D4276, FPT the Cursor X, Kohler the K-HEM, John Deere the 13.6L

Let's stay in Germany with **MAN**. Two previews: the D4276, from 450 to 515 kW, and the construction version of the D1556. The latter is a 9 liters (BxS 115x145 mm) that was launched at Agritechnica 2017. Plastic oil sump and no EGR - which is a traditional MAN feature show its industrial vocation.

Kohler follows the effects of Eima. The Ldw1003 three cylinders is the endothermic core of the K-HEM. The hybrid module, initially designed for material handling, delivers 8 continuous electric kW and 15 peak kW. The hybrid formula will probably be replicated by Kohler on other models, KDI in the first place, even if we do not know exactly when.

Also **Liebherr**, 10 billion turnover last year, is looking at electrification. The brand will also show the 18 and 83 liters (in the same D98 family, DOTY 2017) and a transmission unit including diesel engine and hydraulic package. Others are looking into the near future. **FPT Industrial**, for example, brings in the Cursor X unveiled at Tech Day. This multi-purpose concept is characterized by modularity, versatility and reversibility of the power source: natural gas, hydrogen fuel cell or electric with battery pack. Power Source 4.0 may be equipped with processors and sensors for fault detection, wear analysis and predictive maintenance. Electric power also for E-Axle, Transfer-Box and the mild hybrid powertrain, where diesel communicates with E-Flywheel and E-Turbocharger. Among the most conventional endothermic models we find the F34, the Cursor 9 and the powerpack. A **Perkins** quintet will represent the Stage V family, ranging from half a liter to 18 liters and from 4 to 597 kilowatts. It's quite clear that Bauma's main themes will be Stage V and hybridization. In Peterborough they have clear ideas about the latter subject. According to Matt Coleman, Product Director, «*For construction machines, it's not sufficient to simply carry over hybrid or electric technologies from other sectors such as truck, automobiles or marine. The duty cycles, operating conditions and packaging constraints for off-highway machines drive the need for specific configurations that are highly customised to the individual application*». Still talking about hybrids, the ones from **John Deere** are working for over a million hours. 644K and 944K hybrid wheel loaders have been in operation since 2013 and 2015. Under the spotlight in Munich we'll see the Stage V range, from 36 to over 500 kW, including the 13.6 liters designed to reduce fuel consumption and size while increasing power compared to 13.5 liters.

Klaus Junker

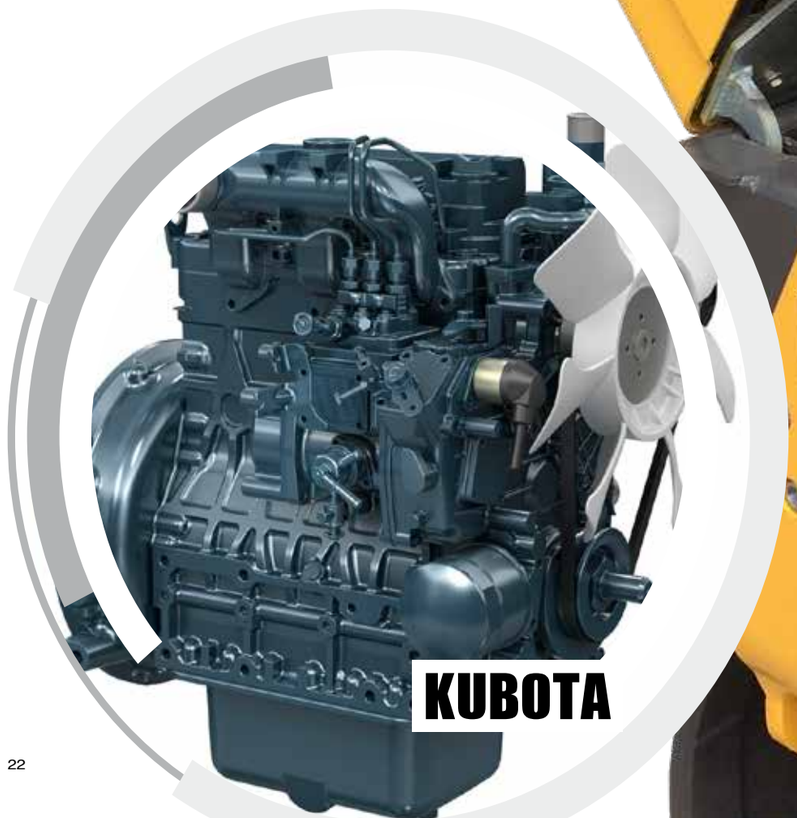
DEUTZ @ WORLD OF CONCRETE

At the Wolrd of Concrete in Las Vegas, Deutz unveiled two engines below the 2.2-liter and 19 kW mark. The two new diesel engines are the D1.2 and D1.7 and will market them under its own brand name from the second quarter of 2019 onwards. The two compact three-cylinder engines, with a capacity of 1.2 and 1.7 litres, will initially be available in the Americas. They are designed to meet the needs of customers who are looking to power machines like small aerial platforms, trenching equipment and mini skid-steer loaders. These small diesel engines can deliver high levels of torque that is usually only available in models with a higher power output and they represent an additional option from Deutz in response to the 'downsizing trend' of the market.

Klaus Dittrich, Chairman and CEO of Messe München: «*The industry is booming, which is also reflected in the growth of Bauma. We've taken account of the rise in demand and expanded our site in eastern Munich to 614,000 square meters*».

MECALAC AND TV1200 UPGRADE

ROLLER IN A STYLISH WAY



“ Mecalac updates one of best selling compaction roller, the TV1200, switching to a totally new design. Joystick only driving, no steering column and a general redesign that – while keeping Mecalac family feeling opens a new era for the French range of tandem vibrating roller ”

bauma Innovation Award 2019

After the acquisition of Terex Construction Equipment based in Coventry, United Kingdom, two years ago Mecalac founded Mecalac Construction Equipment UK Ltd, a design and production unit for backhoe loaders, dumpers and compaction rollers which since then have been added to the existing range of the French company. Being innovation one of Mecalac trademarks, it’s no surpri-

E-TVCS strikes back

It may sound surprising to some but at Bauma, on the first year of Stage V, in a blaze of electric, hybrid and certified engines, there's still a place for indirect injection system. The E-TVCS pre-chamber (Three vortex combustion system) is a high-turbulence prechamber in which the gradient of the combustion pressure is controlled downwards. Japanese engineering has been forward-thinking, and long after the 0.4 gr/kWh ultimatum (applicable from 56 to 560 kW, therefore unrelated to the SuperMini series 05, 03 and 07) imposed by Tier 4 Final had done its utmost to contain NOx without triggering the trade off with particulate and penalizing consumption. Half-float valve cover and coated pistons offer lower noise and provide reduced transmitted vibrations from the valve area. The D1703 is a 1.6 liters, 3 cylinders delivering 24.5 kW steady over 500 rpm from 2,300 and 2,800 rpm. The updated and increased version of the odd Japanese is the D1803-CR, delivering 37 kW at 2,700 rpm, available with DPF and DOC or catalyst only. Pre-chamber is gone, injection is entrusted to common rail.

A whole new design

This drastic change in human-machine interface brought to a general redesigning of the VT1200, always driven by efficiency, comfort, and safety of the driver and all personnel on the job site. The roller's entire architecture then has been redesigned for better visibility to ease operation and respond to user demands. The curves are redesigned, the shape of the roller support now integrates with that of the hood, and a front grille has been added, still keeping Mecalac family feeling adapted to road construction machines. The driver is at the centre of this new design, thanks to innovative standards in ergonomics and construction machine architecture that makes its use safer and simpler.

se that once a range of compaction rollers arrived among its offerings, the company immediately looked for ways to improve both efficiency at work and the safety of the driver. The result is the new TV1200, one of the six models of Mecalac range of tandem vibrating roller, which underwent a massive redesigning to become the first Mecalac roller to be driven exclusively with a joystick on the right console.

Besides meeting the best compaction standards for asphalt and granular layers, Mecalac TV1200 provides what the company calls "rental toughness", being also operator friendly and delivering high productivity thanks to a well calibrated combination of engine power and hydrostatic power management. Kubota D1703, a 1.6 liters, three cylinders engine delivering 24,5 kW together with Rexroth hydrostatic transmission provides excellent hill climbing ability, while the articulation and a tight turning circle makes the TV1200 a highly manoeuvrable machine. Featuring a 1200 mm wide drum, the roller delivers a centrifugal force of 24 kN at 49/63 Hz and a static linear load of 12.18 kg/cm, ensuring an optimal compaction. The operator can easily select one or two drum vibration, including dual frequency vibration.

On the basis of such a productive and effective model Mecalac engineers focused on a series of improvement areas, starting from driver's position. Most tandem rollers are manoeuvred using the wheel on the steering column, which makes difficult for the driver just to get into the seat. Once in position, he drives with one hand on the wheel, the other on the lever, all while keeping an eye on the trajectory of the front drum. So Mecalac R&D took on the twofold task of easing access and improving the driving position for effectiveness, safety and comfort. The result is the new version of the TV1200, the first of Mecalac range of six tandem vibrating rollers to be driven exclusively with a joystick on the right console. Removing the rollers steering column in fact completely changed the access and driving style of this type of machine, making access to the machine safer an driving more comfortable. The freed-up space lets the driver settle easily into position, the steps have been redesigned for easy access from any side, movements are fluid, and there are no obstacles to deal with. With their back comfortably against the seat and right hand on the joystick, the driver has complete freedom to position their legs comfortably while keeping their eye on the work. Removing the steering column also means that the driver has a clear view of the major driving information, while the joystick steering from the right console greatly simplifies driving.

JeanBaptiste Lorrain

INNOVATION AWARD

During Pre-Bauma Mecalac was nominated for the 'Innovation Award' in the Design category, for the TV1200 compaction roller powered by Kubota

MECALAC TV1200 IN FIGURES

Manufacturer	MECALAC
Endothermic Engine	KUBOTA
Total operating weight	2925 kg
Overall width	1270 mm
Overall length	2375 mm
Turning circle	7590 mm
Travel speed	10 km/h
Drum width	1200 mm
Centrifugal force	24 kN
Frequency	49/63 Hz
Static linear load	12.18 kg/cm
Amplitude	0,6 mm

NORTH AMERICA

In 2016, Mecalac established a presence in the US with an initial partnership in Massachusetts and has now moved into the Canadian market with 3 distributors

BETWEEN 1.5 AND 1.7 LITERS

SUCH A LITTLE REVANGE

Ultra-specialized machinery are set up for the 1.5 - 1.7 liters diesel engines, such as Visani landsmaschinen, in South Tirol. Other examples of applications to be fitted are wheel loaders, professional lawn mowers, multi-purpouse machines, stationary

The 1.5 - 1.7 liters range is wider than ever. The brands are the usual ones in the range under 56 kW. Kubota and Yanmar are also competing here, as usual among super-compact engines. From the Far East Kioti has an odd that fits the description, the aspirated 3A165LW, mechanical injection, which however sticks to Tier 3. Displacing 1.65 liters (BxS 87x92.4 mm) this engine delivers 26, 1 kW at 2,600 rpm and 107 Nm at 1,700 rpm.

But there's life also in Europe. Hatz, Kohler and Perkins represent the Old Continent versus the Japanese quartet. But what are the roots of these three cylinders that took up the challenge of the European Union and the EPA?

When Tier III came in DIESEL probed the one liter engines, which we talked about in the last issue. Kubota and Yanmar introduced the D 1005 (BxS 76x73.6 mm) and the 3TNV 86 (76x82). Japanese roots also for Briggs & Stratton with its Daihatsu-born 950 (BxS 72x78 mm) and Perkins with its 403C (BxS 77x81 mm) in collaboration with Shibaura. Lombardini relied on the LDW1003 (BxS 75x77.5 mm). We're in the realm of overhead camshaft, prechamber (where the Japanese planted their flag, see Kubota's E-TVCS) and in-line pump, except for B&S, which uses the rotary one, and Kubota pump injectors that used turbo on this engine. Also Lombardini (now Kohler) changed its clothes: the FOCS Plus increased the 300 cc cylinder to enter this grid and winning the power race with 21 kW, just like Perkins. The British won the highest Diesel Index.

Meanwhile, electronics broke in and imposed after-treatment. Hatz switched its H series 4 cylinders to 3 cylinders in TI, TIC and TICD versions. The latter is Stage V approved and includes DPF, weighing 12 kg more. EGR and DOC complete the package. Common rail adds a boost both to power peak - 42 kW and torque peal. 3H is awarded the Diesel Index again after winning the comparison under 19 kW followed by Perkins. The 400 series derived from IIIB the electronic injection that brought common rail, turbo, DOC and DPF even on Peterborough's smaller engines.

Kohler has also brought the 1603 into Stage V, like the 1003 that has been shown in hybrid version at Eima International. After the 3-liter, one-liter cylinder, it could be the first candidate to join the K-HEM, the hybrids in the Kohler portfolio.

Yanmar controls this range with a double, aspirated and supercharged. Just two millimeters bore gap and 18 percent power for the turbo version. Both engines are part of the common rail family and feature DPF.

Kubota strengthened up its V1505, the only quadricylinder in the comparison, which features common rail and is appreciated for its overall dimensions, in particular as regards the global density (mass-displacement ratio).

In conclusion, two other illustrious Japanese that didn't participate the

Three cylinders engines from 1.5 to 1.7 are very versatile thanks to their wide power range. Our threshold is from 30 and 40 kW, a 42 kW peak by Hatz wins the Diesel Index. The best power density? Perkins. Kubota is the only 4 cylinder although being very compacts. Yanmar scores two goals, two other notorious Japanese brands 'speak' here their voice, Isuzu and Mitsubishi

BRAND MODEL	HATZ 3H50TIC	ISUZU 3CE1	KOHLER KDW 1603	KUBOTA V 1505	MITSUBISHI D03CJ-T	PERKINS 403J-E17T	YANMAR 3TNV86CT	YANMAR 3TNV88C
I.D.								
B x S mm - S/B	84 x 88 - 1,05	88 x 90 - 1,02	88 x 90 - 1,03	78 x 78 - 1,01	86 x 95 - 1,10	84 x 90 - 1,07	86 x 90 - 1,05	88 x 90 - 1,02
Cylinders - dm^3	3 - 1,46	3 - 1,64	3 - 1,64	4 - 1,49	3 - 1,65	3 - 1,49	3 - 1,56	3 - 1,64
Max power kW - rpm	**42** - 2.800	29 - 3.000	27,6 - 3.000	33 - 3.000	36 - 2.500	34 - 2.800	32,4 - 3.000	27,5 - 3.000
Potenza intermittente kW - rpm	12,5	7,2	**6,8**	9	10,6	9,9	8,4	**6,8**
Mep at max power bar	8,2	9	9	**7,8**	7,9	8,4	9	9
Piston speed m/s	**185** - 1.600	118,6 - 1.900	106,5 - 1.600	120 - 1.800	166,6 - 1.600	165,6 - 1.600	125,4 - 1.900	110 - 1.900
Max Torque Nm - rpm	16,2	9,3	**8,3**	10,3	12,9	14,2	10,3	8,6
Torque rise %	34,2	30,9	28,6	26,3	36,2	**38,7**	28,7	30
Torque at max power Nm	**147**	88	88	108	137	118	108	88
% Power at max torque (kW)	73,9 (**31**)	81,40 (24)	64,70 (18)	68,60 (23)	77,60 (28)	81,70 (28)	77,10 (25)	79,60 (22)
DETAILS								
Specific power kW/ dm	**28,6**	17,6	16,7	22,0	21,7	22,7	20,6	16,7
Specific torque Nm/dm^3	**126,5**	72,2	64,5	80,1	100,6	110,7	79,9	66,9
Areal specific power kW/dm^2	**25,30**	15,93	15,16	17,28	20,69	20,48	18,62	15,11
Dry weight kg	133	165	156	114	250	149	175	170
LxWxH mm	576x541x603	611x528x682	563x445x593	591x433x621	559x550x622	514x422x643	781x536x762	781x536x751
Volume m^3	0,19	0,22	0,15	0,16	0,19	**0,14**	0,32	0,31
Weight/power kg/kW	**3,2**	5,7	5,7	3,5	6,9	4,4	5,4	6,2
Weight/displacement kg/dm^3	90,9	100,5	94,6	**76,1**	151	99,6	111,6	103,5
Power density kW/m^3	221,1	131,8	184	206,3	189,5	**242,9**	101,3	88,7
Total density t/m^3	0,70	0,75	1,04	0,71	1,32	1,06	0,55	0,55
Displacement/volume dm^3/m^3	7,70	7,46	**10,99**	9,36	8,72	10,69	4,90	5,30

From 1.8 to 1.9 liters

When a comparison focuses on such a specific segment it's good to expand the view. We find two great brand in the range including 1.8 and 1.9 cc liters: the **Doosan Infracore** D18 and the Kohler KDI19TCR. The first one is the base model of the Korean compact range, which adopted Bosch common rail instead of Delphi in the transition to Stage V, raising from 37 to 45 kW. Here, as on the D24, the EGR remains in place, but has been dismissed on the D34. The KDI features 1,861 liters, available both aspirated and supercharged, which in the most performing version with electronic management delivers 42 kW at 2,600 rpm and 225 Nm at 1,500 rpm.

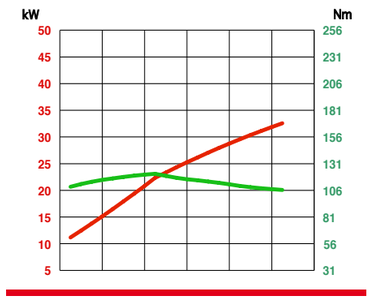
great European fairs. Isuzu delivers 29 kW in aspirated version. If Isuzu updated the ECU of this engine it would probably find application in construction, its natural environment. Mitsubishi could dare more, in terms of marketing because its MEP is high and its stroke-bore ratio would allow to customize the rotation speed and optimize frictions; the automotive expertise would allow the Japanese to transfer this know – how into a hybrid package, under the supervision of Bosch common rail.

■

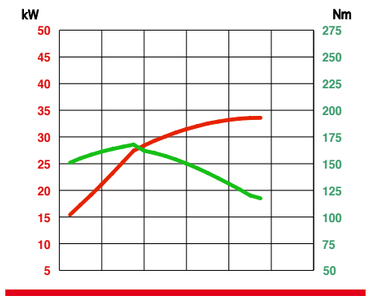
BRAND MODEL	HATZ 3H50TIC	ISUZU 3CE1	KOHLER KDW 1603	KUBOTA V 1505	MITSUBISHI D03CJ-T	PERKINS 403J-E17T	YANMAR 3TNV86CT	YANMAR 3TNV88C
INDEX								
Torque	**14,1**	12,6	15,3	13,5	10,8	14	12,6	12,5
Performance	**4,9**	3,5	3,3	3,6	4,1	4,4	3,8	3,4
Stress	**8,1**	6,1	5,8	6	6,9	7,5	6,4	5,9
Lightness	10	11,7	10,5	8	**16,1**	11,1	13	12,7
Density	37	18,6	24,6	27,6	29,6	**43,6**	14,2	12,3
DIESEL	**7,5**	5,9	5,8	6,7	6	6,8	6,1	5,7

1 HATZ

2 KUBOTA

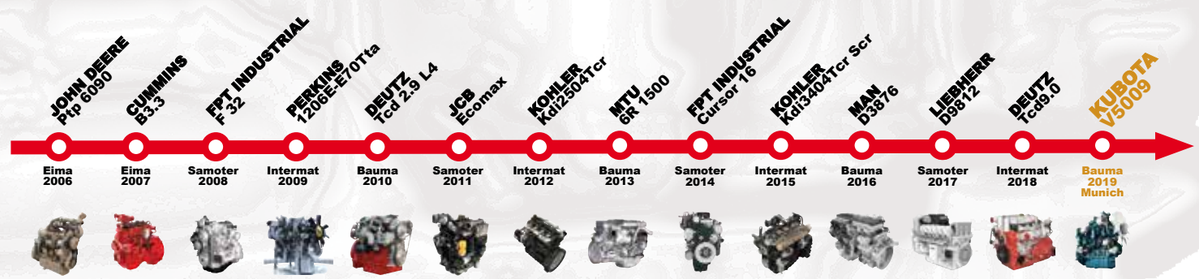


3 PERKINS



2019 DIESEL OF THE YEAR

KUBOTA V5009



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4 CYLINDERS, 1 LITER CYLINDER

LET'S GO, TECHNO DARWINISM

In 1999 DIESEL comparisons was focused on 4-liter, 80 kW four-cylinders. Captive origin, strong roots in the free market (45% of off-highway free market) and three manufacturers that coveted 70% of demand. In 2018 the one liter cylinder displacement has definetely enlarged.

One liter cylinder, the milestone and benchmark of industrial and automotive engines. For some time we considered its case closed, but is this really true? The turn towards power density weakened the one liter displacement, penalized by the overdose of devices to be placed under the hoods. After-treatment has triggered a pincer movement: on one side DOC, DPF and SCR need space, on the other the energy-consuming strategy focused on regeneration and overall efficiency. Therefore, density is needed.

In 1999 DIESEL comparison was focused on 4-liter, 80 kW four-cylinders. Captive origin, strong roots in the free market (45% of off-highway free market) and three manufacturers that covered 70% of the demand. Perkins in the first place, followed by Cummins and Deutz, then John Deere and AIFO (that today stands for FPT Industrial). The renewed Perkins 1000 series stood out for its weight/power ratio, which outperformed competitors by 30 percent. The challengers were Cummins Bt3.9, Deutz Bf4M 1013E, Iveco AIFO 8045 Se00, John Deere 4045T and Yanmar 4Tne106T. The Japanese won the Diesel Index head to head with Perkins (18.8 Yanmar, 18.7 Perkins), followed by Deutz (17.4) and Cummins (17.3).

In 2000 engines featuring one liter cylinder are still the most widespread. Turbo is a candidate for a major role to better fill the torque curve and face the first constraints on emissions. Perkins increased its aspirated by five percent. Competitors put away the one liter cylinder with the only exceptions of Perkins (3.98) and Cummins (3.92) in 2004. Diesel Index clearly rewards Yanmar (10.62), followed by Cummins (9.55) and Perkins (8.22). One of the criteria identified by DIESEL was TBO, Time Before Overhaul. Cummins and Deutz declared 15 thousand hours, compared to 12 thousand average.

In 2011, after eleven long years, the comparison grid seems to be totally transformed. Pure one liter cylinder is still a thing of the past. Cummins replaced the B Series 3.9 with the Qsb 4.5 while Perkins replaced the 1004-40T with the 1104D-E44Ta. Even Same moved to the next level relying on Deutz, waiting for the Farmotion featuring 2.8 and 3.8 liters.

The only pure 4 liter is Deutz TCD2012, while the previous comparison included the BF4M 1013E. We have a couple of common features here, including four valves driven by rods and rockers, fixed turbine and common rail, ignored at the time by MTU alone with its 904C, the latest winner. The Diesel Index belongs in fact to JCB Powertrain Dieselmax (7.9) followed by Cummins Qsb4.5 (7.3), Sisu 44Cwa (7.2) and Deutz Tcd2012 (7.1).

In 2018 the liter cylinder has been definitely enlarged, Deutz Tcd4.1 is the only that sticks to its roots, 4 liters, 115 kW and 610 Nm. The B4.5 (261.4 kW/m3), the NEF (255,1 kW/m3) and the 1200 (261.4 kW/m3) are compared at the top with the Syncro (344.8 kW/m3), the Same Farmotion (322.6 kW/m3) and the KDI (308.8 kW/m3). Power and torque of the three most performing compact units show an average 108 kW and 615 Nm compared to

One liter cylinder, an evergreen for both 4 and 6 cylinders that has undergone a deep transformation over the decades. It is no longer an off-road benchmark, but its restyling added cc and kW. We searched DIESEL Magazine annals to assess the situation

BRAND MODEL	AGCO 44 HD	CAT C4.4	CUMMINS B4.5	DEUTZ TCD 4.1	FPT N45 ENT	JCB ECOMAX	J. DEERE PVX 4045	KUBOTA V4309	MAN D0834	PERKINS 1204J	YANMAR 4TN107
I.D.											
N. cil. - dm3	4 - 4,39	4 - 4,39	4 - 4,48	4 - 4,03	4 - 4,48	4 - 4,39	4 - 4,48	4 - 4,25	4 - 4,58	4 - 4,39	4 - 4,56
Maximum power kW - rpm	110 - 2.100	129,4 - 2.200	149 - 2.500	120 - 2.400	125 - 2.200	93 - 2.200	129 - 2.200	115,7 - 2.200	**162** - 2.100	140 - 2.200	155 - 2.200
Mep at max power bar	14,6	16,4	16,3	15,2	15,5	**11,8**	16	15,1	20,6	17,7	18,9
Piston speed m/s	8,4	9,3	11	10,1	9,7	9,7	9,3	**8,2**	8,8	9,3	9,3
Maximum torque Nm - rpm	650 - 1.500	750 - 1.400	784 - 1.500	608 - 1.600	696 - 1.600	550 - 1.500	713 - 1.600	649,6 - 1.500	**850** - 1.400	825 - 1.400	804 - 1.500
% power at max torque (kW)	48,9	48	42,5	40,7	45,7	**49,4**	45,3	46,3	42,5	49	41,8
Torque at max power Nm	500	559	568	480	539	402	559	500	**735**	608	676
% power at max torque (kW)	92,9 (102)	85,00 (110)	82,70 (123)	85,00 (102)	93,40 (117)	93,00 (86)	92,70 (120)	88,30 (102)	77,00 (125)	86,50 (121)	81,50 (**126**)
Work range rpm	600	800	**1.000**	800	600	700	600	700	700	800	700
DETAILS											
Specific power kW/dm³	25,0	29,4	33,2	29,6	27,8	21	28,7	27,1	**35,3**	31,7	33,9
Specific torque Nm/dm³	147,8	170,4	174,8	150,5	155,1	125	159	152,6	185,5	**187,5**	176
Areal spec. power kW/dm²	30,05	37,40	43,82	37,50	36,76	27,93	36,54	30,45	**44,26**	40,46	43,06
Dry weight kg	530	420	390	400	410	540	540	600	490	420	550
Volume m³	0,65	0,54	0,57	**0,40**	0,49	0,51	0,71	0,57	0,77	0,55	0,56
Weight/power kg/kW	4,8	3,2	**2,6**	3,3	3,3	5,8	4,2	5,2	3	3	3,5
Weight/displacement kg/dm³	120,5	95,5	**87**	99,1	91,4	122,8	120,5	140,9	107	95,5	120,4
Power density kW/m³	169,2	239,6	261,4	**300**	255,1	182,4	181,7	203	210,4	254,6	276,8
Displacement/volume dm³/m³	6,76	8,15	7,87	**10,10**	9,15	8,63	6,31	7,47	5,95	8	8,16

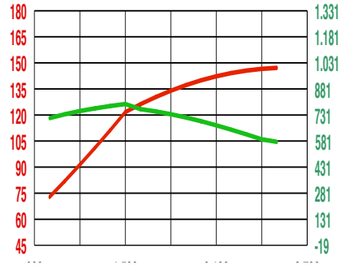
DIESEL Index

Cummins wins the Diesel Index pushing on the accelerator during the transition to Stage V, unveiled in style at Bauma 2016 in presence of Tom Linebarger. Just like the 3.8, the 4.5 liters also increased specific curves and top rates in 2019. Besides that there's a substantial equilibrium, with MAN and Perkins behind the B4.5. Two engines very different from each other, having automotive and industrial roots and different strong points: aggressive performance for Man (delivering 162 kW and 850 Nm), compactness and elasticity for Perkins.

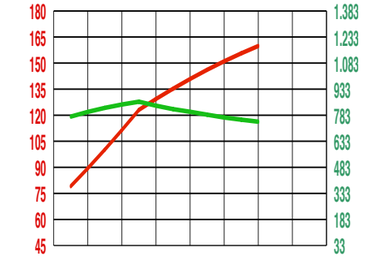
155 kW and 826 Nm of the 4 liters. The overall dimensions range in the two comparison grids respectively from 0.29 to 0.73 m3 and 0.49 to 0.71 m3. Common rail remains a must, with Bosch leading the way followed by Delphi and XPI. FPT Industrial still trusts in the NEF family, while Kubota and Yanmar meaningfully entered this segment . Kubota got ahead of it, Yanmar fought back with a compact 3.8 that stands on top for power and torque and a 4.57 liters. Still in Japan there'a also Isuzu and its B-Series, featuring a 4.3-liter however only available in Tier 2. ■

BRAND MODEL	AGCO 44 HD	CAT C4.4	CUMMINS B4.5	DEUTZ TCD 4.1	FPT N45 ENT	JCB ECOMAX	J. DEERE PVX 4045	KUBOTA V4309	MAN D0834	PERKINS 1204J	YANMAR 4TN107
INDEX											
Torque	8,6	10,8	**12,9**	10,6	8,7	9,3	8,8	9,6	9,9	11	9,9
Performance	5,5	6,3	6,6	5,9	6	5,1	6	5,6	**6,8**	6,7	6,5
Stress	9,1	10,4	**11,1**	9,8	9,9	8,6	9,9	9,3	10,9	**11,1**	10,6
Lightness	14,6	11,3	10,6	12	11	14,8	14,7	**16,5**	13,3	11,1	14,3
Density	13,5	18,8	18,6	22,6	19	14,5	13,5	15,9	14,7	**20,2**	19,2
DIESEL INDEX	6,6	7,5	**8**	7,2	7,1	6,2	6,9	6,7	7,6	7,7	7,3

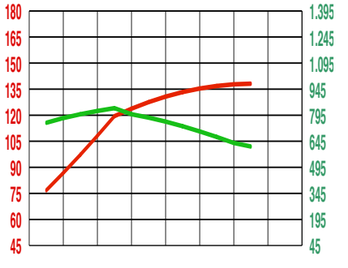
1 CUMMINS



2 PERKINS



3 MAN



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NANNI PLATINUM N16.100 CR3

AT THE TOP OF PLEASURE

Electrification? «*We will say more at Cannes 2019*», Gregorio Passani said. Passani is the Nanni Diesel COO.

Nanni Diesel presented the deal with Scania at the Cannes Yachting Festival. At the Boot Show in Düsseldorf we discussed the Platinum series with Gregorio **Passani**, COO and Commercial Director.

With the Scania 16 litre, Nanni has reached the top of the range.

The N16.1100CR3 is the older brother of the 13 litre, 925 hp which was introduced in Cannes. The V8 16 litres raises the bar to 1200 hp. Its key to success is the power-to-weight ratio.

What else does Nanni have in store?

Nanni is the first engineer to seal a partnership with Ray Marine. Not only displays and integrated navigation systems: Ray Marine has recently presented a docking system which can be installed on the Platinum series. The Prestige shipyard welcomed it immediately.

Where does the deal with Scania stem from?

Scania is strong in commercial applications but not in pleasure, where Nanni has been operating for almost 70 years. We are now able to articulate a complete range between 10 and 2000 hp.

The N16.1100 CR3 combines the performance of Scania 16 litres and Nanni Diesel's competence in marinisation. The 8V cylinder is the new French top of range and challenges big names such as CAT, FPT, MAN, MTU and Volvo, in view of a multiple configuration

Will the top of range be the 16 litres?

Currently the strongest motorisation is the double setup of the 16 litres (with Xpi only, to differ from Scania), which reaches 75 feet. We are talking with a drive manufacturer. The idea of triple or quadruple setups is highly appealing.

Have you updated your distribution network in Europe?

We have complemented the existing network with distributors familiar with this type of engine. Currently we count on 95 distributors and 2500 service centres globally.

Does Nanni only mean pleasure?

Not exactly. We focus on pleasure as well as on light-commercial, military, patrol boats and, in particular, ferry.

Electrification?

In the future a hybrid especially designed for Platinum will electrify between 80 and 180 kW, for ferry and pleasure. **F.B.**

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BONDIOLI & PAVESI

Professionals in motion

MAN ENERGY SOLUTIONS

DUAL FUEL? YES THANKS!

MAN GOES TO HAWAII

MAN will provide propulsion systems for two 2,525-teu containership for Pasha Hawaii. Each system will comprise a 7S80 ME-GI Mk 9.5 main engine, three MAN 6L35/44DF gensets and a MAN Alpha FPP propeller system. Doosan Engine will build the main engines in Korea, Tier III compliants by using an EGR system. Similarly, MAN Energy Solutions will build the auxiliary engines that will meet Tier III as well, with the aid of a SCR system. Engine delivery is scheduled for 2019 with the two vessels due for launch in the first and third quarter of 2020. The new vessels will operate fully on LNG from day one. With the ME-GI two-stroke engine we can see an efficient combination of multi-fuel combustion and reliability. MAN aims to set a new industrial standard for two-stroke propulsion engines aboard LNG carriers, container vessels, car carriers and bulk carriers.

Thomas **Knudsen**, Head of the Two-Stroke business unit: «*The ME-LGIP builds on the succes we have had with our ME-GI and ME-LGI dual-fuel engines, wich have won over 250 orders since the introduction to the market*»

The latest two-stroke, dual-fuel MAN B&W ME-LGIP engine won its first order back in March 2018 when Hanjin announced that it was going to construct two VLCGs (Very Large Gas Carriers) in their Philippines facilities. The job was assigned to two Man B&W 6G60ME-LGIP Mk 9.5 engines.

MAN Energy Solutions, proud of its creation, reported that the ME-LGIP engine has experienced an up to 18% reduction in CO2 and almost 90% reduction in particulate matter when running on LPG, compared with HFO. So, this particular engine seems to have all the right credentials to be elected one of the most environmentally friendly two-stroke technologies currently available on the market, also considering its negligible gas slip.

Moreover, the Diesel principle provides the ME-LGIP with a consistent operational stability and efficiency, including during load changes and fuel change-over while maintaining no fuel penalties.

In Copenhagen, Denmark, MAN Energy Solutions celebrated the launch of its latest two-stroke engine type, a dual-fuel MAN B&W ME-LGIP engine designed for LGP running, in the presence of the CSO, Wayne Jones, and Thomas Knudsen, Head of the Two-Stroke bu, and Bjarne Foldager, Vice President Sales & Promotion - Two stroke bu

The choice behind the development of this project was both part of MAN Energy Solutions call to action to reduce emissions and an answer to the favorable requests of markets such as global shipping, that are more and more moving towards gas, also driven by the IMO. Bjarne **Foldager**, vice president of sales and promotion of Man's Two-Stroke business unit, on this topic, said: «*Interest in using LPG as a fuel, within and outside of the LPG carrier segment, is growing due to its Sulphur-free character, widespread availability and ease of bunkering. In gas mode, the ME-LGIP engine operates on just 3% pilot oil and down to 10% load. Ultimately, we expect the engine to operate without the need for pilot oil*».

Let's, then, dig a little further into the technology behind this engine. We can find a low-pressure supply system, a Fuel Booster Injection Valve with an injection pressure of 500-600 bar and the capability to handle low-sulphur/low-flashpoint fuel types: methanol, ethanol, LPG and dimethyl ether (DME). Man B&W ME-LGIP engines are designed to be dual-fueled, with diesel and LPG as equal alternatives for operation.

Now that LPG joined the list of liquid, environmentally-friendly fuels that can power Man's two-stroke, dual-fuel engines, the company expects the installation of such solutions aboard merchant vessels to be extremely competitive price-wise. Also, from the data collected by Man, there is quite a relevant difference between LPG and Tier II engines on HFO in terms of emissions. In particular, we are talking about a reduction of 10-15% for NOx, of 90-100% for SOx, of 90% for particulate matter and of 18% for CO2 (as already mentioned). LPG engines have indeed the advantage of being able to meet IMO SOx that will come into force globally from 2020. As well as being important players towards reaching the 2050 IMO GHG targets and towards IMO EEDI requirements.

Part of the features of this engine are also 'hidden' in the name. In particular the 'ME-' prefix indicates that the engine benefits from electronic controls that also encompass the fuel being injected by the Fuel Booster Injection Valve. This fuel booster, especially developed for the ME-LGI engine, ensures that a low-pressure fuel-gas supply system can be employed, reducing first-time costs and increasing reliability.

Man expects, going on, a strong demand from very large gas carriers and coastal vessels.

Alessandro Faberi

FPT. AXLES AND TRANSMISSIONS

IT'S A FULL DRIVELINE

In the beginning there was the Iveco - Rockwell joint venture in Cameri, where Meritor currently operates. Here begins the saga of Iveco axles. It was the '70s, but only in 1991 the drivetrain soul of what was to become FPT Industrial was born in Turin. At the headquarters in Viale Puglia we witnessed the genesis of commercial vehicles, trucks and bus transmissions. There are three manual transmissions lines - 2850.6, 2840.6 and 2835.6, handling torques from 200 to 500 Nm and modulating the transmission based on torque and application.

PTO comes from the collaboration with Interpump. The main path, in line with the engine section, is that of efficiency, which is mainly reflected in lower fuel consumption and is on par with premium competition (being the gap just half a point). Besides TCO and durability another target is noise reduction, which is crucial for some applications such as minibuses. At this point the semi-anechoic cell comes in, where acoustic tests are carried out according to ISO standards to allow the replicability and comparability of sound spectra. This is a state-of-the-art room, where the usual wedge-shaped walls have been replaced by sound-absorbing panels.

FPT Industrial driveline portfolio also includes axles and transmissions for truck and bus applications. Lubrication is a matter of the past, efficiency is the driver, the progressive conversion to electrification is in the near future

The problem solving phase manages noise issues in engines or transmissions using spectral analysis and algorithms to identify defects and anomalies, often simply due to process discrepancies.

Rigid steering axles can carry loads from 3.6 to 18 tons, 30 kNm braking torque and gross vehicle weight up to 40 tons. Rear axles are available both with single reduction and bevel gear or double reduction, 2 to 40 tons Gaw, and use disc brakes since 2017 increasing efficiency by 2 percent.

The rear axles machining unit has around 180 operators and 15 employees and includes 4 basic technical units. Machining changes depending on the size and material of the components (from normal turning, drilling, milling to special processes such as tempering, welding and rolling), about 80 percent of the components on the light range are processed internally (for example, differential gear box, Salisbury axle, hubs, etc.). On medium and heavy ranges the main processed components are knuckles, axle body, axle beams, differential housings, reduction gears, carrier housings; Axle beams, for example, are processed from a die cast in a single work center, which delivers an average production of about 12 boxes per shift/machine.

Knuckles machining has been renewed in 2017/2018 when introducing a new family of front and rear axles, and an automatic processing line was developed from scratch (including state of the art lathes and machining centers inspired by Industry 4.0 concepts, including the monitoring of the basic parameters on the operator's panel) and a new assembly line knuckle-lever sub-assy (the concepts of golden zone material, minimum material handling, automatic transport have been implemented).

The deburring, washing and control station with eddy currents is also automated and is used to check for surface cracks thus preventing breakage. 2017 is not only the year of disc brakes and the X-Way revolution, lubrication also has been abandoned by adding a bearing on each wheel side.

The software uses the efficiency matrix, measured according to Acea procedure to determine the overall efficiency of the vehicle. Matrices are calculated on a certified bench that determines the efficiency of rear axles on 130 points (each with a different torque/speed condition), repeating the measurement 4 times to guarantee reliability. Other test benches are used to check the fatigue life of Driveline components (transmissions, single and tandem axles, transfer boxes) through accelerated tests that simulate the life span of the component. The result are outstanding, showing a percentage of non-compliance less than 0.1 per thousand. ■

Domenico **Feola**, Driveline engineering leader, and Alfredo **Tigani**, Driveline Platforms: «*Electric needs transversality. According to our experience, increasing volumes requires looking at several niches and applications*».

ELECTRIC BENCH

When it comes to electric we all think of battery packs and asynchronous motors. Since 2014 FPT is thinking instead in terms of electrification of the entire driveline. The E-Axle introduced at IAA replaces the rear axle and requires a change of the entire layout. The cell allows the testing of any kind of complete powertrain (thermal, hybrid, electric): the bench test of the entire system allows to identify possible problems, lowering risks and cost and time of development. The cell can be used for electrified systems up to 500 kilowatts (together with special battery emulators) in order to manage all possible industrial applications (from Light to Heavy duty). In this environment it is possible to use pressure sensors, thermocouples and set alarm thresholds to map the added features and obtain a coordinated signal.

DRIV & POWERTRAIN

TEAMWORK MAKES THE DREAM WORK

Tenneco and Federal Mogul, this is not just an American story. This business, which began in May 2018 and ended on 1th October, is a financial story that impacts the global powertrain universe. And it is a report that is completing the metamorphosis of its actors in these months. Tenneco and Federal Mogul will merge into two separate entities, which will be oriented respectively to the aftermarket and to the powertrain. From this union are born the Aftermarket & Ride Performance Company and the Powertrain Technology Company.
Followed by answers to our questions directly from headquarters.

DRiV Incorporated is the name of the future publicly traded Aftermarket and Ride Performance company that will launched in the second half of this year. Gestation is in the home straight. From Tenneco and Federal Mogul are taking shape two giants of the aftermarket and the OE market

Could you explain in detail what specific assets will emigrate in the two companies and what will be the focus of the two?

The separation will result in two independent, publicly-traded companies: DRiV™, one of the largest global multi-line, multi-brand aftermarket companies as well as one of the largest global original equipment ride performance and braking companies; and the new Tenneco, one of the world's largest pure-play powertrain companies serving OE markets worldwide. DRiV's principal product brands will include Monroe, MOOG, Ferodo, Champion, Öhlins, among others.
The future powertrain technology company will be focused on serving global OE markets with engineered solutions addressing fuel economy, power output and criteria pollution requirements for gasoline, diesel and electrified powertrains.

Which activities of the two companies will be eventually oriented towards industrial applications or, at least, not exclusively motor vehicles?

While many of DRiV 's brands will serve the light and commercial vehicle markets, they also have a strong presence among industrial customers. The latter include, for example, the oil and gas, marine, mining, agricultural and other industries.
The future powertrain company will serve the light vehicle, commercial truck, off-highway and industrial markets. ■

IROX 2. FOR HEAVY-DUTY APPLICATIONS

Following last year debut of IROX 2 for light vehicle engine bearings, Federal-Mogul Powertrain launched its new high performance polymeric coating for heavy-duty applications at the 2018 IAA Commercial Vehicles in Hanover. IROX 2 provides enhanced seizure and fatigue performance, especially with steel crankshafts. «*By reducing friction, the innovative IROX bearing coatings also help our customers to lower fuel consumption and CO2 emissions. Evaluation using specific in-house developed test rigs showed that the reduction in friction when using IROX-coated bearings is bigger than that obtained by changing from 5W30 to 0W20 oil*» explained Gian Maria Olivetti, CTO, Federal-Mogul Powertrain.

Brian **Kesseler**, CEO, Tenneco: «*DRiV will be a unique new business, a more than $6 billion start-up, built from the combined strengths of Tenneco, Federal-Mogul and Öhlins - laser-focused on innovation, performance, brand development and customer service*»

AFTERTREATMENT FOR AFTERMARKET

At Automechanika in Frankfurt, Germany, Tenneco unveiled the Walker branded SCR for the aftermarket. Conceived for the Ford Transit 2016, it opens up an interesting scenario in homologation strategies in the industrial engines field as well. The system is made by an additive tank containing the reducing liquid; an additive injector to insert this liquid into the exhaust system; a ring that mixes the reducing agent with the exhaust gases; an SCR catalyst, where chemical reactions take place; and an electronic control unit that works in conjunction with multiple sensors so as to ensure correct operation. The amount of reducing agent added to the system is 5-7 percent of fuel consumption.

FUEL CELL. A GLOBAL VIEW

LOOK WHO'S BACK, HYDROGEN!

At the very beginning of the century hydrogen seemed to be the philosophical stone of energy, about to overcome fossil fuels for good.
Swallowed up by the dominance of battery packs in energy and transport, it covers only a decimal part of the market, despite the double digit growth rates and an encouraging outlook on the next decade.
According to the International Energy Agency (IEA), approximately 7 thousand cars were circulating worldwide in December 2017; 6 thousand of these wearing the symbol of Toyota Mirai, currently the most produced car in the world (US its primary market, with about 3 thousand units put on the road). Other players are Honda, Hyundai and the French Symbio, which at the beginning of 2019 claimed to have already put on the road "several hundreds vehicles", especially Kangoo ZE H2. Symbio itself advertises the "possibility to fill up in just 3 minutes" as one of its strongest assets, with a clear reference to a slower, more traditional electrical power charging.
In terms of circulating vehicles, North America - but we should rather refer only to California - hosts two thirds of the hydrogen powered light duty. A generous promotion of the infrastructures (still being carried out with tenacious incentives towards the construction of filling stations) has proven successful. Asia wins 30 percent of the market, Europe is left with peanuts. Worth of mention is the Parisian Hype taxi fleet, already reaching 100 units.
Again by the end of 2017 the fuel cell buses "officially" on the road were 27 in North America (33 in 2018 and 71 in 2019), 68 in Europe (313 scheduled), 159 in Cina.
In this case as well, the comparison with battery-driven electric buses culminates with hydrogen parading 300-450 travelling km, an estimated city autonomy of (at least) 18 hours and about 10 minutes for refuelling. On the other hand, the current quotation for a fuel cell bus is between 550 and 650 thousand Euros, remotely affordable only with specific and consistent subsidies. The comparison is nonexistent with any other type of motorisation, traditional or not.
The scale economies however all seem extremely promising. «*As early as in 2023*» the Fuel Cell Industry Review states «*we will likely reach the target of half a million Euros, with the possibility to drop to 400 thousand, or even just 350 thousand, when a production line will be able to overcome the 100 buses/year threshold*».
It is interesting to note that, although a real market is in fact lacking, the number of manufacturers with a fuel cell model in their lists is already quite consistent: Autosan, Van Hool, Mercedes/Evobus, Wrightbus, VDL, fuelled with Ballard stacks, and Caetano with Toyota fuel cells. For the British market (bearing in mind that London will only be able to acquire zero emission vehicles from 2025, to substitute the 9,500 vehicles currently in service) Alexander Dennis has announced a partnership with Arcola Energy for a double decker fuel cell.
In 2018 the overall fuel cell production for all automotive uses has been only 527 MW worldwide, of which 475 aboard cars. The growth rate deserves to be congratulated (37 MW in 2014 and 114 in 2015), but the absolute value is still laughable.
We move to Japan and Korea, very active in the hydrogen community and leaders in the automotive industry. Japan has announced 40 thousand fuel cell cars by 2020, 200 thousand by the end of 2025 and 800 thousand by 2030. In parallel,

In 2018 the overall fuel cell production for all automotive uses has been only 527 MW worldwide (37 MW in 2014 and 114 in 2015), of which 475 aboard cars. In terms of circulating vehicles, North America - but we should rather rfer only to California - hosts two thirds of the hydrogen powered light duty

EUROPE

Mobility Europe project aims to have 49 stations operating by 2020, serving (at least) 1,400 fuel cell cars. The filling stations may reach 747 units (with a peculiar precision in number). The bus fleet should reach 291 units by 2030. Meanwhile, the Belgian Van Hool has received a first order for the manufacture of 40 hydrogen buses for the cities of Cologne and Wuppertal, with a capacity of 350 km and 38.2 kg of hydrogen onboard. In 2018, Volkswagen and Daimler developed a concept van based, respectively, on the Crafter and the Sprinter. In Germany, DHL wishes to add to its fleet 500 fuel cell vehicles.
In September last year, in Lower Saxony, the very first train line (about a hundred km) with an Alstom hydrogen train for passenger transport was put into regular service. A "full tank" guarantees an autonomy of a thousand km.

According to **IEA**: «*In stationary applications, more than 235MW of fuel cell back up power generators have been installed in the United States and in Japan 42,000 small-scale micro CHP systems (Ene-Farm) were deployed in 2017, bringing cumulative installations to nearly 236,000 units*».

CHINA

The Technology and Industrial Development Strategy aims at 1,000 stations by 2030, 100 by 2020 and 300 by 2025. 5 thousand vehicles are scheduled to be on the road by the end of next year, 50 thousand by 2025 and as many as 1 million by 2030.
«*China is experiencing a fast-paced development of small and big manufacturers*» The Fuel Cell Industry Review 2018 states «*even on a regional scale, but the question is exactly how many buses are circulating on Cinese roads. In many areas of the country the infrastructure development is not keeping up and therefore some vehicles have been delivered but are still not circulating. Amongst the 2018 announcements, 50 buses in Sichuan by the end of last year and 30% of the electrical fleet in Shanghai; Shangdong Heavy Industry aims to produce 2,000 buses, and the city of Datong has made an order for 300 fuel cell vehicles. In view of the Winter Olympics in 2020, the city of Zhangjakou has formalised an offer for 74 vehicles*».
Same vagueness in goods transport. Apparently thousands of small trucks should already have been manufactured, but more precise data is lacking; 600 should be for a daily use in Shanghai. However, it is hard to go from conditional to indicative.

UNITED STATES

In California the Air Resources Board has set a target of 13,400 FCEV vehicles by 2020 and 37,400 by 2023 along with 94 stations. We should note that the National Fuel Cell Bus Program has granted 90 million dollars for the local public transport. In the US the cost of the fuel cell system is estimated around 325 dollars/kW for a very low production volume (200 systems/year), with the possibility to drop to 100 dollars for approximately 100 thousand systems/year.
Nikola Motor, almost a start-up only a few years old, has decided to replicate the “Tesla model” in the heavy-duty sector and claims to have already received pre-orders in the US for 11 billion dollars and in Europe for 380 million for the Nikola Tre model (in production in 2022/2023). The American company Anheuser-Busch, operating in beverage, intends to completely substitute the 800 truck long-haul fleet.
Commercial vans are also on the move. In autumn 2018 the California Air Resources Board has appointed 41 million dollars to Toyota, Kenworth and Shell towards 10 trucks and two large hydrogen filling stations.

fuelling stations will be 160 in 2020 and will double in number by 2025. Along these lines, Toyota declared to be able to sell 30 thousand FCEV vehicles in the next couple of years. The bus fleet should increase by 12-fold between 2020 and 2030 (from 100 to 1,200 units). In October 2017 Toyota introduced the Sora prototype, a 10.5 m long hybrid that accommodates a Mirai fuel cell and ten gas tanks, currently in service in Tokyo. Its statement that 100 will be regularly functioning by the 2020 Olympic Games is at the very least challenging.
In the short-haul goods transport, Toyota has put on the road Project Portal with 228 kW, in its second generation, Project Portal “Beta”, starting from the Mirai fuel cell.

Even more ambitious are the plans for stationary. The Japanese Hydrogen Basic Strategy (in December 2017) shows a plan for 2050 where in the Land of the Rising Sun

Investment in water electrolysis to produce hydrogen for clean energy applications is on the rise. If all the current projects come online by 2020, cumulative capacity will rise from 55 MegaWatt in 2017 to over 150 MegaWatt

hydrogen will have reached costs similar to those of conventional energies. The first products were released in 2009 and 250 thousand units had been installed by March 2018. The ENE-FARM program aims at 1.4 million installations by 2020 and 5.3 million by 2030.
For its part, Korea is dreaming of a dramatic acceleration from the 10 thousand vehicles and 100 stations expected by the end of 2020, to 630 thousand vehicles and 520 filling stations by 2030. In June 2018, the South Korean Ministry of Commerce announced an agreement between government and industry to invest 2.3 billion dollars in the next five years, in order to expedite a complete supply chain for fuel cells in automotive. It is estimated that by 2020 the local industry will be able to supply 16 thousand fuel cell units only for the mobility sector. Almost out of reach is the plan announced by the South Korean government regarding the local public transport: the aim is, by 2030, to substitute 26 thousand buses currently fuelled with compressed natural gas with fuel cell units. This means a substitution rate - starting from today - of 2,000 units per year. Also on heavy goods vehicles, Hyundai Motor was awarded, together with H2 Energy, the supply to Switzerland of 1,000 fuel cell trucks (18 ton capacity, 190 kW, 400 km autonomy) between 2019 and 2024.

Shintaro Tagaguchi

FUEL CELL MARKET PER TARGET SECTOR (MW)

Year	Portable	Stationary	Trasport	Total
2014	21.200	39.500	2.900	63.600
2015	8.700	47.000	5.200	60.900
2016	4.200	51.800	7.200	63.200
2017	5.000	54.900	10.600	70.500
2018	5.600	57.500	11.200	74.300
% '18/'17	12	4,74	5,66	5,39

FUEL CELL MARKET PER MW

Year	Portable	Stationary	Trasport	Total
2014	0,4	147,8	37,2	185,4
2015	0,9	183,6	113,6	298,1
2016	0,3	209	307,2	516,5
2017	0,6	222,3	435,7	658,6
2018	0,7	239,8	562,6	803,1
% '18/'17	16,67	7,87	29,13	21,94

Recent trends, quoting the **International Energy Agency:** «*Compared to BEVs, FCEV deployment is slow, but hydrogen focused national policies which have been recently announced could help accelerate deployment*».

CUMMINS: 100 YEARS OF SUCCESS

POWER IN EVERY DECLENSION

DARLINGTON, MORE THAN HALF A CENTURY

Cummins recently celebrated half a century of settlement in Darlington, UK. Noble father of the establishment is the famous architect Eero Saarinen, known for his Tulip Chair and Gatway Arch in Saint Louis. By 2015 over 1.5 million units had been manufactured. The first engines were VAL and VALE, 6 and 8 V cylinders with 5.7 and 8.3 litres. Over 350,000 of the Small Vee engines were generated between 1965 and 1986, when production switched to the B Series. The 3.9 and 5.9 litre were a significant move away from Cummins' traditional heavy duty trucks. The B Series was followed by the 8.3 litre C Series in 1989. The fully electronic ISBe appeared in 2000. In 2007 the B3.3 was awarded Diesel of the year.

Alexei **Ustinov**, Cummins Vice President Off-Highway Engine Business: «*Throughout the 100 years Cummins has proven its dependability to our customers by developing market leading products, and we will continue to do this into our second century*»

A century of Cummins. From two-stroke engines to Aeos Electrified Power Semi Trailer, from HVID to QSK95. The 1/19 issue of Diesel International quotes "*The importance of being… Clessie*", paraphrasing Oscar Wilde. In the words of Alexei Ustinov, Vice President Off-Highway Engine Business: «*Our centenary theme is 'challenging the impossible' reflecting the spirit of innovation of our founder Clessie Cummins which lives on today in our current employees*».

In the early 1900s Rudolf Diesel was gaining support in Europe and word of the cycle named after him reached overseas. In 1919, Clessie Cummins founded Cummins Engine Company in Columbus, Indiana USA, backed by banker William G. Irwin.

From 2,500 dollars invested by Irwin for the HVID licence to over 20 billion turnover in 2018, from 28 4.4 kW (6 hp) units to 1.2 million units manufactured in 2017, from 36 kW with QSB3.8 to 3,281 kW with QSK95. The first entirely Cummins model dates back to 1924, marked with the letter F, slip ring with 1, 2, 3, 4 and 6 cylinders, with a power of 9.2 kW per cylinder. Other milestones of this pioneering era were the U model, in 1928, the first American diesel to have all working parts enclosed and the NH series in 1946, which for over half a century has accompanied Cummins hand in hand. Clessie put the diesel engine under the spotlight all across the US, testing its innovations at the Indianapolis 500 race, where his car was the first to complete the race without stopping in 1931 and achieved pole position in 1952 using turbochargers for the first time. From the automotive sector the founder realised the strategic value of supercharging. His Pressure Time (PT) fuel system, also tested on the 1952 Indy car, is a forerunner of today's high-pressure fuel systems. At the time of his death in 1968, Clessie had 33 patents relating to diesel engines and fuel systems.

Fast forward to the present day, at Bauma Monaco 2016 Tom Linebarger personally presents the Stage V, dismissing the Egr and exponentially increasing performances, especially with the 3.8 and 4.5 litres. Brammo's acquisitions of one of Johnson Matthey's branches, and Efficient Drivetrains accelerates on electrification. A future that embraces all of Cummins' applications: onroad, offroad, powergen, pleasure and commercial.

100 years have passed since Clessie Cummins obtained Irwin's financial support. Since then Cummins has become the leader in internal combustion engines, with unlimited applications. From the F Model to electric, via Indianapolis 500, QSK95 and Diesel of the Year with the B3.3

CUMMINS @ BAUMA 2019

The shields will bear the signature red coloured internal combustion engines. Three years ago in this exact location the secrets of the Stage V were unveiled. However, at the first Bauma since the new legislation, Cummins is planning on sending a strong message. A 3.5 ton mini-excavator prototype will be on display at the stand. Of Korean origin, Hyundai, its modular battery pack is the BM4.4E, located at the base of the machine. Each module yields 4.4 kWh, for a total capacity in its serial 8 module configuration of 35 kWh, allowing for its application at different tonnage and work cycles. The energy storage technology is the well established lithium-ion.

BONFIGLIOLI. O&K AND BAUMA

ONE STEP FORWARD

Fausto **Carboni**, Bonfiglioli Group CEO: «*The 3 year investment plan of 158 M€ and the strong commitment of Bonfiglioli global team have supported an extraordinary growth, and, at the same time, provided a solid foundation for future development in terms of Technologies, Processes and Service*».

Bonfiglioli celebrated the acquisition of 100% of O&K Antriebstechnik's shares in Hattingen. A step towards the future that happens on the eve of a promising Bauma and after an excellent year for Bonfiglioli in terms of turnover. In particular, we are talking about a 13% growth. 913 million of pure organic growth in 2018.

Andrea **Torcelli**, Bonfiglioli CTO.

«*First of all, a compact truck loader reducer with an integrated engine called 705 XT. It has an intermediate size and provides about 12 thousand Nm of output torque. The peculiarity is the integration of an axial piston swash plate engine, designed for high pressures, at 450 bar, which allows variable control of the displacement, not on two positions. The second product is the crawler reducer, a 31,000 Nm truck drive, for heavier machines. The permanent magnet engine is protected inside a cast iron case, very robust and sealed to have the highest level of protection from external agents, dust and contaminants in general.*

The third is the driveline, the complete solution for mini excavators. It is our first serial approach. We have chosen a compact type of electric motor, which allows you to create a realistic solution. Up to now, the electric solutions have faced the problems of the required power density and the available space. With this type of permanent magnet engine with stators made with concentrated winding, we believe we can replace the hydrostatic application. The application concerns small machines, 2 or 3 tons. The mini excavator is the ideal machine to maximize the benefits of electrification, since it is mostly not operational. It is absurd to have an engine running when you are not working». **F.B.**

In addition to O&K and the inauguration of the Forlì plant, dedicated to electromobility, there are also the new Chennai facility in India, and EVO, the main plant for industrial gearmotors technology, based in Bologna, in accordance with 4.0 best practices

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