

MASERATI'S RETURN TO RACING



Focus on Victory

You almost hear your heartbeat inside your helmet, and feel the pulse of power for the perfect start. You give your best – just like ZF does with the high-tech Drivetrain for the Formula E. **zf.com/motorsports**





Why Audi coup signals fresh start for F1



ON THE COVER 20 AUDI ENTERS F1

Formula 1's sustainability agenda reaped its first rewards when Audi confirmed its entry for 2026. Tony Dodgins gets reaction from the grand prix paddock

24 MASERATI'S RETURN TO RACING

With the famous brand poised to return to the racetrack in Formula E and GT2, Chris Pickering talks to Maserati boss Giovanni Tommaso Sgro

34 PORSCHE 911 GT3 R

Porsche's new GT3 offering taps larger performance reserves for different Balance of Performance classifications, but also prioritises driveability. Anthony Peacock talks to Sebastian Golz, project manager for the new 911 GT3 R

INDUSTRY NEWS 6

Toyota and Porsche push hydrogen combustion into the spotlight; Swiss Embassy to host World Motorsport Symposium; IndyCar eco tyre debut; Mahindra Racing to power ABT Sportsline's Formula E comeback; Andretti to build \$200 million motorsport HQ; report says sport can increase climate impact 100x by engaging fans; new simulation approach advances tyre modelling within rFpro; Stratasys to acquire Covestro's AM materials business

72 COMMENT

Sergio Rinland delivers his verdict on the new regulations for the 2026 Formula 1 Power Units

42 TECHNOLOGY TRANSFER

McLaren Applied boasts a 30-year heritage in top-level motorsport. But it's the challenges of the future - in motorsport, automotive and beyond - that are dictating its innovation as it adapts to life under new ownership. By Chris Pickering

50 WORLD RX GOES ELECTRIC

Hal Ridge reports from Norway at the start of an electrifying new era for the FIA World Rallycross Championship

60 NEW CARS: ACURA ARX-06

The might of Honda Performance Development's simulation, design, development and manufacturing technologies underpins the new Acura ARX-06 GTP challenger. By Mark Skewis

66 ADDITIVE MANUFACTURING Mark Skewis discovers how two companies from the Silverstone Technology Cluster created unique solutions for an F1 team using the latest stereolithography technology

in early October 2022 ISSN 1356-2975

Volume 29 Issue 11 Published September 2022 The next issue will be published

HYDROGEN MOMENTUM GROWS WORLD RX GOES ELECTRIC

RACE TECH

SUBSCRIPTIONS

Subscriptions from Kimberley Media Group Ltd 841 High Road, Finchley, London N12 8PT Tel +44 (0)20 8446 2100 Fax +44 (0)20 8446 2191

EORSCHE 911 GT3 R

Engine

MASERATI'S RETURN TO RACING

Why Audi coup signals fresh start for F1

lotorspor

Overseas copies are sent via air mail 12 issue subscription UK: £71.40 Europe: £118, USA/Rest of World: £149 All major credit cards accepted. Cheques and money orders only in Pounds Sterling payable to Kimberley Media Group Ltd.

BACK ISSUES AVAILABLE:

8,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 148, 149, 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262

Price including post & packing: UK: £5.95, Europe: £6.50, Rest of World: £7.55 You can pay by cheque or credit card but please note the minimum on Switch & Delta is £14

Race Tech (ISSN: 1356-2975) is published monthly by Kimberley Media Group Ltd.

Cover image: Audi AG

Design & Production: Paul Bullock, Maluma

© Kimberley Media Group Ltd.

All rights reserved. Reproduction (in whole or in part) of any article or illustration without the written permission of the publisher is strictly prohibited. While care is taken to ensure the accuracy of information, the publisher can accept no liability for errors or omissions. Nor can responsibility be accepted for the content of any advertisement.





STREET PERFORMANCE / HIGH PERFORMANCE / INCONEL / SODIUM FILLED / TITANIUM VALVE FUSING PERFORMANCE, DURABILITY, AND SUPERIOR CRAFTSMANSHIP THERE ISN'T A BETTER CHOICE FOR PERFORMANCE VALVE TRAIN COMPONENTS. CHOOSE YOUR WWW.SUPERTECHPERFORMANCE.COM

GROUP FOUNDER

William Kimberley

EDITOR Mark Skewis

HEAD OF DIGITAL Sara Kimberley

PHOTOGRAPHY LAT

ART EDITOR Paul Bullock

ACCOUNTS Fiona Keeble

COMMERCIAL DIRECTOR Maryam Lamond

MANAGING DIRECTOR Adrian Goodsell

PUBLISHING DIRECTOR Soheila Kimberley





841 High Road, Finchley London N12 8PT Tel: +44 (0) 208 446 2100 Fax: +44 (0) 208 446 2191

www.kimberleymediagroup.com



@racetechmag



facebook.com/ RaceTechmagazine



OW quickly embarrassment can turn to euphoria.

The long-delayed publication of Formula 1's 2026 Power Unit regulations had begun to cause unease. Ask those involved when the rules would be published, and they would roll their eyes and reply with a deadpan "June 2021!" But when they *did* arrive, Audi's immediate response – that it would enter F1 in 2026 – made the wait worthwhile. Porsche next? In fact, had the discussions not been so protracted, VW's brands might not have taken the plunge at all.

Inevitably, not every element of the new rules earns universal approval – you can see in his column that Sergio Rinland has a few things to say! Nevertheless, Formula 1 and the FIA should be congratulated for their endeavour and the results it has already reaped.

Early on in the process of formulating the rules, sceptics might have regarded their talk of sustainability as merely a tick-box exercise. But as time has passed and the world changed, that focus has now become an essential selling point.

The electrification of the F1 powertrain has tripled for 2026 but it was to many people's relief that F1 made it clear, early on, that it would use sustainable fuel in order to retain that most endangered of species: the Internal Combustion Engine.

The World Rallycross Championship's top tier went fully electric last month and the social media reaction it provoked was mixed. Lose the sound of the engine and you lose some of the sport's visceral appeal. That's why the hydrogen combustion experiments of Toyota and Porsche, reported in our lead news story, caught my eye.

Yes, things are changing quickly and motorsport must evolve, but there is more than one solution. That is sure to be a hot topic of debate at this year's World Motorsport Symposium on Thursday December 1 and Friday December 2. The event will be themed: 'Sustainable Motorsport 2030 – From Race to Road'.

It seems the smart money is on Audi's F1 team being run from Switzerland, so it is fitting that this year's Symposium will be held at The Embassy of Switzerland in the UK, in London. Join us there.



Mark Skewis EDITOR



TOYOTA AND PORSCHE PUSH HYDROGEN COMBUSTION INTO THE SPOTLIGHT

From the world rally stages to the Nordschleife, the momentum behind hydrogen combustion engines is growing, says **Mark Skewis**

OYOTA's World Rally squad and Porsche Engineering's simulation experts have both offered an intriguing insight into a possible future role for hydrogen-fuelled combustion engines in motorsport.

Different powertrain solutions, including hybrid systems, electric drives and efficient combustion engines, are currently all being developed in parallel for use in future vehicles. Hydrogen represents a potential alternative to conventional fuels or synthetic fuels (e-fuels) for use in combustion engines.

While hydrogen has forced its way onto the motorsport radar, much of the initial discussion – as with the plan to introduce a class of hydrogen prototypes to the Le Mans 24 Hours by 2025 – revolved around the use of fuel cells.

Now, however, Toyota, ORECA and Pipo Moteurs are all investigating hydrogen combustion engines. The Japanese manufacturer provided the latest indication of its progress with the concept when its GR Yaris H2 was driven on a stage each day at the Ypres Rally, preceding the competitive field on the ninth round of the World Rally Championship. Demonstrating Toyota GAZOO Racing's commitment to exploring options for achieving carbon neutrality, the experimental concept features a combustion engine running on hydrogen fuel.

The engine was based on the same turbocharged block found in the regular production car. The innovative powertrain – a 1.6-litre, in-line 3-cylinder, turbocharged engine that is found in the award-winning GR Yaris, but with a modified fuel supply and injection system has been developed in the GR Corolla
H2, the car successfully raced by WRC
Team Principal Jari-Matti Latvala and
Toyota Motor Corporation President Akio
Toyoda during the Fuji 24 Hours.

The rally was the first time the vehicle had been driven on public roads outside Japan.

Toyoda, aka "Morizo", his racing alias, shared driving duties with none other than Finnish rallying legend Juha Kankkunen, who won his fourth WRC title with Toyota in 1993.

Having driven on stage 3, Kankkunen turned co-driver for the challenging 11th test. The stage featured extremely narrow farm roads that ran along fields and between houses, making for a terrain that was challenging even for professional drivers. Even though Morizo had never driven on those roads nor had a chance to survey them before he began his run, by relying on Kankkunen's guidance, he was able to complete the course without incident.

"I am grateful to Juha for his courtesy in allowing me to drive," said Toyoda. "He guided me in sync with my driving, making me feel comfortable. The roads were tough: not only slippery but also narrow, and their surfaces seemed to change from moment to moment. They were like the roads used in Rally Japan, and it was a good chance to think about races with spectators in mind.

"Thanks to the support and cooperation of many parties including the FIA, WRC Promotor, and the organiser, we were able to let WRC fans hear the exhaust sound of a hydrogen engine.

"Motorsport is really a sport. I believe people get excited because sports stimulate our five senses, and that's why

RIGHT Star crew: rally legend Juha Kankkunen teamed up with 'Morizo', Toyota Motor Corporation's president





ABOVE & BELOW The GR Yaris H2 opened some of the stages during the ninth round of the World Rally Championship in Belgium

I want to keep the engine's vibration and exhaust sound in motorsports.

"While we are trying to achieve carbon neutrality, we still want to keep the excitement. It was great that we were able to share that feeling in Europe."

Afterwards, Kankkunen said: "The hydrogen engine put out solid torque, making it no different from a gasoline engine. Because they emit zero CO2, I believe hydrogen engines will become one of the options for achieving carbon neutrality not only in the world of motorsports but also in the world of everyday cars."

The WRC has taken its first steps towards a more



sustainable future with the introduction of the newfor-2022 Rally1 hybrid cars, powered by 100 percent sustainable fuel.

Could hydrogen one day become an option? Latvala, who sampled the technology as part of the Fuji endurance race team, but had to focus on running the works WRC squad in Ypres, doesn't rule it out.

"I think in rallying, now we are in the hybrid mode, but in 10 years' time we will need to find another solution," he said.

"Hybrid is for this era but I think we need something new and I think hydrogen could be an option in the rally world because in rallying we can't go full electric, it is impossible.

"And without the sound nobody will go to the forest or to the mountains to watch the cars; we need to have sound in rallying. In circuit racing it is not as important but in rallying we need it."

Hydrogen in Green Hell

While Toyota was tackling the world rally stages in Ypres, Porsche Engineering was mastering the Nürburgring Nordschleife with hydrogen – in the digital world.

Work is currently proceeding on hydrogen engines worldwide, however this is predominantly being done for commercial vehicles with a relatively low specific output of around 50 kW per litre of displacement. "For the passenger car sector, this is insufficient," said ►

7



Vincenzo Bevilacqua, Senior Expert Engine Simulation at Porsche Engineering. "We have therefore developed a hydrogen combustion engine that aims to match the power and torque of current highperformance gasoline engines as a concept study. At the same time, we also had the objective of achieving low fuel consumption and keeping emissions at the same level as ambient air.

"The starting point for our study was an existing 4.4-litre eight-cylinder gasoline engine – or rather, its digital data set, since we conducted the entire study virtually using engine performance simulations."

Modifications to the engine model included a higher compression ratio and combustion adapted to hydrogen, but most importantly, a new turbocharging system. "For clean combustion of hydrogen, the turbochargers have to, on the one hand, provide around twice as much air mass as they do in gasoline engines. On the other hand, however, the lower exhaust gas temperatures result in a lack of energy for their propulsion on the exhaust side," explained Bevilacqua. This discrepancy cannot be resolved with conventional turbochargers. Porsche Engineering has therefore examined four alternative, particularly powerful turbocharging concepts, some of which come from the world of motorsport.

All systems consisted of several electrically assisted turbochargers, some of them combined with additional control valves in the air system or electricallydriven compressors.

For this study, the development team selected a turbocharging system with backto-back compressors. The special feature of this design is the coaxial arrangement of two compressor stages, which are driven by the turbine or the supporting electric motor using a common shaft. The air flows through the first compressor, is cooled in the intercooler and then recompressed in the second stage.

With an output of around 440 kW, the hydrogen engine is on par with the original gasoline unit. In order to better assess the performance of the powertrain, Porsche Engineering tested it in a luxury-segment reference vehicle with a relatively high total weight of 2,650 kg on the Nürburgring Nordschleife – albeit entirely virtually: the drive was carried out using a 'digital twin'.

With a lap time of eight minutes and 20 seconds – 41 seconds slower than the Cayenne Turbo GT's SUV lap record at the Nürburgring – the vehicle demonstrated high potential with regard to driving dynamics.

In extensive optimisation rounds, Porsche's experts adapted the engine's operating strategy for the cleanest possible



LEFT The selfimposed project goal was the development of a clean, economical and sporty hydrogen engine to conquer 'Green Hell'

BELOW Porsche Engineering examined four alternative, particularly powerful, turbocharging concepts combustion, enabling them to dispense with an exhaust aftertreatment system.

"As it turned out, the nitrogen oxide emissions are well below the limits set by the Euro 7 standard currently under discussion and are close to zero over the entire engine map," reported Matthias Böger, Specialist Engineer Engine Simulation at Porsche Engineering.

The company's extensive experience in modelling and calculation enabled the Porsche Engineering team to carry out all tests virtually and therefore very efficiently.

"It took us only six months from the initial idea to the completion of the study," noted Bevilacqua. "That included fundamental work such as creating new simulation models that take into account the different chemical and physical properties of hydrogen compared to gasoline."

Porsche says the hydrogen engine is unlikely to enter production in its current form, but that wasn't the goal of the project anyway. Instead, the focus was on examining the technical potential of the alternative drive technology and expanding the capabilities of existing engineering tools.

"The study allowed us to gain valuable insights with regard to the development of highperformance hydrogen engines and add models and methods specifically for hydrogen to our virtual simulation methodology," explained Bevilacqua. "With this know-how, we are ready to efficiently handle future customer projects."

Challenges ahead

Hydrogen combusts at a faster rate than petrol, resulting in good responsiveness while delivering excellent environmental performance. But the challenges - as both Toyota and Porsche are discovering - are many.

Toyota has been strengthening its efforts towards achieving carbon neutrality, such as by aiming to promote the use of hydrogen through the popularisation of FCEVs and numerous other fuelcell-powered products. But by further refining its hydrogen engine technologies through motorsport, it intends to aim for the realisation of an even better hydrogen-based society.

As Akio Toyoda, President of Toyota Motor Corporation, said: "We've taken the first step to compete with and develop our hydrogen-powered engine with the mindset of taking on the challenge. I imagine things will look a little different 10 years from now, and I hope people will look back and see how we took on the challenge with positivity and enjoyed every moment of it." 💷









Swiss Embassy to host 2022 World Motorsport Symposium

THE 2022 RACE TECH World Motorsport Symposium will be held at The Embassy of Switzerland in London.

Dubbed 'The Davos of Motorsport', the WMS has carved itself a unique position as the annual international cabinet meeting that leads the conversation in motorsport and automotive technology.

The event returns this year following a two-year hiatus caused by the global COVID pandemic. It is scheduled to take place on Thursday December 1 and Friday December 2. The event will be themed: 'Sustainable Motorsport 2030 – From Race to Road'. Formula 1 Chief Technical Officer Pat Symonds will join former Audi engine guru Ulrich Baretzky as co-chairman.

"Our two countries share a number of strengths: both are world leaders in innovation, research and technology," said the Ambassador of Switzerland, Markus Leitner. "The Swiss Embassy looks forward to supporting and hosting the WMS 2022."

"I'm delighted that WMS 2022 will take place at the Embassy of Switzerland," said Soheila Kimberley, Publishing Director of the Kimberley Media Group. "The former Ambassador, Alexandre Fasel, was beyond impressed by the calibre of influential guests he met at the last World Motorsport Symposium. It was his suggestion originally that we should hold the event at the Embassy, but then COVID intervened. I'm so pleased that now we finally get the



opportunity to do what we hoped would be possible two years ago, holding the event at the prestigious Montagu Place in the heart of London.

"Motorsport, like every other sector, faces so many challenges right now. I can't think of a better setting in which we can all meet to discuss how emerging technologies will shape the future of the sport, as well as impact other sectors across the globe."

The UK and Switzerland are opening up new opportunities in the areas of trade, finance, mobility, and science and innovation.

Switzerland is the third most important non-EU market for overall UK exports (goods and services).

LEFT The Embassy of Switzerland will host WMS '22

Audi entry livens up F1's "last combustion party"

FORMULA E founder Alejandro Agag has suggested that Mercedes left the all-electric series to enjoy gasoline's "last combustion party" – but based on Audi's confirmed F1 entry, it might be quite some party.

"There's a lot of movement in the grid. We just got Maserati and McLaren to sign up for the championship next season," said Agag. "Mercedes, for example, decided to stop. I'm very good friends with Toto Wolff, the team principal of Mercedes, and I told him that they're having the last combustion party.

"They're racing as much as they can with gasoline until they cannot race with it anymore, and then they will come back."

But F1 CEO Stefano Domenicali hailed Audi's arrival as "a major moment" for the sport.

"I am delighted to welcome Audi



LEFT F1's sustainability push lured Audi

to Formula 1, an iconic automotive brand, pioneer and technological innovator," he commented. "This is a major moment for our sport that highlights the huge strength we have as a global platform that continues to grow.

"It is also a big recognition that our move to sustainably-fuelled hybrid engines in 2026 is a future solution for the automotive sector."

Audi will enter F1 as an engine manufacturer in 2026, with Sauber its likely entry route.

The new technical rules for 2026 focus

on greater electrification and advanced sustainable fuel. In addition to the existing cap on costs for teams, a cost cap for power unit manufacturers will be introduced in 2023. Audi's decision was taken against the backdrop of F1's ambitious goal of being a carbon-neutral racing series by 2030.

Oliver Hoffmann, Member of Audi's Board for Technical Development, said: "In view of the major technological leaps that the series is making towards sustainability in 2026, we can speak of a new Formula 1. Formula 1 is transforming, and Audi wants to actively support this journey."



FOR OVER THREE DECADES, MCLAREN APPLIED HAS CONTINUED TO SET NEW STANDARDS IN HIGH-PERFORMANCE MOTORSPORT SOLUTIONS FOR THE WORLD'S MOST PRESTIGIOUS SERIES

Our team of experts are dedicated to developing electronic systems, and pioneering software to deliver quantifiable performance advantage for teams and drivers

We are the heartbeat of motorsport

mclarenapplied.com

IndyCar passes sustainability milestone with eco tyre debut

INDYCAR'S efforts to promote sustainability took a step forward on the streets of Nashville last month, where the Firestone Firehawk guayule race tyre made its ontrack debut at the Big Machine Music City Grand Prix.

This new, eco-friendly tyre is partially composed of a new sustainable natural rubber derived from the guayule shrub (pronounced Why-u-lee), which requires less reharvesting than traditional sources of rubber.

"The introduction of guayule natural rubber to America's pre-eminent open-wheel racing series speaks to the confidence we have in the technology and its promise as a scalable, sustainable and domestic source of natural rubber – a vital raw material," said Nizar Trigui, chief technology officer and group president, Solutions Businesses, Bridgestone Americas, Inc.

"This milestone represents our commitment to realising a more sustainable future for tyres, racing and mobility."

The guayule natural rubber is located within the Firestone Firehawk's sidewall. Bridgestone race tyre engineers decided to use the guayule rubber in the entire sidewall because that area is made up of the most natural rubber. This allows Firestone to maintain the same quality and performance as the existing race tyre.

All NTT IndyCar Series teams used the guayule tyre as the alternate tyre at Nashville. Based on driver feedback, the evidence was that, as was the goal, the racers couldn't feel a difference in performance between the guayule race rubber and the typical alternate race tyre.

Bridgestone plans to incorporate guayule natural rubber into more of its race tyres, starting in 2023. That effort will begin with using guayule rubber at multiple Firestone tyre tests throughout the year to see how its use can be expanded for the 2023 race season.

"The Music City Grand Prix was a great weekend for the competition debut of the Firestone Firehawk race tyre made with guayule. The guayule race tyres performed as expected," commented Cara Krstolic, Director of Race Tire Engineering and Production, Bridgestone Americas. "Nashville was the only race we planned to run the guayule race tyres for the 2022 IndyCar season, but we are looking at ways to use guayule again in 2023."

Drought-resistant

Guayule is a drought-resistant, heat-tolerant woody desert shrub native to northern Mexico and the southwestern United States. Natural rubber can be extracted from the branches, bark and roots of the shrub.

The racing debut of the guayule tyre is an important step in a journey that started 10 years ago for Bridgestone. In 2012, the company launched a



guayule research initiative aimed at diversifying the world's natural rubber supply.

Guayule is not currently a commercial crop, so Bridgestone must produce the seed and grow the crop. The shrub doesn't compete with traditional food source crops, instead using a grower's existing row crop equipment to save costs.

After years of development and research, Bridgestone has landed on the variations and growing conditions that it expects will make guayule a commercially viable crop and is actively building an ecosystem to bring guayule-based rubber to market.

To date, Bridgestone has invested over \$100 million in its efforts to commercialise guayule, achieving major milestones such as producing the first tyre made from guayule-derived rubber in 2015 and continued expansion of its molecular breeding programme to improve important traits, such as rubber content and rubber yield.

Bridgestone aims to commercialise use of guayule rubber in tyres by 2030 and will continue to improve guayule productivity through sustainable methods.

Guayule gives Bridgestone the opportunity to reduce the risk of relying on a single source of natural rubber and has impactful sustainability benefits. Further, it gives Bridgestone the opportunity to localize production of a key material in the United States. **ABOVE** The use of guayule rubber will be extended through the 2023 season

KIMBERLEY MEDIA GROUP LTD

OUT NOW Learn & Compete Formula SAE®/Student book Second edition



Published by Kimberley Media Group, producers of RACE TECH and Historic Racing & Technology magazines and organisers of the RACE TECH World Motorsport Symposium

kimberleymediagroup.com







historicracingtechnology.com



Mahindra Racing to power ABT Sportsline's Formula E comeback

MAHINDRA Racing – styled the Greenest Team in Motorsport – has announced its first customer racing programme.

The Indian team, which has been net carbon zero since inception, has committed to providing the powertrain to FIA ABB Formula E World Championship-winning team ABT Sportsline for its return to the all-electric racing series.

From 2023, Formula E teams will race identicallooking Gen3 machines, with manufacturers developing the electric drivetrain that can then be made available for privateer teams. A pair of Mahindra Racing powered by ZF Gen3 cars are due to arrive in ABT Sportsline's facilities in Kempten in October – in the meantime, ABT engineers are working with the Banbury-based team on software, set-up and simulation, as well as joining for test days.

Dilbagh Gill, CEO and Team Principal at Mahindra Racing, commented: "ABT Sportsline is one of the top-level race outfits in the world and we've longenjoyed racing competitively against them. It's an honour to be able to take our powertrain, developed in partnership with ZF, and support the team in its return to the FIA ABB Formula E World Championship.

"Both Mahindra Racing and ABT Sportsline were championship founding teams and its absence in the paddock has been felt hugely. We look forward to seeing the team back winning races from 2023 and we are committed to supporting them with whatever they need to succeed."

Thomas Biermaier, CEO at ABT Sportsline, added: "As a customer team, we also want to bring our experience from seven years of Formula E with over 80 races and over a decade of electric mobility at ABT Sportsline to the partnership. We are looking forward to this new Allgäu-India connection and are grateful that Mahindra Racing and its partners are supporting us in our comeback in Formula E.

"Mahindra and ABT have a long history together: both brands were founding members of Formula E almost a decade ago, have had many great battles and have jointly driven the development of the series off the track. Now we are continuing our journey within an intense technical collaboration."

Mahindra Racing joins Porsche and Nissan in providing powertrains to Formula E's privateer teams from next season, with Porsche supporting Andretti and Nissan working with McLaren.

ABT Sportsline will enter as a customer team and makes its way back to Formula E having been a fixture throughout the championship's first seven seasons. Despite a hiatus in Season 8, following the exit of Audi, ABT can still count itself among the most successful teams in Formula E history, with 47 podiums and 1,380 points to its name.

The German squad won the first ever Formula E race in Beijing, 2014, while Lucas di Grassi steered to the Drivers' title in 2017. ABT sealed the Teams' crown a season later and partnered with Audi between 2017 and 2021.



Stratasys to acquire Covestro's AM materials business

BELOW Mahindra and

ZF will be key players in the Gen3 era

STRATASYS Ltd, a leader in polymer 3D printing solutions, is to acquire the additive manufacturing materials business of Covestro.

The acquisition will include R&D facilities and activities, global development and sales teams across Europe, the US and China, a portfolio of approximately 60 additive manufacturing materials, and an extensive IP portfolio comprised of hundreds of patents and patents pending. The purchase price is approximately 43 million euros. In addition, there is a potential earnout of up to 37 million euros, subject to the achievement of various performance metrics.

Covestro has been a key part of Stratasys' third-party materials ecosystem, and the acquisition will benefit customers using multiple Stratasys 3D printing platforms, including its Origin P3, Neo stereolithography, and H350 printers. Stratasys is already a distributor of Covestro's Somos resins and they are already available for Neo and Origin One 3D printers.

"Innovative materials are the fuel of additive manufacturing and translate directly into the ability to create new use cases for 3D printing, particularly in the production of end-use parts like automotive components," said Stratasys CEO Dr Yoav Zeif. "The acquisition of Covestro's highly regarded Additive Manufacturing business positions us to further grow adoption of our newest technologies. We will now have the ability to accelerate cuttingedge developments in 3D printing materials, and advance our strategy of providing the best and most complete polymer 3D printing portfolio in the industry."

The acquisition is expected to close during the first quarter of 2023. The majority of employees of the acquired entity will continue to be based in Geleen, Netherlands and Elgin, Ill.



Andretti to build \$200m motorsport HQ in Indiana

ANDRETTI Global, the parent company of Andretti Autosport, has announced that the team has chosen Fishers, Indiana, to be the future home of its universal motorsports headquarters.

The \$200 million facility is planned to serve as the headquarters of Andretti's global commercial functions and the base of operations for the team's current NTT IndyCar Series, Indy Lights and IMSA programs and other future racing initiatives. In addition to housing day-to-day operations for the racing team, the building will be home to the advanced research and development of Andretti Technologies.

Planning is underway on the new facility, with construction expected to begin in the fall of 2022. The building is projected to be operational by 2025.

The team intends to build a 575,000 square-foot facility that will occupy approximately 90 acres alongside the up-and-coming Nickel Plate Trail, the Ritchey Woods Nature Preserve and near the Indianapolis Metropolitan Airport. The new global headquarters would add up to 500 jobs to the local community by early 2026.

"Indiana holds an important place in the history of racing, and in my career as a driver and an owner; I'm happy to confirm that the Racing Capital of the World will continue to be the home of our global racing efforts for a long time to come," said Andretti Global Chairman and CEO Michael Andretti. "We're excited about our plans for the new campus and looking forward to becoming a part of the Fishers community.

"Over the past 20 years, I've worked to expand our operations and I'm proud of our steps to create a diverse racing portfolio. Our current facility has served us well. Our team has expanded in both competition and commercial areas and our people deserve the best environment and resources available. I'm excited to have so many of our teams under one roof as we continue to build and grow. For us, it's about more than just having somewhere to work on the cars; it's about having a global motorsport home and sharing that with our people, our fans and our sponsors to advance the sport and leave a lasting legacy."

"Indiana has long been the racing capital of the world, and Andretti Autosport's commitment to growth here will only further cement our state's leadership position in motorsports and STEM-related pursuits," said Indiana Governor Eric J. Holcomb. "This new campus will not only bring new, exciting employment opportunities and serve as an asset for one of our fastest growing communities but will also show just how much this living legacy, one of the most globally iconic brands known, continues to invest in the future of our great state."

The new campus will give Andretti Global the opportunity to welcome the community and race fans from around the world through involvement with the Fishers Parks Nature First program, planned indoor amphitheatre and a museum and innovation centre that will preserve and showcase the Andretti legacy and inspire the future of motorsports.

If Michael Andretti is able to land approval to enter a new 11th team in Formula 1, the program will be headquartered in Fishers. At present, the team operates worldwide in seven racing championships and across eight types of motorsport with 17 fulltime drivers. Andretti first became a team owner in 2003 after retiring from his full-time driving career. Nearly two decades later, Andretti has built a diverse, global enterprise competing at the highest levels of motorsport and reaching all five habitable continents. In his time as a team owner, Andretti has collected 17 championship titles and 252 race wins - including five Indianapolis 500 victories, victory at the Bathurst 1000, a Sebring 12 Hour title and wins in the ABB FIA Formula E World Championship and Extreme E series. 🛄

ABOVE The new Indiana HQ will house Andretti's F1 operation if the team's plans get the green light





Report says sport can increase climate impact 100x by engaging fans

A REPORT released by the Planet League, supported by Extreme E, brings a new term to the fore as sport continues to take action on climate change. Introducing 'Scope F'.

Scope F is the term to describe the influence sport can exert on fans' greenhouse gas emissions and climate impact in their daily lives. For some sporting organisations that influence can extend to millions of fans, so Scope F could be significant.

The Planet League asserts that this fan engagement could increase climate impact 100x beyond what they can achieve 'in-house'.

The report highlights examples of how sports are incorporating Scope F strategies into their operations. For Extreme E, having a positive influence on fan behaviour in their own lives is key.

Extreme E, which features electric off-road racing in some of the world's most remote and challenging environments, aims to: pave the way to a lower carbon future through the promotion of electric vehicles; use sport to draw attention to the impacts of climate change; and inspire fans, companies and locations in the solutions we can, and must, all be part of.

During its inaugural season, Extreme E joined forces with Count Us In, a group of global companies united in taking action on climate change.

The Extreme E challenge harnesses the power and excitement of sport to call on its fans to take real life steps which reduce their carbon footprint and to **ABOVE** Extreme E is committed to highlighting the impact of Climate Change urge governments, cities and businesses to do more to address climate change. Fans are asked to pledge up to 16 different steps, including to avoid singleuse plastic, to walk or cycle more, to eat more plant-based foods, to drive electric vehicles, among other actions

In total, Count Us In's global campaign has seen over 500,000 people globally pledge to take over 15 million steps, which equates to 170,725,353 kg CO2e carbon saving, demonstrating that seemingly small steps, when multiplied on a global level, can have a huge accumulative effect.

The concept of Scope F was inspired by Scope X, a term coined by Solitaire Townsend of Futerra, who noted in her TED Talk that Scopes 1, 2 and 3 don't account for 'emissions of influence', or what she calls Scope X.

The report highlights how this is already starting to happen and organisations from several sports have proven that they can positively encourage their fans to make lifestyle changes to reduce their impact on the planet.

Scope F underlines that emissions should not only be seen as "my responsibility" or "your responsibility", but also as the consequence of lots of influences across society. To unravel this requires a new level of cooperation, which Scope F brings to life.

Ali Russell, Chief Marketing Officer at Extreme E, added: "Sport is the most powerful platform in the world for uniting and exciting audiences. At Extreme E, our entire mission is to harness that power, use it to educate on climate change, and inspire our audiences, which include fans, companies and governments, to change course and make decisions which ultimately lower our impact on the planet. The potential is limitless, but it requires everyone to do their part.

"Recognising Scope F and the influence athletes, teams, sponsors and the media can have on their fans and consumers' bigger picture behaviours – whether positive or negative – is a truly exciting development for sports strategists. The better Scope F is understood, adopted and injected into decision making in our industry, the more effective sport becomes as a force for change."

The report goes into depth on the rationale behind Scope F, its implications, its economics and case studies. While examining the potential of Scope F in depth, the report makes it clear that sports organisations need to continue to work hard on cutting their Scopes 1, 2 and 3 emissions. Indeed, there is substantial interplay between them and Scope F.

Claire Poole, Founder of Sport Positive, commented: "Scope F is a new way for sport to consider their wider reach, and modelling the impact measurement of it could be a gamechanger for our work to encourage sport to increase its action and ambition on climate change."

New simulation approach advances tyre modelling within rFpro

FOR the first time, simulation software specialist rFpro is integrating third-party tyre model suppliers directly into its road surface model software, TerrrainServer. This access to highly-detailed road surface data is helping motorsport teams to develop more advanced tyre models.

"The tyre is the only part of a race car connected to the road," said Matt Daley, rFpro Operations Director. "For motorsport teams, optimising the tyres is critical to reducing lap time. Using a more advanced tyre model during simulations provides a better understanding of the tyre behaviour and improves correlation with the real world."

A tyre model is made up of two elements: the contact patch model and the dynamics and force calculations. For highly-efficient processing during real-time simulations, TerrainServer takes an average road position of the contact patch, which the tyre model uses to calculate the force and directions being applied to the wheel.

The new development gives tyre modelling providers encrypted access to the road surface model so they have complete control of the tyre model calculations. This is enabling the contact patch to be split up into 1cm x 1cm segments each with its own road position. As a result, the forces and stiffnesses of different areas of the tyre can be simulated creating a much more advanced tyre model.

During offline simulations, the new tyre model can be run at extraordinarily high detail because it isn't constrained by real-time. This enables a sweep of test parameters to be run to evaluate how the parameter changes affect the vehicle. For example, different tyre pressures, downforce levels and weight distributions can all be evaluated to see the impact on lap times.

"We have been entrusted by race circuits around the world with their track surface IP for over 20 years," said Daley. "It was therefore critical to enable customers to integrate their own tyre models into our simulation whilst also encrypting the road surface data."

The first tyre model provider to be integrated into rFpro's TerrainServer is MegaRide. Its customers have already adopted the new solution and are benefitting from the results.

"rFpro is the most open and agnostic simulation platform in the industry," said Daley. "The integration of tyre models into TerrainServer is a big step toward increasing the flexibility of our solution." BELOW Access to highly-detailed road surface data is helping teams develop more advanced tyre models



Roll hoop safety to be overhauled

THE FIA is to push ahead with a significant overhaul of its roll hoop tests to ensure that cars in the future resist significantly more severe loads.

The move was triggered by an extensive review of the crash of Zhou Guanyu at Silverstone, where the roll hoop came off the chassis. The key findings were that the pointed top of the roll hoop dug into the tarmac, which contributed to the high horizontal force involved in the incident.

Interim measures for 2023 include the requirement for a rounded top of the roll hoop, plus the creation of a new physical homologation test where the load pushes the roll hoop in the forward direction.

The World Motor Sport Council also approved measures to clamp down on both flexing floors and porpoising. From the Belgian Grand Prix, the FIA will be measuring the latter phenomenon and expecting teams to operate below a certain threshold in order for their car to be considered safe.

FIA President Mohammed Ben Sulayem said: "Safety is absolutely the highest priority for the FIA, and we have devoted significant time and resources to the analysis and resolution of the issue of porpoising. I have personally discussed this matter with all of the teams and drivers, and while of course there are some differences in opinion owing to varying competitive positions, it is very clear that the FIA has a duty to act and ensure that the drivers are not put at undue risk of injury as a result of this phenomenon.

"It was evident that an update to the requirements for the roll hoops was needed after the crash of Zhou Guanyu at Silverstone, and while this incident showed us all how remarkable the safety systems in Formula 1 are, it also proved once again that we must continue to innovate and pursue safety matters without compromise."





Pre-order tickets here



Celumo-

At The Embassy of Switzerland in London

Sustainable fuels
Latest electronic technology

Carbon neutral motorsport events
Future materials: tyres, brakes, aero and composites

THE CHAIRMEN



ULRICH BARETZKY Former Director, Audi Motorsport Engine Development, Audi AG



PAT SYMONDS Chief Technical Officer Motorsport Division, FORMULA 1®

The W

The WMS presents a rare opportunity for like-minded engineers to discuss areas of the sport that they may not be so familar with thereby expanding each other's knowledge for mutual benefit. It is also an excellent networking opportunity."

Pat Symonds, Chief Technical Officer, Motorsport Division | Formula 1 pot symonds

worldmotorsportsymposium.com



limited conference places!

Don't miss the opportunity to attend; contact sara.kimberley@kimberleymediagroup.com to secure your place.



The world is currently moving very fast. To shape the future of motorsport it is essential that all people involved put their thoughts together and show that motorsport can be the enabler for new sustainable technical inventions. The World Motorsport Symposium offers the platform to be part of creating that future! It is great to see how the WMS has accelerated over the last few years and it was stunning to see that the ACO, FIA and F1 Liberty Media were using the platform to announce their new programmes and regulations!"

THOMAS KRAEMER, Director Motorsport Quality Management, Porsche Motorsport





THE AUDI NEWS IS PRETTY MONUMENTAL"

Formula 1's sustainability agenda reaped its first rewards when Audi confirmed its entry for 2026. **Tony Dodgins** gets reaction from the grand prix paddock

EW for 2026 Formula 1 Power Unit (PU) regulations revealed in August have had the desired effect of attracting new manufacturers to the sport's top echelon. Audi has already revealed its F1 participation as an engine supplier beginning in '26, with an announcement from sister VW-owned company Porsche also expected.

The complicated MGU-H (Motor Generator Unit – Heat) element of the current engines will be removed, with greater emphasis placed on the MGU-K (Kinetic). The 'K' is an electric motor connected to the internal combustion engine. During braking it recovers energy normally lost in heat and stores it in a battery mounted flat under the car's fuel cell. The 'K' is connected to the crankshaft by timing gears and helps to turn the crankshaft, producing more power.

The current MGU-Ks, present on F1's 1.6-litre turbo hybrid engines introduced in 2014, produce a maximum 120 kW or 160 bhp. In 2026 that will rise to 350 kW, approximately 470 bhp. The total power output of more than 1,000 bhp will be maintained as F1 moves to fully sustainable fuels that use significantly less energy with net zero exhaust emissions.

With the increased proportion of electrical power, less fuel flow will be needed. In 2013, the last year before the current hybrid PUs were introduced, F1 cars used 160 kg of fuel in a race. That came down to 100 kg and, for '26 onwards, F1 is aiming for just 70 kg. It is also moving from controlling the fuel flow through a maximum mass flow rate, to a maximum energy flow rate.

In addition to F1's new team cost-cap, from 2023 an engine spending cap will be introduced, limiting the amount that can be spent on the new PUs. From 2023-'25 inclusive, that figure will be \$95m per annum, rising to \$130m from 2026. New manufacturers, such as Audi, will be permitted an extra \$10m in the first two seasons of the new regs and an extra \$15m in year three, plus additional dyno hours.

The new regulations have been worked on for almost two years, with F1 meeting with the management of existing and prospective manufacturers and batting around various iterations while contending with differing agendas and arriving at a compromise acceptable to all.

Governing body the FIA's Single Seater Technical Director, Nikolas Tombazis, says, "The Audi news is pretty monumental. It's fantastic to have a major brand like that join the sport – a fantastic addition. It was one of the key objectives to make regulations that would make that possible.

It's tight. Even 2026... you know, it's ten past midnight and Cinderella has already buggered off!"

"If the regulations had stayed as they are now, everybody else would be many years behind. And especially with the addition of the financial regulations, it would have been virtually impossible for anybody to ever catch up. And that would have put off anybody from joining the sport. One of the key objectives alongside all the environmental and other messages – cost, close racing and so on – was to make it attractive. And the announcement by Audi is a vote of confidence."

Audi, of course, will be competing against Mercedes, which stole such an impressive march when the first hybrid PU was introduced back in ►

ABOVE Audi's announcement marked a "major moment" for F1's sustainability push

5

9

M

Audi Spo



2014, with Red Bull and Honda ending a seven-year run of three-pointed star domination only in 2021.

Reacting to Audi's arrival, Hywel Thomas, MD of Mercedes Benz AMG High Performance Powertrains, said: "It's clearly very, very exciting. There was a large part of the regulation discussion which was about making sure that we did have a set of regulations that knocked down some of those barriers to entry. We'll look forward with great excitement to competing against them, because they're going to be formidable. And that's what we look forward to, in any competition.

Fuel will be a big challenge

"The changes for '26 are quite broad. It's a whole new power unit. We look forward to the challenge and are excited by it. The increase in the electrification of the power unit, the increase in the size of what up until now has been the MGU-K – that's going to be hugely important and very different, and links well to what is going on in the road car environment. And, to go with that, the reduction in output of the combustion engine and the conversion over to running with sustainable fuel, is another challenge. The fuel challenge is going to be a big part of this regulation set.

"Someone like Audi is not new to making combustion engines, they're not new to making racing engines, and they're not new to electrical racing. So, whilst I'm sure there will be a lot of new technology, a lot of differences, they'll have a very capable engineering team and a very capable operations team to back that up.

"Yes, it's going to be tough, but then it'll be tough for all of us. We've all got the same constraints in terms of the cost cap. We've all got the same constraints from physics. But I'm sure all the engineering teams will be looking at these regulations with a lot of excitement and plans about how they're going to exploit them."

F1's current huge popularity and appeal to a younger demographic has been important in seeing the 'go' button pressed by the VW-owned prestige manufacturers, with a Porsche tie-up with Red Bull Powertrains widely anticipated. **ABOVE** Audi is building its PU at its Neuberg facility

BELOW Although starting from scratch in F1, Audi's experience with electrification with its Formula E powertrain gives it a launchpad



Without the addition of the financial regulations, it would have been virtually impossible for anybody to ever catch up"

Interesting, is that rather than a badgesharing deal around the same unit, the two companies have gone in different directions, with Audi building its PU at its Competence Centre Motorsport facility in Neuberg, near its Ingolstadt base. A tieup with Sauber at Hinwil in Switzerland, some 450 km away, is mooted, with Alfa Romeo recently announcing a '23 end to its Sauber sponsorship agreement.

Red Bull team principal Christian Horner said at the Belgian GP that pushing back the new regulation by a year from 2025 was crucial to the entry plans of both manufacturers, although could not offer direct comment on Porsche's position ahead of any announcement.

"I think it's great that there are new manufacturers and Audi's announcement is obviously a significant one with a really first-class brand," he said. "It's testament to where the sport is that the manufacturers are looking to re-enter F1.

"But the disadvantages for a newcomer are two-fold: one is that we have to catch up and cover the ground of pretty much 10 years of these regulations. And of course, within the budget cap constraints that there are, \$10 million extra for a newcomer is pretty frugal.

"The other challenge for a newcomer within those financial regulations, is establishing your facility when you're starting from scratch as Red Bull Powertrains has.

"Within 55 weeks, we've created a factory and produced our first combustion engine, which is an enormous achievement – but there's still a long, long way to go in terms of manufacturing capacity, etc. "There are timelines, some of which are slightly unrealistic. I think something that will need to be revisited is effectively the safety net, so that if a power unit manufacturer misses the target, what is the allowance to correct that? So that we don't have massive disparity, as we saw at the introduction of the V6 era in 2014.

"You absolutely shouldn't underestimate the scale of the challenge. Of course, a company like Audi's reputation speaks for itself. But the scale and the size of the challenge, as we've seen ourselves at Red Bull, is enormous. It's exciting because it's a challenge and you have to believe anything is possible.

"Thankfully the regulations were delayed 12 months to 2026, otherwise I don't think you'd have seen either Red Bull or Audi participating. But, even 2026... you know, it's ten past midnight and Cinderella has already buggered off! It's tight, but that's Formula 1." ABOVE In its bid to make up ground on existing manufacturers, Audi will be permitted an extra \$10m in the first two seasons of the new regs and an extra \$15m in year three, plus additional dyno hours ASERATI TURNS

24

RIGHT Giovanni Tommaso Sgro is orchestrating the brand's motorsport comeback

BELOW Maserati returns to the GT ranks with its MC20

With the famous brand poised to return to the racetrack in Formula E and GT2, **Chris Pickering** talks to Maserati boss Giovanni Tommaso Sgro

NATURA HABITAI

ASERATI is a name deeply entwined with motorsport. In its early days, the Modenese manufacturer won the Indy 500 twice, scooped four consecutive victories at the Targa Florio and powered the great Juan Manuel Fangio to his fifth and final Formula 1 World Championship. More recently, the Maserati MC12 utterly dominated the FIA GT Championship from 2004 to 2009, winning five teams' championships and four drivers' championships in a row.

Despite some long absences from the sport, Maserati has always been a name that felt like it belonged on the track. And now it's returning with a two-pronged attack consisting of a Formula E powertrain programme with Venturi, and a new customer sports car, the MC20 GT2.

Maserati Corse has a new boss too, in the form of Giovanni Tommaso Sgro. Born in Rome and educated in the United States, he previously managed the motorsport sponsorship programmes for global drinks giant Diageo, which included a seven-year commitment with NASCAR, Grand-Am and Rolex 24.

"Maserati has almost a hundred years of history in motorsport. For us, to go back to racing now, showcases once again the talent that we have internally to really compete on track. And I think also it sends a really unique message to our broader stakeholders and consumers across the world that we were born on the track, and it really makes sense for us to go back there," he comments. "For us, that competitiveness is in the blood, so it almost felt a little bit out of place to be away from racing."



Maserati

The firm's CEO Davide Grasso announced intentions to return to motorsport two years ago, and according to Sgro, the decision to target GT2 and Formula E followed on organically from there.

"It wasn't about one specific platform over the other, it was just going back to racing," he notes. "I think GT2 and Formula E complement each other. It really shows the diversity of Maserati as a brand and as a company. GT2 allows us to show the performance and technical capabilities [of the MC20] and then we have Formula E, which is the most advanced electric platform in the world. We're developing a line up of electric cars for the future, so it sends an important message – not just showcasing our technical abilities in Formula E, but also to generate awareness of what we're able to do for a street car. That connection is very important." ▶

Gen3 and beyond

Maserati is set to join Formula E at a particularly fascinating time for the championship. The thirdgeneration car illustrates just how far the series has come, with a top speed in excess of 200 mph and three times the regenerative braking capability of the Gen1 car.

The Italian brand will enter the series as the powertrain supplier to ROKiT Venturi Racing, headed by former DTM racer and F1 test driver Susie Wolff. Maserati's parent company Stellantis is already involved with the series through the DS brand, which supplies powertrains to the Techeetah team.

The tie up with Venturi will operate on a similar basis, with Stellantis reportedly having pushed for the FIA to allow large corporations to re-label their powertrains under an additional brand.

This, in effect, is what Maserati will be doing. Much of the hardware will come from DS, but the software will be developed in-house. It's a pragmatic move, as DS has been present in Formula E since the Gen1 car was first opened up to manufacturers in 2015, making it one of the most experienced outfits in the championship. Grasso previously referred to it as a "plug and play" opportunity, allowing Maserati to join the series with the support of a championshipwinning powertrain constructor behind it, yet opening up the potential for the two brands to follow their own separate paths.

Friends and rivals

"Being part of Stellantis is a great benefit for us in general," comments Sgro. "And I think that when you have the opportunity to speak to colleagues who have been in Formula E already, it gives you sort of a cheat sheet as to what Formula E is all about – sharing





ABOVE & LEFT Maserati enters Formula E's Gen3 era (above) by joining forces with ROKiT Venturi Racing (left in Gen2 competition)



The message of an electric car that can perform at speeds in excess of 200 mph, with battery power to go almost one hour, is extremely impressive"

knowledge, sharing resources and sharing input is extremely valuable for us. But then we're Maserati and they're DS; so the way that we absorb and sort of interpret that information is up to us. Our strategy and our objectives are different."

The exact details of the collaboration remain flexible, we're told: "I don't want to say it's a work in progress. But I think as we enter the season nine in January, it's beneficial to have open conversations about different topics that are related to Formula E. But at the end of the day we're an individual team, and we're competing against all of the other teams, including the other Stellantis team, so our focus is just on performing as best as we can."

A design team from Stellantis is understood to have been one of the groups that consulted on the design of the Gen3 car, prior to its unveiling earlier this year. It's yet to be officially confirmed, but DS is also believed to be supplying powertrains to Jay Penske's Dragon Racing squad next season, bringing the total number of Stellantis teams to three. On top of that, senior VP of Stellantis Motorsport, Jean-Marc Finot, has suggested that one of the Maserati Formula E drivers could be shared with Peugeot's LMH programme (another outpost of the Stellantis empire).

Looking further ahead, discussions are already understood to have taken place with the Formula E manufacturers about future evolutions to the new Gen3 rules (dubbed Gen3 Evo), and the Gen4 regulations that will come afterwards. In what's described as a brainstorming session, topics including hydrogen fuel cells, open battery development and even partial autonomy – in the pitlane or under safety car conditions – were reportedly discussed.

Sgro believes there will be plenty to keep the engineers busy: "If you look back at all the achievements that Formula E has made since it started, I think that gives you an indication of what's going to happen in the next 10 years. If you think about the message of an electric car that can perform at speeds in excess of 200 miles an hour, this next year, with battery power that allows them to go almost one hour, that to me is extremely impressive. I think it'd be great to showcase more of the individual manufacturers' technical capabilities in the future."

So could the next step be something like a degree of freedom in the battery design? "I think so," he replies. "From a technical aspect, any point of differentiation, where you can showcase the value of the manufacturers, I think, is key."

MC20 GT2

While Formula E is very much a tool to promote the Maserati brand and expand its technological prowess, the MC20 GT2 will be a commercial enterprise, sold largely to wealthy amateurs. It will also help to showcase the road-going MC20 supercar, with which the racing version shares much of its technology.

This high level of carryover was one of the reasons for going for SRO's GT2 class, which has been developed specifically with amateur drivers in mind. Not to be confused with the old GT2 category that evolved into GTE, the new class actually sits between GT4 and GT3 in terms of outright lap time, although it achieves this with higher powered cars that are faster in a straight line but less dependent on aerodynamic downforce through the corners.

"I think it's the right fit for us in terms of the performance of our road car. Plus, we have the right customers in GT2 and we believe it's a platform that's growing," comments Sgro. "It was an **b**

ABOVE RIGHT

Maserati's Formula E project spearheads the brand's move to Folgore, its full-electric range. The new GranTurismo will be the first model in Maserati history to adopt 100% electric solutions

opportunity for us to develop a car, put it on track and be a top performer."

Asked why Maserati decided to go for the incoming GT2 category as opposed to the more established GT3 format, which will soon be eligible for Le Mans, he points out that it all comes back to the customer base: "Those are the people that are interested in our car. When we were in the process of developing the car for GT2, we found that the interest was extremely strong. We're going to kick-off mid-season of 2023, and I think we can also help to push and draw additional awareness to the platform. That's why we also chose GT2 – not over any other platform, but it was just the right fit at the right time."

Pre-chamber combustion system

Internally, the MC20's 3-litre twin-turbocharged Nettuno V6 will be unchanged from the road car, complete with its innovative pre-chamber combustion system. This initiates combustion in a separate chamber, creating jets of flame that ignite the main charge at multiple points, raising the knock limit. ►

The opportunity to speak to colleagues, who have been in Formula E already, gives you sort of a cheat sheet as to what it is all about"



ABOVE Matilde La Guardia is the engineer responsible for the MC20 GT2 **BELOW** Care has been taken to ensure that the GT2 car is stable and predictable for amateur drivers







Power steering racks for left or right hand drive, front or rear steer, in an almost infinite variety of dimensions ...with a 3 to 4 week lead time.

Download a Type CF design worksheet at woodwardsteering.com





It's possible that the turbocharger will be resized to optimise fuel consumption, so the car can complete the Fanatec GT2 European Series' standard 50-minute race duration without refuelling. In other respects, we're told there will be no changes to the engine hardware, although the road car's 8-speed dual clutch gearbox will be substituted for a 6-speed sequential, along with an uprated clutch and differential.

In the case of the MC20, the power level would be similar in GT3 or GT2, points out Matilde La Guardia, the engineer responsible for the MC20 GT2, but the reasons for selecting the category lie elsewhere: "The road car's power-to-weight ratio would be too high for GT4, but when it comes to GT3 or GT2 the balance of performance wouldn't be a problem. But following a recent change in the regulations, GT3 has become a very intense category for gentleman drivers. There are now a lot of professional drivers coming into GT3, so GT2 is perfect for our customers."

Downforce levels in GT2 are lower than GT3 and care has been taken to ensure that the car is stable and predictable. A new aerodynamic package ►



ABOVE Internally, the MC20's 3-litre twinturbocharged Nettuno V6 will be unchanged from the road car, complete with its innovative pre-chamber combustion system

LEFT Optimisation of the GT2 package is taking place in simulation at Maserati's Innovation Lab in Modena



is in development, which will include an adjustable rear wing, a large front splitter, diffuser and side skirts. A new air intake on the roof and larger side intakes will aid the cooling, along with a redesigned bonnet for improved aerodynamics and cooling.

"We're looking to optimise the downforce and the drag," comments La Guardia. "For example, the air extraction from the side of the car will be increased to maximise vertical load at the front. The understeering characteristics when this type of car enters a corner is one of the most important factors for a gentleman driver."

Innovation Lab

The Dallara-built carbon fibre monocoque will be carried straight over from the road car, as will the double wishbone suspension with its semivirtual steering axis. "Obviously, we will be using racing components, such as adjustable shock absorbers and torsion bars, but the geometry will be the same," notes La Guardia.

The MC20 road car is said to provide a good base for its GT2 counterpart, although plenty of work will still be required to optimise the new package. Much of that is being carried out in the simulation at Maserati's Innovation Lab

GT3 has become a very intense category, with lots of professionals, so GT2 is perfect for our customers"

in Modena, which is said to be one of the most advanced in Europe.

"We inherited a lot of experience from the road car development in the simulator," comments La Guardia. "This thought process allows you to anticipate problems and generate a consolidated database before you move on to the development on track. It's another tool that's helping us to optimise the car and ensure that it's focused on gentleman drivers and not just professionals."

So could the MC20 spawn future versions for GT3 or other classes? "Right now, our focus is on Formula E, GT2 and the Project 24 track car that we launched recently," comments Sgro. "This is exactly where we want to be right now. The future has a lot of other opportunities for us, but it's too soon to make a statement about that."

Electric GT racecar

While we're peering into the crystal ball, there's one more question that I'd like to put to Maserati Corse's new boss. The company previewed its first all-electric road car earlier this year, the Folgore. That's based on the forthcoming Maserati Grecale SUV, but electric sports cars are soon to follow, so can Sgro

BELOW The marque's absence from singleseaters stretches back to the revered 250F, in which Juan Manuel Fangio won the last of his F1 titles





LEFT Maserati's single-seater heritage includes two victories at the Indy 500 with the 8CTF. Here Johnny Rutherford, a threetime Indy 500 winner, like the celebrated Wilbur Shaw, victor in the Maserati Boyle Special in 1939 and '40, drives the historic machine

BELOW Maserati's place in GT folklore was cemented by the feats of its MC12, which dominated GT1 ever see Maserati offering an electric GT racer?

"I think that it's possible. Absolutely," he comments. "When you think about how far, for example, Formula E has come ... I'm not sure if 15 years ago, someone would have thought that a Formula E Championship could have been as successful as it is today. And I think that we have to look at product development in many different ways. There will be opportunities in the future to develop hypercars that are different than the ones that are produced today. And when that opportunity comes, I can guarantee you that Maserati will be a key player."

Big ambitions, then. But there again, Maserati has the financial might of one of the world's largest car corporations behind it, it has handson experience of motorsport both internally and through its sister organisations, and it has a passion for racing that stretches back nearly a century. Don't be surprised if this is just the start of the brand's motorsport revival.



THE MOST VERSATILE GT RACING CAR PORSCHE HAS EVER BUILT

Porsche's new GT3 offering taps larger performance reserves for different Balance of Performance classifications, but also prioritises driveability. **Anthony Peacock** talks to Sebastian Golz, project manager for the new 911 GT3 R

GOING to be honest about this," says Sebastian Golz, project manager for the new 911 GT3 R. "It's not the sort of car that you can put anyone into and they will be lightning quick straight away. You have to know how to drive it in a specific way; or adapt yourself to drive it in a specific way, and then you will be quick. But that's just because it's a 911 and it really has all the DNA of a Porsche. And this, I think, is what makes it special."

Thank God for that. The GT3 moniker is synonymous with the Porsche 911 as the flagship performance model, but it's only in comparatively recent years that the Stuttgart manufacturer has >

The measure of success for me is if we can help as many drivers as possible to achieve their full potential"

BELOW It is essential that the intensive test programme generates feedback from drivers at many different levels

II photos: Porsche AG ·

Į

truly cracked the racing category of the same name that nowadays forms the bedrock of GT competition around the world – despite being the most successful manufacturer at Le Mans, with 19 overall wins.

Introduced in 2019, the previous 991.2 generation of the 911 GT3 R won the Spa 24 Hours, the jewel in the crown of GT racing, at each of its first two attempts. That ended a drought dating back to 2010, when Porsche won the flagship event with a GT2 car, with German rivals Audi, Mercedes and BMW dominating in the meantime.

This year, the leading Porsche finished only seventh in the Belgian classic, which unusually stayed dry from start to finish. But by then, just a few days earlier, the company had already unveiled the car's successor.

The pace of development is high in GT3 racing, with manufacturers regularly

bringing updates or entirely fresh models to the track. The new Porsche, which will be raced by customer teams from the beginning of 2023, is based on the latest generation of 911 road car, the 992 (it's only the second racing car based on the 992 that the Stuttgart firm has ever built, after the 911 GT3 Cup car). Both on the road and on the track, it's rather different to its predecessor – in an evolutionary way.

Big shoes to fill

"The new 911 GT3 R has big shoes to fill," Porsche Motorsport's sales director Michael Dreiser says. "Its forerunner has won almost everything there is to win in the GT3 scene in four seasons since 2019." As well as overall wins at Spa and the Nürburgring 24 Hours, the outgoing model has also taken class victories at the two major early-season endurance races in the United States, the Daytona 24 Hours and Sebring 12 Hours. But GT racing is never an entirely level playing field – and that's ironically because it tries incredibly hard to be just that.

The competitiveness of GT3 is built firmly on the Balance of Performance (BoP) system that aims to equalise the competing cars, and this means there is not so much to be gained from improving outright speed as there might be in other racing categories. Porsche's focus has therefore been on better driveability to help both professional and amateur drivers extract more from the car over a stint.

"We hit the bull's eye with the enormously successful predecessor. So the bar for its successor is high," says Golz. "Our task was less about making the new 911 GT3 R even faster: the classification within performance windows set by the ►


RIGHT LED headlights on the 911 GT3 R rely on so-called collimator technology developed for the new LMDh 963 prototype

BELOW The new 911 GT3 R features a larger engine than its predecessors, plus improved balance and consistent aero performance





ICHELIA

ThidoM

BoP quickly cancels out this advantage. For us, it was primarily about our customers being able to drive the racing car fast for longer. This is why we focused predominantly on improved driveability. That's always been our approach at Porsche: to put the customer first and make sure they have what they need to perform. It's not just about chasing the outright wins."

Perhaps counter-intuitively, one way in which Porsche has achieved this has been to increase the capacity of the normally-aspirated flat-six engine from four to 4.2 litres, raising the power output to 557 bhp. However, it has also optimised the torque and power curve across the entire rev range, better suiting amateur drivers.

Improved weight distribution

With the engine still sitting at the rear of the car – albeit tilted forward by 5.5 degrees to create more space for the diffuser – other parts such as the alternator and air conditioning compressor have been moved "a good metre forward" and further down for improved weight distribution.

The KW suspension and kinematic has been modified to allow for more precise steering and reduced wear on the rear tyres, with a double wishbone layout at the front and multi-link rear. The setup around the front axle, borrowing components from the GTE-class 911 RSR, has also been designed



to create a better airflow underneath the car back to the diffuser. This should give the car more stable aerodynamics, while the longer wheelbase (by 48 millimetres) will also lessen the load on the rear tyres and help their consistency over longer stints. Other key suppliers include BBS, Cosworth, ZF (for the power steering), Bosch, Racetech seats, and Mobil 1 lubricants to name a few examples. The whole car weighs in at about 1250 kilograms.

"The 911 is renowned for its traction and its performance under braking," continues Golz. "That's >

ABOVE The singlepiece alloy rims clad brakes from AP Racing. The car features a Generation 5 racing ABS from Bosch

BELOW Every aspect of the car has been reviewed, even down to the interior lighting variants





Around the world, all leading Formula, Sports Prototype, GT, Touring & Stock Car Manufacturers and Series choose ATL

World-Leading Safety Fuel Cells that offer performance gains alongside major safety improvements

Custom Design



Scan code or contact us for more information about our Fuel Cells



SAVER CELLS

Ranging from 10 - 170L

+44 (0) 1908 351700

Standard Or Custom

sales@atlltd.com



#ATLInside





been improved too for this latest model, with generation 5 ABS, for example. We've not done anything dramatically different: just made everything a bit better."

The development from a driver's perspective has also taken a 360-degree view. The first people to drive the car were Porsche's well-known factory drivers: people like Matt Campbell, Kevin Estre and Mathieu Jaminet. "This makes sense as you first have to make sure that the basics are right, and they will see that straight away," points out Golz. Then the contracted drivers with strong associations to Porsche tested the car. Finally, Porsche's customers got a go, and as Golz points out: "This was a vital part of the development too as it was important to take their feedback on board. The car had to be easy to drive."

Only once it had proved its capabilities in the hands of a wide variety of drivers was it signed off, ensuring that it was fit for purpose from the very beginning. Porsche claims that this is the most versatile GT racing car that the company has ever built.

Porsche also says it focused on making the car easier and less costly for teams to run: another key battleground in the GT3 customer racing marketplace. That's the same reason why Porsche isn't going to



LEFT The rear wing now features a swanneck mount to clean the airflow

RIGHT The elevated underbody at the fore of the front axle acts for the first time in conjunction with a smooth undertray and a rear diffuser. This combination improves downforce without a significant increase in drag

LEFT The lightweight body features aluminium-steel composite design with mounting points for a removable rescue hatch in the roof

BELOW LEFT The seat has moved closer to the centre of the car, with an improved roll cage and newly developed FIA side impact protection



be churning out huge quantities of this car: production is limited to provide the best service to existing loyal customers, maintain a degree of exclusivity – this is a Porsche, after all – and keep residual values high, which allows customers to sell their cars for proper money afterwards. The second-hand GT3 market is awash with Audi R8s, for example, but finding a 911 is harder. Not to mention more expensive, with demand outstripping supply.

Devil in the detail

It's the details that count. The safety harness has been modified to be fastened quicker in the latest car, which it's estimated will save around one second during driver changes. Headlights have long been an area of rapid development in through-the-night endurance racing, and the LEDs on the new 911 GT3 R make



FF It was primarily about our customers being able to drive the racing car fast for longer"

use of collimator technology from the company's new 963 LMDh prototype, working like a 'magnifying glass in reverse' to light up more of the track ahead.

"We have to keep on reinventing ourselves, but this is far from the ultimate 911 GT3: there will always be another step forward," adds Golz. "That's the thing with motorsport: you're never completely happy."

The stakes are increasing all the time for GT3 manufacturers. In addition to the Intercontinental GT Challenge and regional GT World Challenge series as well as the numerous national GT championships, the DTM adopted GT3 regulations last year while the class was promoted to professional status within the North American IMSA SportsCar Championship for 2022.

What's more, this set of rules will form the basis of the GT category in the World Endurance Championship from 2024 onwards. It means the new 911 GT3 R will be the car tasked with continuing Porsche's proud GT record at Le Mans, even as it returns to the prototype ranks to fight for outright victory.

"In the end, the measure of success for me is if we can help as many drivers as possible to achieve their full potential: that's a little bit the philosophy of Porsche customer racing," concludes Golz, who started off his own career in karting, before concluding that it was too expensive to make the desired full-time switch to cars. In a way, that experience shaped his personal philosophy in creating cars for customers, although he has worked in the upper echelons of factory racing too, in Formula 1 with BMW. He then worked on a number of BMW GT cars, including the M4 GT4.

"In the end I liked F1 and my time at BMW, but I was happy to get back to Porsche, where I did my thesis, to work on the GT3 programme," says Golz. "It's a company that lives and breathes motorsport at every level. You go to pretty much any department, and you'll find someone there who has worked in motorsport. It's a real passion, and I think that shows in the cars we make. This latest GT3 R is one that we're really proud of."

HELPING SHAPE THE FUTURE

HE past 12 months have marked the start of a brave new world for electronics specialist McLaren Applied. The business was founded in 1988 as a sister company to the all-conquering Formula 1 team where Ayrton Senna and Alain Prost were battling it out for supremacy at the time. It remained part of the McLaren Group for more than 30 years, but in August last year the company was sold to private investment firm Greybull Capital. And it has big plans for the future.

Strictly speaking, McLaren Applied (formerly McLaren Applied Technologies) was always a separate entity. But under

McLaren Applied boasts a 30-year heritage in top-level motorsport. But it's the challenges of the future – in motorsport, automotive and beyond – that are dictating its innovation as it adapts to life under new ownership. By **Chris Pickering**



its new ownership, the firm hopes to underline the message that it's an impartial technology provider that's not aligned with any one team. It's also hoped that a new corporate structure will leave it better placed to identify innovations that can be applied beyond motorsport and help to bring those to a wider market.

On the other hand, much will remain the same. Notably, the name is unchanged, as is the McLaren tick in the corporate logo. Development and manufacturing are still carried out at the McLaren Technology Centre in Woking, with commercial activities at nearby Victoria Gate.

"There's not a lot of change when it comes to the day-to-day business, but on the strategic side of things and how we're set up, there's quite a significant change," comments Matthias Dank, Director of Motorsport at McLaren Applied. "The difference isn't a result of being independent, it's about having a private venture capitalist firm that has a natural interest in what we do.

"We still do motorsport for the sake of motorsport, but whenever we spot something that could be spun out into other markets, we can take it to the venture capitalists. At the core of what they do is the idea of investing in something and making it bigger."

McLaren Applied has become particularly adept at this form of technology transfer – taking concepts from motorsport and adapting them to some quite unexpected applications. But Dank emphasises that it's usually a question of integrating motorsport knowhow into a product that's specifically developed for its intended market, along with a business model to suit.

"I think it's a big misconception that you can have a good motorsport product and then just put it out there for other industries," he comments. "We find

FIA

that theory does not hold, because a motorsport product is developed to a different set of specifications. For instance, we talk all the time about the harsh environment of motorsport, and that's absolutely true when it comes to G-forces and vibration, but you'll never realistically need to start a racing car when it's -40 deg C outside, whereas you might need to do that in automotive. Similarly, reliability is always important, but the approach to downtime and servicing can be very different in one market to the next."

Powerful inverters

Dank points to several recent projects that have highlighted this approach. The first is McLaren Applied's IPG5 800-volt silicon carbide inverter. Its inverter experience started with the McLaren P1 and it refined and honed that through motorsport bringing that combined knowledge ►

> **BELOW** The experience of working with Formula E since the championship's inception has helped shape the company's direction

ICHELIN



www.racetechmag.com
TECHNOLOGY TRANSFER McLaren Applied

1.Br

ABOVE The Active Antenna system was derived from motorsport but adapted for public transport

to bear in the design of the IPG5, which took the company's vast experience in Formula 1 KERS and Formula E applications and optimised it specifically for mainstream automotive use. It's said that the highvoltage silicon carbide technology can potentially increase a vehicle's range by upwards of seven per cent, as well as enabling faster charging times.

"Through motorsport we've learnt how to design and manufacture very lightweight, very efficient, very powerful inverters," he notes. "The automotivecertified product that's been spun out of that has no direct link to motorsport, but the IP behind it comes straight from racing."

A less obvious application of the firm's motorsport knowhow is the 5G edge computing Active Antenna system that it has developed in collaboration with Swiss communications specialist Huber+Suhner.

Instead of 'yes, you can use it for an electric car as well', we are paying attention to the specific needs of electric motorsport"

Based on technology used in telemetry systems for Formula 1, it integrates the modem and computer hardware into the antenna itself, eliminating the need for RF cables and routers in the carriages. We're told that this can reduce the capital expenditure relating to the Wi-Fi system by as much as a third as well as providing a weight saving that translates into fuel and environmental benefits.

"In public transport, you want all the carriages to communicate with each other, and you want a train to communicate with the infrastructure. But the biggest problem – and one that's getting bigger all the time – is providing passenger Wi-Fi," Dank explains.

"Traditionally, you would have had a master unit

where the computing was carried out – these could be quite delicate, so they were kept in the interior of the carriage – and then you'd have cables going up to a separate antenna on the roof. We now have just one box on the roof."

Bandwidth battleground

The Active Antenna is compatible with numerous different communications technologies, so it could simultaneously be connected to several different 4G networks in addition to a 5G network. By brokering the data through multiple networks, it can maximise the available bandwidth, speeding up the data connection for both the passengers and the train operator.

"If your mobile phone switches from one Wi-Fi network to the next, it takes a couple of seconds to connect, and that pause can be very annoying. We're constantly connecting to every network that's out there in real time with a very, very low latency, so it's not even noticeable for the user," says Dank. Fittingly, the motorsport-derived technology developed for the Active Antenna has now gone full circle, with elements of that being incorporated into the company's next generation telemetry systems, he notes.

Dank likens the thinking behind these motorsport spin-offs to the mentality of a start-up company:

"Our new structure gives us direct access to venture capitalists who are constantly asking, 'Where else can you grow these ideas that you're having?'. That's completely different to being a small part within a larger group.

"When we spot an opportunity it's not about finding a pilot customer, but looking at what data we need to prove this technology to a specific industry, and what will be needed to scale it up. We'll take external capital

to grow a brilliant idea, but at the same time we don't always have to look for new partners, because our owners are the first people we would talk to."

It's not just a question of optimising the technology to its chosen purpose, but the whole business approach, Dank explains: "Public transport and motorsport are completely separate customer segments with completely different requirements on your availability and your support, hence we have a dedicated business unit for these customers. You need to provide 24/7 uptime for your systems, which isn't a requirement in motorsport. On the other hand, 99.9 per cent uptime is a very good KPI for public transport – a minimal amount of downtime is acceptable to the customer – whereas that has no value for motorsport if the 0.1 per cent downtime occurs during the race."

There are similar contrasts when it comes to safety >

RIGHT Matthias Dank, Director of Motorsport at McLaren Applied

BELOW McLaren Applied's IPG5 800volt silicon carbide inverter took the company's experience in F1 and Formula E applications and optimised it specifically for mainstream automotive use







and redundancy in the systems, he points out. The complexity of road car systems, with numerous providers for different subsystems and a non-expert driver, is such that it's best to simply stop the car if a major fault is detected. In contrast, the first priority in motorsport is to finish the race, so providing it doesn't endanger the driver, it's generally preferable to work around any issues.

Formula E influence

McLaren Applied's involvement in the fledgling world of electric and hybrid powertrains was relatively little known until the company was awarded the contract to supply the battery for the Second Gen Formula E car. Since then, this side of the business has expanded rapidly.

"The whole team did a fantastic job on the Formula E battery," comments Dank. "I think it shows that while batteries for mainstream automotive applications isn't really our focus, doing batteries for motorsport very much is – not just as a provider, but with our experience in track support, how you run a series and how you run a race car, including the health and safety side."

Working with Formula E wasn't just a valuable technical experience, but it has helped to shape the company's future



direction and its approach to electric motorsport, he explains. One of the first products to come out of this is the new VCU-500 – an integrated vehicle control unit and data logger aimed specifically at electric motorsport.

"We've made a complete generation change in the architecture, and also the process architecture that we have there, which unlocks the significant bigger bandwidth of calculation, performance, logging and performance complexities that you can run in real time on this unit," explains Dank. "At the same time, it's smaller and lighter, because we've stripped out all the parts that are needed to run a combustion engine, like the drivers for ignition, injection and wastegate control. Instead of 'yes, you can use it for an electric car as well', we are ►

> ABOVE Development and manufacturing are still carried out at the McLaren Technology Centre in Woking



LEFT Its nextgeneration SAW (Surface Acoustic Wave) torque-measuring sensor will soon be mandated for use across a motorsport series switching to hybrid technology







POWER DISTRIBUTION PANELS

A switch panel and Power Distribution Module in one. Our Power Distribution Panels are a fully integrated solution designed to replace all the fuses, switches and relays of your race car.

- CONFIGURE CHANNELS IN 5A STEPS UP TO 30A.
- CHANNELS CAN BE PROGRAMMED TO CONTROL
- HEADLIGHTS/WIPERS/RAD FANS/STARTER MOTORS etc. EACH OUTPUT IS PROTECTED FROM SHORT CIRCUITS AND OVER-CURRENT.
- ADDITIONAL INPUTS ALLOW CHANNELS TO BE CONTROLLED BY ECU OR SWITCHES ON STEERING WHEEL.
- COMES WITH LABEL SHEETS FOR FULL CUSTOMISATION -RETRO EDITION NOW AVAILABLE.
- NO COMPLEX CONFIGURATION SOFTWARE AMP SETTINGS AND LOGIC FUNCTIONS ARE SELECTED THROUGH THE FRONT PANEL







BATTERY ISOLATOR GT Designed for OEM ECU's/Ignition systems

SOLID STATE BATTERY ISOLATORS

GO TO OUR WEBSITE TO VIEW OUR FULL RANGE OF MOTORSPORT ELECTRONICS

www.CARTEKMOTORSPORT.com

Cartek Battery Isolators are designed to overcome all of the problems and restrictions associated with mechanical and electro/mechanical battery disconnects.

- FULLY ELECTRONIC WITH NO MOVING PARTS COMPLETELY RESISTANT TO SHOCK AND VIBRATION.
- MUCH SMALLER AND LIGHTER THAN TRADITIONAL KILL SWITCH.
 MEETS NATIONAL AND FIA REGULATIONS.
- MEETS NATIONAL AND FIA REGULATIONS
- STATUS LED FOR FAULT DIAGNOSIS.
- SEALED INTERNAL AND EXTERNAL SWITCHES REPLACE TRADITIONAL PULL CABLES THAT ARE PRONE TO SEIZING.
- MOUNTS CLOSE TO THE BATTERY FOR REDUCED CABLING.
- QUICK AND EASY TO INSTALL.

paying attention to the specific needs of electric motorsport."

Elsewhere, the company is also said to be looking into products for an electric powerboating series, as well as investigating an electric air racing series. But it's motorsport that remains McLaren Applied's core business, and another interesting example of this is the torquemeasuring SAW Sensor that it has developed. Now in its second generation, this technology uses surface acoustic waves (SAWs) to excite a crystal that's embedded within the surface of the shaft. When a torque is applied to the shaft, it places the crystal in strain, which changes the frequency at which it resonates. This is picked up by a small, lightweight coupler ring that sits around the shaft.

Dank and his colleagues believe this approach has a number of key benefits over the traditional methods of strain gauge-based sensors or magnetostriction. Sensors based on magnetostriction require the shaft to be magnetised or fitted with a magnetic ring, and they then measure the change in the magnetic flux as the torque applies strain to that material.

SAW system

Meanwhile, the strain gauge approach measures this effect directly using a series of strain gauges aligned on different axes, with a device on the shaft that transmits the information back to the sensor.

"The big disadvantage of a magnetostriction sensor if you have a hybrid or electric drivetrain is that those come with huge EMC issues that interfere with the magnetisation. And each shaft has to be individually paired with its sensor," he explains. "With the SAW system, you can produce a bunch of shafts, embed the calibration as a parameterisation within the shaft, and then you're good to go. If you need to change something or replace a broken part, you can just take another one off the shelf – it doesn't have to be a matched pair."

The downsides to a strain gauge-based system relates to the way that the data is measured and transmitted, he explains: "You need more hardware for a strain gauge. First of all, you're measuring very, very low voltages and currents, which means you need an onboard amplifier. And then you need a telemetry system to transmit that data back out to the sensor. Plus, the other major advantage that a SAW system has over strain gauges is that the bandwidth is significantly higher."

The sensor's bandwidth is particularly relevant in R&D applications. Here, it's not necessarily smooth, steady state



measurements that the engineers are looking for; with sufficient bandwidth it's possible to capture and measure highfrequency phenomena like gear rattle, torsional effects in the drivetrain and balance issues in the motor or engine.

"We're talking about excitation that's in the kilohertz or even tens of kilohertz for an electric motor, and you can't measure that with a strain gauge," comments Dank. "You can see if, for instance, your rotor is out of balance in the motor."

The small packaging volume and low weight mean that multiple sensors can be applied right across the drivetrain. This gives engineers greater scope to employ a well-established technique of tracking mechanical efficiency by measuring how much torque is lost at various stages between the powerplant and the wheels. For instance, the torque (and from that, the power) can be compared at the



ABOVE RIGHT Perhaps the biggest testament to McLaren Applied's neutrality is the fact that its ECU is the heart of every car on the F1 grid

RIGHT A trusted supplier to NASCAR for many years, McLaren Applied's digital dash and ECU are an integral part of the Next Gen car that has revolutionised the stock car scene this season

LEFT The SAW system could be used as a balance of performance tool in categories such as GT3



gearbox input shaft, the output shaft and the individual driveshafts.

This technology is said to be comparatively affordable, opening it up not just to R&D departments and professional teams, but also to customer-level racing. McLaren Applied is currently in discussions about using it as a balance of performance tool in categories such as GT3.

Blending braking

Another application is monitoring braking performance – especially on electric and hybrid vehicles, where regenerative braking needs to be blended with mechanical braking. "The effectiveness of mechanical

braking varies depending on things like

temperature, wear and track conditions, so balancing that with the regenerative braking to give the driver what they've requested with their pedal input is not at all straightforward," comments Dank. "So being able to measure that torque accurately in real-time is a huge benefit when it comes to balancing the mechanical braking to the regen, and the overall brake balance front-to-rear."

These are just a handful of the new applications that McLaren Applied is developing, alongside its traditional offerings such as dashboard display units, injector driver modules and telemetry systems. Proof that life outside the McLaren empire is a tremendous opportunity for this innovative firm.





Red Bull/World Rallycross Championship

Hal Ridge reports from Norway at the start of an electrifying new era for the FIA World Rallycross Championship

LANCING at the results list from the opening round of the FIA World Rallycross Championship at Hell in Norway recently, you could be forgiven for thinking it was a case of 'the same old...' as Swede Johan Kristoffersson claimed victory in a Volkswagen Polo, ahead of compatriot Timmy Hansen in a Peugeot 208. After all, excluding his 2021 foray with the EKS JC team and an Audi S1, three of Kristoffersson's record four World RX crowns had been at the wheel of

Polos, built by Volkswagen Motorsport, derived from their World Rally machines.

Hansen, meanwhile, the only driver to have competed in every World RX event since 2014, has been racing 208s since the discipline was granted World Championship status.

A closer look at the results, however, revealed a lot. A lower case 'e' after each car's name gives the game away. Finally, after years of discussion, a range of technical concepts and hurdles to overcome, World RX has made its electric transition.

With plans for single-specification carbon tub chassis - the FIA's first concept for the mixed surface discipline's electric top-flight - now a distant memory, a new breed of cars has emerged. They feature single-specification four-wheel drive powertrain kits, developed by Austrian firm Kreisel and fitted to steel-

BELOW World RX finally entered its electric era at Hell, in Norway



bodied machines, much like the rallycross Supercar (RX1) that came before them. Having won the FIA tender process, that kit concept has been developed over the last two years by Kreisel using a Skoda Fabia Rally2 concept to put more than 5,000 kilometres of testing into the programme. That showed in the opening test and race, with reliability already a strong element of the package, but for teams it was a huge effort to even get to the first event.

Double whammy

52

Timescales were tight. Not only had the indecision around World RX's electric transition been further hobbled by the COVID pandemic, but the Ukrainian war had a part too in delaying the start of the series earlier in the year.

Nevertheless, at the end of the first week

F It seems that the public are a little bit against the electric switch, but they should try to give it a chance"

in August, three teams met at Holjes in Sweden for an official test. Then, less than a week later, they rocked in up in Hell, Norway, for the first ever round. By this time Hansen Motorsport, Kristoffersson Motorsport and the Construction Equipment Dealer Team had been joined by Munnich Motorsport. The latter had been given dispensation to test in Hell in the days before the event: that alone shows how up against it the teams had been. Kristoffersson Motorsport aside, the other teams at the season-opener carried over existing platforms into the discipline's new

era. That choice made the most of rules that have allowed the 'retro-fitting' of the 500 kW [680 horsepower, 800 Nm torque], four-wheel drive powertrain kit into Supercar bodyshells, using rallycross-based suspension from the previous incarnation of cars.

The KMS squad however, led by engineer Richard Browne, opted to go down the other route available to teams at this time, to base its car's suspension around an R5 (Rally2) concept.

Where the two alternatives are similar is the backbone of the car. Each machine effectively has its floor cut away and replaced by an FIA-



RIGHT The good level of reliability reflects the many kilometres Kreisel put in with its mule car

BELOW World RX makes its electric transition with Kreisel's 500 kW RX1e powertrain kit



derived frame, to house the car's 52.65 kWh, 860V battery and the rest of the interior. "The installation of the battery and the battery frame in particular was the biggest challenge, I would say," explains Browne. "When we joined the [FIA] technical working group it was four fixation points, then it went to six, and then it went to eight, which are good steps in our opinion, for safety, and for strength.

"Then to integrate that into the chassis, while trying to maintain some strength, took a huge amount of resource at the beginning. Every team has a window to work with [with regards to frame design] for the fixation points to fit their own car, [but] the basic battery frame is the same for everybody. Then what the FIA did was pick the most extreme, the most outward pickup points, and tested that model in simulation."

Outside of the frame, each car uses independent front and rear subframes, much like an internal combustion engine Supercar would. But while the rear of the Polo has a differential, as it conventionally would, it's also joined by a 250-kW motor.

"We use R5 subframes, which are proven to be very strong. But for the front motor in particular you have to add extra tubing to mount it on basically," says Browne. "For the rear, it sits a little more in the normal position, the diff and the e-motor as well, so there's less modifications on the rear. The packaging of the motors and inverters was not so bad. This Polo, the MK6, was a little bit bigger than the MK5, so there was a bit more space in the engine bay and the rear so the integration of those was a little bit easier. The cooling, we have experience already in the past with the front-mounted radiator. We stick with what we know. Whether we're correct or incorrect, we'll have a better idea after the first few races."

Making the most of freedom

The cooling package referenced by Browne is one of the few areas in a heavily restricted first iteration of the new rules where teams have some leeway. Historically ICE Supercars have adopted a rear-mounted cooling package, aside from a number of outliers, which went for front cooling, with both the intercooler and water radiator in the front.

To date, the front-mounted cooling concept has been executed most successfully in an ICE machine by Volkswagen Motorsport. It features in what the KMS squad has nicknamed the 'killer' Polo, the car that won





ABOVE Like its WRC counterpart, the World RX paddock is adjusting to the presence of chargers

the World RX crown in 2017, '18 and '19. It's only natural therefore that, despite being a private effort using some team members from the works programme, the new KMS Polo also has a front-cooling arrangement, especially as there is no longer an intercooler to get in the way of proceedings. In fact, the Hansen Motorsport Peugeot 208 and Munnich's Seat Ibiza use a similar concept. So far only the CE Dealer squad has gone for a rear cooling package.

The kit has two separate radiators: one for the two motors, and the other for the battery.

"You can have one or two pumps as an option in the beginning [that you have to specify], but in the end they meet as a Y-piece and they're all cooled individually in one cooler and then split again after that, to front and rear powertrain," says Browne. "We had the mule car to look at and Kreisel were very helpful when you **>**



asked questions about their concept." The other decision-making process for teams has concerned the suspension options: to carry over existing concepts, or adopt the R5 (Rally2) variant?

So far, only KMS has gone with the new version of the rules in that area, but built a bodyshell to suit the specific requirements of the discipline. "We looked at the R5 bodyshell but in the end it's essentially very, very different – the requirements for rallycross with regards bump travel at the **ABOVE** The number of variables, including torque deployment and regenerative braking, are giving drivers a lot more to think about

BELOW The new KMS Polo (top) retains a front-cooling arrangement. So far only the CE Dealer squad (bottom) has opted for a rear cooling package



different tracks we already have some experience of, [with] modified pick up points and top mounts etc," says Browne. "The subframes remain the same [as R5] because they worked for us; the kingpin also on the upright. We tried to use as much existing parts, especially the parts that require both design and simulation testing, because this is big cost we don't have the budget for. The critical components we used as much as we can, then the other components we have some experience with, we are free to modify a little bit within the regulations."

The squad has maintained a link with ZF for its dampers, a relationship that was born from the works WRC and World RX programme, while the car uses Alcon brakes.

Teams across the paddock currently use different suppliers for their MacPherson arrangement dampers. Hansen is sticking with Öhlins, while the CE Dealer squad is going with BOS Suspension to accompany its Brembo braking package. Munnich Motorsport is continuing its longstanding relationship with Reiger, while using AP Racing for its own brakes. Aside from the brand of the shock absorbers, those teams that have used the retro fit option for their suspension architecture are frozen for the next three years.

Technical declaration

Within appendix J of the FIA's sporting regulations, cars that receive a technical passport and first race in 2022 must comply with the technical regulations for suspension in article 279-8, with the exception that damper travel is limited to 260 mm, they be fourway adjustable and be of MacPherson design. Teams have to file a technical declaration form to confirm their suspension design.

For the Hansen team, it was a no-brainer to go with the retro-fit option of the rules, when that became possible. "We know the 208 chassis very well," says team boss Kenneth Hansen. "With a lot of new things coming, it was a good way for us to learn the new technology but keep something that we know very well. This is cost efficient but also performance efficient."

While the reigning World RX teams' champions have kept elements they know in the latest version of the 208, front cooling is a new concept. "It's a little about **>**



Discover The PressurEvolution

Introducing the EvoScann® P16-D. The most advanced miniature true-differential 16 channel digital pressure scanner available.

- 0.1% Full Scale Accuracy
- Data output directly in engineering units
- Lightweight <45g (including 1m cable)
- Small dimensions: 50 x 32.4 x 10mm
- True-differential measurement, shared static reference
- Lightweight carbon fibre external construction
- Integral microprocessor
- CAN-FD output

Get your competitive advantage now. Book a demonstration or request a quotation. n ar



Call: +44 (0) 1264 316470 Email: enquiries@evolutionmeasurement.com www.EvolutionMeasurement.com



the weight position and weight balance; we believe this is a good concept," says Hansen. "Of course, it's a little more fragile to have it in the front, but we see the advantages too. I hope we are right."

That weight is critical. With the car's minimum weight increased for the new electric era to 1,430 kg [from 1,300 kg in ICE trim], but without the mass of the ICE and gearbox at the front, it's a mental reset in terms of using existing suspension geometry with new weight distribution.

Electronic wizardry

Speaking of the transmission, coupled with the motor on each axle, along with an inverter, is a single-speed transmission, developed by British firm Xtrac. The P1316 'ILEV e-axle' has an overall ratio of 7.90:1 and can manage an input speed of up to 15,000 rpm, lubricated through an internal oil pump and semi-dry sump pick up. The e-axle is joined by a multi-plate ramp-type limited slip differential, which like the similar version used in ICE Supercars, has adjustable pre-load.

Aside from being single-speed, where the transmission differs most from the ICE predecessors – unlike in the new FC1-X covered in Race Tech earlier this year – is that the RX1e concept has no physical propshaft, much like the STARD-developed ERX electric rallycross powertrain. Instead, the propshaft is effectively housed in the electronic wizardry of the management software.

"We are switching over from old numbers, let's say, with your centre differential, or lack of one," says Browne. "But there you talk about a torque split of 50/50. Now it's more a distribution: you can have 100% [torque] front and 100% rear, then ABOVE Where its rivals carried over existing platforms into the new era, the KMS squad elected to base its car's suspension around an R5 (Rally2) concept

BELOW The Hansen team opted for the retro-fit option

you're back to old numbers with 50/50. You have to pick something for the launch and the race [that is then locked], but you're allowed to balance your torque accordingly. So if you have a generally understeering chassis, you can have a huge influence with the torque distribution, and reduce on the front axle to aid it."

Drivers and teams endured a lot of head-scratching in the first official test and the season-opener. A number of them, including former champion Timmy Hansen, talked about how much there is to think about with the new concept. Especially when discussing the variables and setup options around the torque deployment, as referenced by Browne, and the regenerative braking from the powertrain, how that is used when offthrottle or pressing the conventional hydraulic brakes to influence the balance of the car on corner entry, for



JOIN US THIS OCTOBER AND MEET THE WORLD OF MOTORSPORT AT THE HEART OF MOTORSPORT VALLEY®



MOTORSPORT ENGINEERING & TECHNOLOGY SHOW 19 - 20 OCTOBER - SILVERSTONE

FREE-TO-ATTEND Register your ticket today!





Media Partners

Platinum Partner



<u>uteline</u>





Contact: Rachel Carn • rachel.carn@the-mia.com +44 (0)2476 692 600 • www.the-mia.com/event/MIACTS2022



ABOVE Front cooling is a new concept for the Hansen 208. One radiator is for the two motors, the other for the battery **BELOW** A mental reset was required to reconcile existing suspension geometry wisdom with a new weight distribution



example. There are more setup options than ever, but for now, much of that is locked away in the software by Kreisel with the first phase of the new rule set.

Speaking about building an RX1e instead of the kind of RX1 (Supercars) they've been creating for 30 years, Kenneth Hansen says: "They are not so different really. You want to build a light car, you want to have the weight where you want it and the geometry how you want it. It's more the software and the mapping [that is different now], but the car itself can be calculated. We just need to learn to adapt powertrain to the chassis, and that's a process. We get more and more into our knowledge bank and of course every time we are on track we will learn something new."

Asked if, now aged 61 years-old, the 14-time European Champion feels out of his depth with the new era of technology, Hansen gives an interesting response: "To set up a combustion engine I was a little lost also. I knew what I wanted as a driver, but to get that out of it [the ICE], that was more to the engineers. Now it's more understandable for me. At the moment it's good that we cannot change so much, but you can see what the car is doing and understand why.

"Like I said it's a learning process, but it's easier overall to understand than a combustion engine, I would say. But it's a









big challenge. It's a little like when you went into four-wheel drive rallycross [in 1993]: we didn't know so much and it was huge motivation to be there. It's interesting, but really we just want to win and that's what gets you up in the morning."

Where electric motorsport has perhaps fallen down in other disciplines is that there has been no direct performance comparison with previous ICE machines, aside from in the Andros Trophy where electric cars went head-to-head with ICE cars and won. But ice racing is largely under the radar. Using Formula E as an example, which still doesn't race on the same circuits as ICE machines in Formula 1 or Formula 2, the direct comparisons are shied away from.

While the new RX1e cars are not racing directly against their ICE counterparts, at some World RX events the European Rallycross Championship, still using ICE Supercars, is also in attendance, with many drivers competing in 2021 World RX-specification machines. That was the case in the World RX opener in Norway. The margins were not much, a matter of tenths in fact, and it's almost impossible to directly compare rallycross lap times when cars are not in the same races as the tracks are constantly evolving. Nevertheless, with the benefit of only three days testing, ever, the best RX1e lap time was faster than the best of the ICE machines.

"We're never happy!"

That gives reason to be positive about the potential performance. Especially when in Hell, the RX1e cars were only using 25% of their battery capacity in one race, potentially giving more opportunity for more performance output in the future.

"As engineers I guess we're never happy," reasons Browne. "Maybe when we start to be happy our drivers will never let us because they will always keep us under pressure, but that's their job too.

"I think all of the [World RX] cars in general look like they have a decent

balance, they look like the old Supercar. I think for the team KMS has, they should be really proud. We joined quite late to the TWG and for the short space of time we had, it's really good. It's been so much work, more than we ever expected. It's a big achievement.

"That can be said for all the teams. They have done a good job to get to the first test and the first race. Social mediawise, it seems that the public are a little bit against [the electric switch] but they should try to give it a chance. For me, watching my own car, I quickly forgot about the noise because you're looking for the details. This is the direction we're going, whether you like it or not. People should give it a chance."

It's a very new world then in a discipline created in 1967. But some things never change. Just as their fathers did decades ago, and they have done more recently, it was Messrs Kristoffersson and Hansen at the top of the order in the season-opener.

"We started with the rule book, a challenging spirit and an open mind"



The might of Honda Performance Development's simulation, design, development and manufacturing technologies underpins the new Acura ARX-06 GTP challenger. By **Mark Skewis**

CURA Motorsports has unleashed the allnew, electrified Acura ARX-06 prototype sports car, which will make its competition debut next January at the Rolex 24 at Daytona.

The latest in a line of successful Acura endurance racing prototypes, the ARX-06 features Acura-specific bodywork and aerodynamics based around an all-new ORECA LMDh chassis. It utilizes an electrified hybrid power unit featuring an equally new, bespoke twinturbocharged 2.4-litre V6 internal combustion engine designed, developed and manufactured by Honda Performance Development [HPD], the racing arm for Acura Motorsports in North America.

"HPD has 30 years of race-winning and championship-winning history," says David Salters, HPD President and Technical Director. "Not only in endurance sports car racing, but in developing championship-winning Honda Civic-based racing cars, the powertrain for the Baja Ridgeline race truck, Formula Regional Americas and Formula 4 powertrains with the Type R engine, and of course the Indy 500 and the IndyCar Series.

"We are looking forward to the challenge of racing Porsche, BMW and GM in IMSA's pinnacle GTP championship. We are very cognizant this is a big step for us. We have a lot to learn, but that is why we race.

> "The new Acura ARX-06 has elements of our Indy-winning technology, Honda Formula 1 technology and Rolex 24-winning technology in it. This was achieved using HPD's world-class simulation, design, development and manufacturing technologies, that our own engineers have developed, tested and validated. We are very proud of that. Now the challenge and hard work really starts, including gruelling 24-hour simulations, and learning how to maximize all aspects of performance."

LEFT The ARX-06 will take on Porsche, GM and BMW in IMSA's flagship GTP category **RIGHT** At 2.4 litres, this is the smallest displacement ICE conceived by HPD for endurance racing

Powertrain

The complete hybrid power unit is based around the Acura AR24e internal combustion engine (ICE), an all-new bespoke 2.4-litre, twinturbocharged direct injection racing V6 that was designed, developed and manufactured by HPD.

At 2.4 litres, this is the smallest displacement ICE conceived by HPD for endurance racing, yet still meets the performance target of 500 kW as measured at the rear axle by torque meters. It features a 90-degree V-angle to reduce its centre of gravity and polar moment of Engineering. The HPD Electrical Group completed both hardware and software development to best match the spec MGU and battery pack to the Acura ICE.

"We've taken the challenge presented by this new rule package from IMSA, and developed what we believe is a very competitive solution," says Pierre Descamps, who led HPD's powertrain design team for the ARX-06. "We've gone in a new direction for HPD in the design of the ICE. It is still a V6, which of course for Honda is well-known, but we have incorporated several new elements which we believe will make best use of the electric MGU and battery pack. Our new engine will rev to the maximum 10,000 rpm set by the rules, so it also makes a wonderful sound!"

Using VR headsets, the drivers were able to sit in the car virtually and recommend a much lower placement for the side mirrors"

inertia. In addition, the combustion chamber has been designed to run on sustainable low-carbon fuel.

The hybrid power plant includes an IMSA-specified electric Bosch Motor Generator Unit (MGU) and Williams Advanced Engineering battery pack. The MGU is contained in a common transmission casing and gearbox internals provided by Xtrac. The battery, within the chassis survival cell, is built by Williams Advanced

Chassis

Both IMSA in North America and FIA World Endurance Championship rules require manufacturers to use one of four approved prototype chassis, fitted with IMSA-homologated, manufacturerdesigned and branded bodywork and engines.

In the case of the ARX-06, HPD and Acura have elected to continue their successful relationship with ►



ORECA [ORganisation Exploitation Compétition Automobiles]. Since moving into chassis design and construction in 2007, ORECA has produced a series of winning sports prototypes, including the Acura ARX-05.

"We're extremely pleased with our relationship with ORECA," says Mark Crawford, HPD Large Project Leader for the ARX-06. "They've been great partners throughout both our ARX-05 DPi program and now with the ARX-06. The GTP [Grand Touring Prototype] project has brought with it a new set of challenges and, while you certainly can see the Acura 'family resemblance' to our previous collaboration, the ARX-06 is an entirely new design."

HPD's Vehicle Performance Group worked closely with the ORECA design team and engineers to simulate chassis layout geometries – the new car features double wishbone, pushrod suspension front and rear, with Penske dampers – and lap time optimization studies. They also 'coded' the new car into HPD's static and dynamic Driver in the Loop simulators to begin development of the car's vehicle dynamics and vehicle dynamic control systems.

Critical to the project was a clean sheet hybrid powertrain control system, brake-by-wire and vehicle dynamics control system – all written inhouse at HPD. This control system architecture was implemented on a Formula 1-spec ECU hardware platform. HPD also utilizes its custom, in-house developed ultra-high speed data logging system.

Salters praises the ORECA-HPD relationship during the development process. "I would like to note the

stand-out collaboration between the ORECA and HPD engineering groups. Working with the extremely talented ORECA engineers on chassis and aero design and powertrain installation has been a real pleasure. Both groups have put their heart and soul into this intense project and sophisticated race car," he says.

Bodywork and aerodynamics

Exterior styling of the Acura ARX-06 was led by the Acura Design Studio in Los Angeles, California, in conjunction with HPD and ORECA.

HPD's aerodynamics engineers and in-house CFD aero engineers worked with the Acura styling studio and chassis builder ORECA to help develop the styling and maximize the aerodynamic performance envelope of the ARX-06, while keeping it within the homologation boxes as specified by IMSA and the FIA.

"The process we used in creating the exterior design for the Acura ARX-06 is exactly the same as how we create a new Acura passenger vehicle," notes Dave Marek, Acura Executive Creative Director.

"The same world-class stylists that lead Acura production car design created initial sketches, then pared those down to several potential designs. Next, we created a scale model, did aero and wind tunnel model testing, and brought HPD and our partner teams in for their feedback," Marek recounts. "The design continued to be refined throughout the testing and evaluation process, until we came up with a final treatment that met our performance goals while maintaining all-important Acura styling cues. It's been an exciting process." >

BELOW The new LMDh cars are more complex machines than their DPi predecessors



BAUTOSPORT INTERNATIONAL

12-15 JANUARY 2023 | NEC BIRMINGHAM

12-13 JANUARY 2023 TRADE | 14-15 JANUARY 2023 PUBLIC





ENGINEERING SHOW

12-13 JANUARY 2023 TRADE ONLY



12-15 JANUARY 2023 TRADE & PUBLIC



12-15 JANUARY 2023 TRADE & PUBLIC

EUROPE'S LARGEST Motorsport Event is back

Kick start your motorsport season AutosportInternational.com

Kick start your motorsport season here! AutosportInternational.com





Driver and team input was also sought throughout the design process. One effective change was a revision to the placement of the rear-view mirrors – a seemingly minor adjustment that in fact has a large effect on vehicle aerodynamics. Using VR headsets, the drivers were able to sit in the car virtually and recommend a much lower placement for the side mirrors, improving both the aero efficiency of the ARX-06 and visibility for the drivers.

Partner teams

Acura will continue its partnerships with the proven, race- and championship-winning Wayne Taylor Racing and Meyer Shank Racing organizations to campaign a pair of hybrid-powered Acura ARX-06 entries in the featured GTP category of the 2023 IMSA WeatherTech SportsCar Championship, North America's premier endurance sports car racing championship.

In addition to sweeping all three major IMSA prototype titles in both 2019 and 2020 – for Manufacturers, Drivers and Teams – Acura has won the Rolex 24 at Daytona in both 2021 and '22, including a 1-2 finish for the manufacturer at this year's twice-around-the-clock endurance classic. Additional podiums at Sebring, Watkins Glen and the Petit Le Mans in 2021 resulted in a sweep of IMSA Michelin Endurance Cup titles for Acura and partner Wayne Taylor Racing.

This season, Wayne Taylor Racing has recorded four wins and a second to rank lead the IMSA Drivers' and Teams' championships heading into the final race of the season at Road Atlanta in October. Meanwhile, Meyer Shank Racing started off 2022 with a second consecutive Acura victory in the Rolex 24 at Daytona and five second-place finishes in eight races to rank second in both the drivers' and teams' standings.

These results have unofficially clinched the 2022 IMSA Manufacturers' Championship for Acura, while the Drivers' and Teams' titles will go to either Meyer Shank Racing or Wayne Taylor Racing.

Development timeline

"We started with the rule book, a challenging spirit and an open mind," observes Salters. "Then our engineers got to work, utilizing all of the vehicle performance, powertrain simulation and development tools we have at HPD to address the critical areas for performance, including weight, power, packaging, centre of gravity, etc." Here is the timeline of the development process for the

Acura ARX-06:

They have put their heart and soul into this intense project"

- The HPD Vehicle Performance Group used simulation tools to determine the overall vehicle envelope and key requirements that would need to be met to maximize performance.
 Efficiency, power, weight distribution, aero balance, centre of gravity, tyre energy, hybrid management and chassis stiffness were some of the parameters included in determining the core architecture quidelines.
- This process determined the key architecture for the Internal Combustion Engine [ICE], displacement, fuel injection and turbocharging strategy, and the intercooler layout.
- The Design Group then schemed different concepts and weight aspects over a three-week evaluation period.
- The Acura ARX-06 concept was then finalized in a single meeting of HPD technical leaders, who then signed off on the project.
- Prototype parts were designed and produced for testing in HPD's inhouse single-cylinder research engine. These parts were manufactured within four weeks.
- The HPD Development Group tested these concepts, analysing performance, efficiency, combustion characteristics, heat rejection etc. Results were analysed and compared to the initial simulations – the simulation results were spot-on and validated.
- Simulation work was also carried out for a novel intercooler packaging and anti-tune induction concept to reach the performance targets while allowing the downsized engine to meet the 500 kW rules target without damaging combustion 'events'.
- Next, parts were designed and built for the V6 internal combustion engine,

LEFT Early test duties were performed by HPD engineer Matt McMurry and Ricky Taylor. McMurry, an HPD Vehicle Performance engineer as well as a successful racer himself, led development work on several software control systems

BELOW The ARX-06's predecessor became the car to beat in DPi. A one-two finish at Daytona this year was the foundation for its sweep of the IMSA titles



including the machined from billet sump, block, front cover and ancillary parts made using in-house agile manufacturing techniques. Five months after the initial simulation and concept study, the Acura V6 ICE ran on the dyno and met all performance targets.

- The complete control system written jointly by HPD's Electrical Control Systems group, Vehicle Performance and Performance Application groups – was prototyped in HPD's Hardwarein-the-Loop and Driver-in-the-Loop simulator systems.
- The control system was then taken to the state-of-the-art transient dyno facility at HPD where engineers tested the complete hybrid powertrain – ICE-Hybrid MGU-Gearbox. (The rear-wheel

drive machine uses an IMSA-specified Xtrac six-speed, sequential, paddleoperated transmission.) This system simulates key aspects of the cars during track running and the durability cycle, including running complete 'laps' of a circuit, including 12- and 24hour endurance runs with shifting, acceleration and braking all reproduced on the dyno.

• The Aerodynamic Group at HPD made use of its in-house CFD capability during the design phase to optimize aerodynamic and cooling performance. The group worked closely with ORECA on the overall aerodynamic concept of the ARX-06. This has been recently validated in a full-scale wind tunnel test. HPD aerodynamicists, using advanced simulation techniques, are working with IMSA to ensure the safety of the racing car, and that it satisfies stringent flip-over criteria for highspeed prototype sportscars.

Time to race

"Precision Crafted Performance is at the heart of everything Acura does," insists Jon Ikeda, vice president and Acura brand officer. "If you're a performance brand, you have to go racing. It's that simple.

"Both the existing ARX-05 prototype and our production-based NSX GT3 have proven to be race- and championship-winning designs on tracks all across North America. Now, with the introduction of the new, electrified Acura ARX-06, we look forward to facing off against other premium automotive brands from around the world – and continuing our winning ways."



"THERE WAS NO ALTERNATIVE "

Mark Skewis discovers how two companies from the Silverstone Technology Cluster created unique solutions for an F1 team using the latest stereolithography technology



OCATED in the heartland of British motor racing and Formula 1, Silverstone Composites Ltd is a solutions provider with industry expertise in the design and manufacture of carbon fibre, covering the whole manufacturing process from design to the production of composite components and parts.

The company provides bespoke composite manufacturing solutions to a variety of trade sectors, including aerospace, automotive, marine, medical mobility, military and track bikes industries. But in keeping with its surroundings, the company primarily operates in the motorsport sector.

Silverstone Composites Ltd is a member of The Silverstone Technology Cluster (STC), an organisation aimed at pooling the knowledge of advanced engineering, electronics and software businesses in the wider geographical area surrounding Silverstone.

It is within the STC that a partnership began with fellow member Mackart Additive: a mechanical engineering business with expertise in Designing for Additive Manufacture (DfAM), maximizing its in-house additive manufacturing (AM) capability, providing product development and production solutions.

Aiming high

The partnership has grown over the course of three years and benefits from a shared technological and industry expertise. As the collaboration developed, both companies researched and implemented new methods of exponentially increasing the service offering they could provide customers – a key driver in Mackart's purchase of a Stratasys Neo450s 3D printer in October 2021.

According to Steven McCarthy,

Founding Director and Principal Technical Engineer, Mackart Additive, it is specific customer demands that led to the investment in the Neo450s 3D printer: "We have had significant experience with a number of AM technologies since our inception as a company. As customers started to demand bigger parts with more complex geometries, we had to expand our offering, so in collaboration with the Silverstone Composites team last year we identified Stratasys' Neo solutions as the next step in our growth.

"The ability to efficiently produce accurate, high quality industrial-grade parts with robust repeatability directly answers the increasingly exacting demands of our customers and helps our business and that of Silverstone Composites evolve and develop new and exciting solutions."

As an open resin system, the Neo range **>**

BELOW Innovation behind the scenes drives racing's relentless pace of development



of 3D printers provide materials with a wide array of properties to suit customers' specific application requirements – be it chemical resistance, heat tolerance, flexibility, durability, or optical clarity – particularly useful in high intensity sectors such as motorsport. They feature dynamic laser beam technology that enables improved build accuracy, increased feature detail, and low variability across the full extent of a large build platform. The Neo450s can produce complex industrial-grade quality prototypes, tooling or master patterns and build parts with accurate detail and outstanding sidewall quality.

Unique and repeatable solutions

With a wide range of customers in different industries, Silverstone Composites must adapt to the often-meticulous demands that are required, especially in Formula 1. The team has to constantly find ways of evolving and differentiating itself from its competitors and even the Formula 1 teams, many of whom have AM facilities in-house.

In this regard, the team is often commissioned to fulfil projects in collaboration with Mackart Additive that are needed quickly, making traditional

FF Dynamic laser beam technology that enables improved build accuracy"

production and manufacturing methods a less viable option or maybe not an option at all.

According to Marcus Trofimov, Founder, Silverstone Composites Ltd, these demands were typified by one project the team undertook for a Formula 1 customer. "In this instance, the customer urgently needed an internal mandrel tool to create a composite pipe and had no alternative solutions to hand. This provided both our companies the perfect opportunity to implement our knowledge and expertise into a use-case and corner a new area of the market," he explains.

The project presented a number of challenges: no alternative solution for mandrel tooling for a composite pipe had been previously implemented; production of mandrel tooling using traditional methods such as aluminium was not viable as it could not be extracted from the composite pipe; and prior to using SL technology, each mandrel tool could **>**



BELOW The Stratasys

Mackart Additives' AM

solutions capabilities

Neo450s expands

Delivered directly to your door





Motorspor

NEW HYDROGEN SERIES LAUNCHED

SUBSCRIBE TODAY

Free access to digital edition with all print subscriptions

FIRST RUNG ON ELECTRIC RACING LADDER Available in Print

Available on the App Store

android app on Google" play

available on

kindle fire

DUEL IN THE DESER

e noë



RACE TECH is the only world-leading technology led motorsport engineering magazine that focuses on every aspect of the racing car, from the drawing board to the race track. News reactive and highly topical in its content, it covers everything from the design and manufacturing processes to the cutting edge products that are constantly being developed for racing. To be kept up to date on the hottest technology in the motorsport world, subscribe to **RACE TECH**.

racetechmag.com



take up to one-hour of post-processing per tool, with human error a danger as a result.

"The composite pipes used on vital components of cars, such as brake ducts or engines, require a specific type of manufacturing method that retains good internal surface in order for the tool to be extracted from the pipe," adds Trofimov.

One-build capability

"Any mandrel tool produced using traditional methods would require a lot of post-processing after the print and then once the part has been produced the extraction of the material needs to be dissolved in a solution. This can take days if not weeks to dissolve and is therefore unviable."

To further complicate the issue, each individual mandrel could take up to one hour of manual post-processing time, inviting human error and increased manual labour into the equation – particularly strenuous as around 15 kgs worth of resin is used to produce the mandrels each week.

In contrast, the one-build platform capability of Mackart Additive's in-house Neo450s streamlines the whole process as the part is almost ready to be sent off to Silverstone Composites as soon as it leaves the 3D printer. As a result, the Formula 1 customer and other clients can request the parts on-demand.

Trofimov continues: "We have to constantly adapt

RIGHT The surface finish of the mandrels greatly reduces postprocessing time and minimizes the need for manual labour

BELOW RIGHT Use of Somos DMX SL-100 stereolithography material meets the internal mandrels' strict requirements in terms of the amount of pressure and temperature they can manage

BELOW The internal mandrels are easily extracted from the composite pipe, not previously possible with traditional manufacturing methods







to our customers' needs and come up with unique solutions to thrive as a business. The internal mandrels are a perfect example of that. Elements such as the composite material being easily wrapped around the mandrel and then extracted just isn't possible using traditional tooling methods. The surface finish is so good, that post-processing time is greatly reduced and there is no need for manual labour, other than lifting the mandrel out of the build tray and transporting it."

Right material, right time

After taking on the project, the team at Mackart Additive made direct comparisons with other materials used previously on its other in-house 3D printers and identified the Somos DMX-SL 100. It is a durable and tough stereolithography material that enables the production of complex, hollow composite parts in days thanks to a unique and cost-effective 'dry removal' process – and all with no compromise on quality and aesthetics.

The 'dry removal' process enables

G We were blown away with the results"

the mandrels to be removed from complex, convoluted geometries after the autoclave without the need for submersion in caustic (which can affect the composite part). Somos DMX-SL 100 produces very accurate parts with a superb surface finish and outstanding feature detail that can withstand the extreme temperatures of the autoclave process utilised in composites manufacturing, maintaining its flexural strength, elongation and tear resistance.

Trofimov continues, "The composite parts produced using DMX-SL 100 have the best overall tolerance to temperature and pressure that I have seen for the mandrel application, which has strict requirements in both cases. The mandrel also needs to be sealable and releasable so it can be extracted from the composite part. We approached Mackart Additve with these material challenges and were blown away with the results."

Both companies have stated they will look to push the boundaries of the technology further as customer demand continues to increase.

McCarthy states, "The journey we have been on so far has been incredible and this is just the start of our lifecycle using the Neo solutions. It is natural for us to be thinking about further investment as we create new opportunities for both our companies. Having the 3D printer in-house and the help and support of Stratasys increases our chances of evolving even further as a business."

This sentiment is echoed by Trofimov, as he concludes, "The aim is to explore in collaboration with Mackart Additive new tooling applications as well as potentially end-use parts. Our customers have seen the benefits of the technology and the demand is increasing."









Sergio Rinland delivers his verdict on the new regulations for the 2026 Formula 1 Power Units

HE new 2026 F1 Power Unit regulations involve big changes in many areas. They focus mainly on sustainability, both ecologically and financially. All good and well-intended.

Motorsport can't save the planet. It would be preposterous of us to think it could. We are a sport, an entertainment, and that is something F1 and the FIA have recognized in the way they have framed the new regulations. At the same time, racing can help the fuel companies to develop sustainable fuels that the world will need. Some time ago I suggested in this column that F1 could, and should, be championing e-fuels. I am pleased to see that the FIA and its technical team were already working exactly on those lines.

First and foremost, F1 will keep the current hybrid philosophy with an ICE supported by electric power. Then there is the matter of fuel, mandating that from 2026 all fuel constituents must come from sustainable resources. That's great news: no more fossil fuels and ABOVE Audi's confirmed entry is the biggest vote of confidence for F1's new Power Unit regulations no more 'new GHG' in the atmosphere.

To produce e-fuels it is necessary first to separate hydrogen to combine it with carbon captured from the atmosphere. To separate hydrogen, a great amount of electrical energy is required, so the question hanging there is: where does the electricity come from? I hope the FIA and the potential fuel suppliers are tackling that issue right now. Otherwise, we are solving one problem and creating another.

All that we need to see, to remind us of this, is a world map showing the CO2 emissions to generate electricity in every country on the planet:

Just a few numbers to bring to your attention: the UK, US, and Germany emit in the region of 300 grams of CO2 per one kWh of electricity generated. Some a lot more; a few a bit less. So, it is not sustainable – we know that much!

The other regulation for the ICE specifies that the bottom part of the engines – involving the engine block, crankshaft, connecting rods, pumps and ancillaries – will be heavily restricted to save costs and allow more freedom for the development of the top part. The aim is to encourage the development ►


KIMBERLEY MEDIA GROUP LTD

Essential BOOK for the motorsport engineer's library:

Making Sense of Squiggly Lines: £40, \$50, €45

The Basic Analysis of Race Car Data Acquisition by Christopher Brown



To order this fine book and many others, please go to www.kimberleymediagroup.com/shop or phone +44 (0) 20 8446 2100 where our friendly staff will take your order.

kimberleymediagroup.com







historicracingtechnology.com

of combustion chambers to improve on the already impressive combustion efficiency of current F1 engines. The removal of the MGUH is just the tip of the

iceberg when it comes to a range of standardisation and simplification measures that have been developed across the whole ICE to achieve a cost reduction.

It will help the industry by developing a breed of engineers learning to work with limited resources"

Historically we have learned that relying on sole suppliers does not save money and that restricting the entry of other suppliers slows down development even of the simplest of sensors. I have always been critical of motorsport's single supplier/single brand policy. It never worked; why would it work now?

Besides, who told the FIA that there is not more to come from the lower part of the engine? By reducing mass and friction, turbo compounding or, heavens forgive, opposed piston two-stroke engines (as proposed by Pat Symonds to provoke debate some time ago)?

When it comes to regulating the Energy Recovery

learr age, Thi VW the

BELOW Audi announced its entry at a press conference at the Formula 1 Belgian Grand Prix at Spa-Francorchamps

System, emphasizing that the battery cell development should be in line with what is needed by the transportation industry is great news. But it will not be cheap, even if it is open source, i.e. non-exclusive.

I fail to understand why the regulations have to tightly specify where the ERS components should be located in the car. I understand that having an array of small battery packs distributed around the car is not that safe, but car designers should be given some credit for the fact that they will not be designing a hazardous machine for drivers and mechanics.

The financial regulations, even with the experience of budget caps, are something that teams and suppliers will have to learn to live with. Limiting hours of testing and development is a good policy. Not only will it help save F1 teams from themselves, but it will also help the industry at large by developing a breed of engineers learning to work with limited resources. In this day and age, that is a skill that will serve them well.

This last concept is one that helped prompt the VW Group to come into F1 with Porsche and Audi, the latter of which has just purchased Sauber for its assault from 2026 onwards.

From 2026, F1 will have five engine suppliers – or six if Honda changes its mind. Great news which guarantees the survival of the sport for the foreseeable future. Well done FOM and FIA!







Make Your Childhood Dreams a Reality.

The National Motorsport Academy's online motorsport engineering degrees allow you to study flexibly from anywhere in the world, making them the degree of choice for top-flight engineers in F1, WEC and WRC. All courses have been designed by motorsport engineers for motorsport engineers so you can be sure that your qualification is industry relevant and up to date.

The world of motorsport is fast-paced which is why we make our courses as flexible as possible. Choose your own start date and fit your studies in around your work and family life.

Don't put your career on hold! Accelerate your chances of promotion, bring your skills up to scratch or retrain with the National Motorsport Academy's online motorsport engineering qualifications.



Motorsport Engineering

Get your motorsport career on track with the world's first online degree designed for motorsport engineers.



Motorsport Engineering Final Year Top-Up

Take your existing skills and qualifications and make them motorsport ready with our 1 year Top-Up Degree.



Advanced Motorsport Engineering

Become a Master of Motorsport Engineering with the world's only online, motorsport specific Postgraduate degree.

BRED TO WIN

;80x34



Our new 380 and 405 track day packages offer the best in braking technology and performance for those who are looking to upgrade their track day or daily driver braking system. With over 30 years of brake experience and more championships than any other, this package is truly bred to win.





