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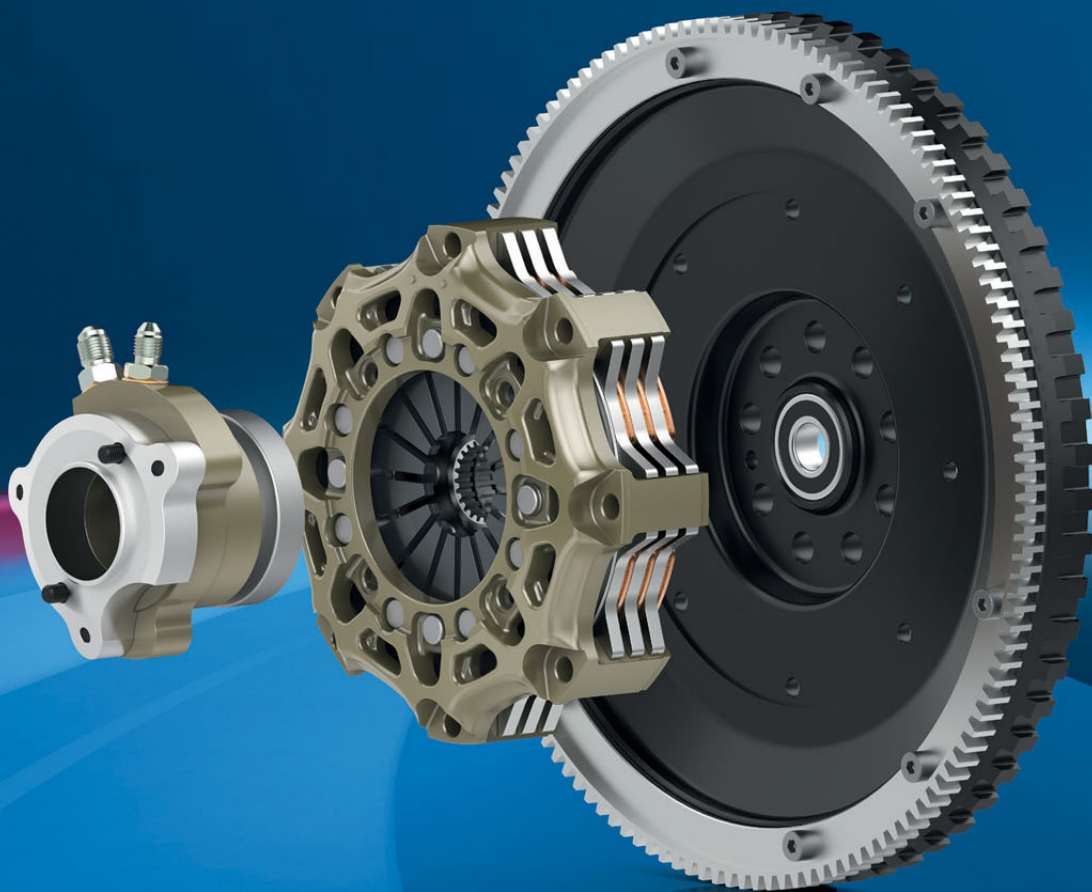
Formula E launches Gen2 Evo



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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

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COME BACK KINGS

Behind McLaren's battle to make it back to the big time

COVER STORY PAGE 26

ON THE COVER

20 HOW SENNA'S LEGACY SAVED 100,000 LIVES

The whiff of fascists, Hitler and tabloid
scandal will provoke headlines when *Mosley*
premieres at the Manchester Film Festival
this month. But William Kimberley says
an even more fascinating story underpins
this documentary on a man who ruled
motorsport for more than a decade

26 FORMULA 1: McLAREN MCL35

McLaren is a team on the rise, but it's a
long road from where it is now to where
it wants to be. Matt Youson reports

INDUSTRY NEWS

- 6 Formula E to benefit Merc F1 programme;
F1 signs UN Sports for Climate Action
Framework; BTCC hybrid ahead of
schedule; Formula E reveals Gen2 Evo;
Volkswagen runs electric Golf concept;
Aston Martin postpones WEC Hypercar
entry; Toyota begins testing new Yaris WRC
car; Penske announces Indy 500 revamp

COMMENT

- 74 Given that it is cheaper to buy Carbon Credits
than to develop innovative technology, Sergio
Rinland wonders which route F1 will pursue
to become Net Zero Carbon

ENDURANCE RACING

- 36 Gary Watkins examines the landmark
agreement for the convergence of the top
categories of endurance racing

TRANSMISSION TECH

- 46 Supplying transmissions to an entire grid of
snarling electric racers presents a number
of problems, but as Alan Stoddart finds out,
one company is ready with the solutions

RALLY RAID

- 50 Hal Ridge finds out how Prodrive is
approaching the fulfilment of a long-held
ambition: competing in the Dakar Rally
- 58 X-raid is back to winning ways on the Dakar
Rally with the MINI John Cooper Works
Buggy. Chris Pickering discovers the secrets
behind the success

GREEN TECH

- 68 Chris Ellis believes the ACO's H24 initiative,
bringing hydrogen-powered racecars to the
Le Mans 24 Hours, should go further still

ECR Engines Rely On



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The banned plays on!

THIS year may seem to be a bit of a dead rubber in Formula 1 with all eyes focused on next season and beyond, but it does not mean that the teams have stopped innovating on the 2020 car. The Mercedes AMG Petronas F1 Team, for example, has been working on a revolutionary steering system that has every other team questioning its legality – many even confessing to being impressed at the same time.

The FIA's position appears to be that the so-called Dual Axis Steering (DAS) is legal because it alters only the steering angle of the front wheels.

Whatever its impact this season, DAS has already been banned from Formula 1 under the 2021 technical regulations, so it is going to be a one-year wonder.

Interestingly, as James Allison, the team's technical director, points out, each of the cars the team brings to the track is festooned with innovation, but they are not as obvious as a discrete, standalone system like DAS.

This innovation typifies the thinking out of the box of the typical motorsport engineer where the best is never good enough. There is always room for improvement, even if the outside world thinks otherwise. That mentality underpins the innovations that filter through to other industries and is why the role of motorsport must never be undermined.

On another matter it was sad to see the robust response by the ACO on the news that Aston Martin was reconsidering its decision to join the new Le Mans Hypercar programme. In the circumstances, the disappointment by the series organisers must be immense as the Aston Martin

name is such as attractive one, but at the same time, it is easy to understand the carmaker's decision.

As David King, Aston Martin's vice president, told the press, the final decision to 'pause' the programme was made shortly after the IMSA-ACO convergence announcement at Daytona in January. He said that the Hypercar programme now appeared to make little sense for the brand if the Le Mans Daytona h (LMDh) class car – which takes inspiration from IMSA's upcoming DPI 2.0 prototype rules as well as the ACO's LMP2 cars and Hypercar class – could compete in the FIA WEC at a reduced cost.

He explained that Aston Martin signed up for Hypercar in the belief that a Valkyrie customer car programme would help fund it in the long run. He said that every racing Valkyrie is an expensive car because it comes from a road car which costs two and a half million pounds (\$3.2 million). Under the convergence, privateers will be able to secure premium brand LMDh cars that are much cheaper to buy and cheaper to run.

While I am sorry to see Aston Martin reconsider its position on the new class, it is an understandable move and the ACO was wrong to partly blame the carmaker coming to its decision due to a strained financial situation. **RT**

William Kimberley
EDITOR



Formula E payback for Mercedes

F1 World Champions stretched by all-electric venture, but now innovative W11 will benefit. By **William Kimberley**

THE Mercedes team again proved to be the class of the field in the pre-season Barcelona F1 tests, but one of the interesting facts to have emerged is how the 2020 Formula 1 engine development has benefitted from Mercedes-AMG High Performance Powertrains' experience in developing

the Formula E Power Unit.

"Having two highly competitive series to do engineering work on is initially a strain, because it takes a period of time to find the right people for the new series," said Andy Cowell, managing director of Mercedes-AMG High Performance Powertrains. "Some

of those people have transferred from the F1 team, some have been recruited from outside.

"However, I think overall it is a benefit because it provides opportunities for careers to flourish on new technology, on a new series and now we are seeing the ideas flow between both. Both powertrains will benefit as a consequence."

Expanding on the all-electric single-seater series, Cowell said, "Formula E is a fascinating championship with the electric machine as the only device propelling the car. Therefore, the efficiencies of that electric machine, the inverter and all the control systems are paramount, and the torque accuracy delivery is crucial. Some of the development learning there has now fed back into Formula 1, so from Melbourne this year, our Formula 1 hybrid system will benefit from our Formula E development work.

"We've also made some manufacturing improvements that originate in the FE programme. We manufacture our own electric machines and some of the techniques developed for Formula E are

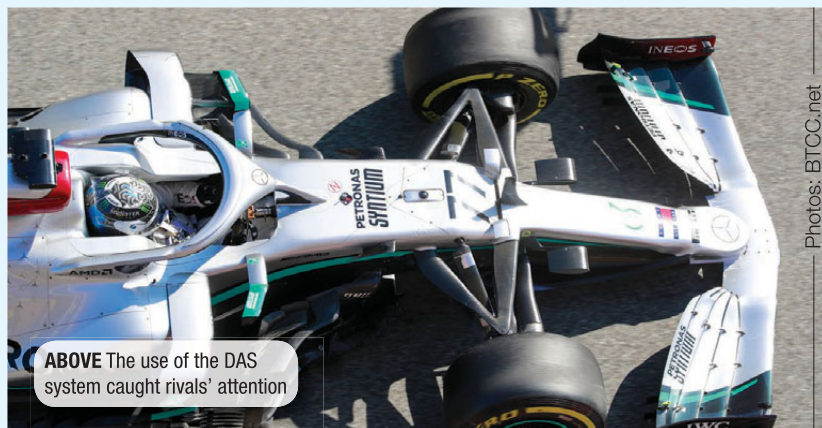
Innovation rules

THE Mercedes F1 team surprised everyone at the first Barcelona test when video footage appeared to show Lewis Hamilton moving his steering wheel in the car to effect a change in angle of the front wheels. The system, nicknamed DAS [Dual-Axis Steering] by technical director James Allison, was so advanced that it immediately drew the attention of every other team on the F1 grid, who queried whether it met the F1 regulations.

As the footage showed, Hamilton would pull the wheel back on the column as he drove down the straight, which had the effect of straightening-out the usual 'toe-out' of the wheels. He then would push it back in just before the corner, at which point the wheels would adopt their conventional 'toe-out' setting.

Mercedes has remained tight-lipped about the advantages it hopes the system will bestow to its W11, but there has been much speculation as to the Brackley team's motives, with suggestions that it could seek to better balance high and low speed cornering performance, reduce tyre wear, or even improve aerodynamic efficiency. Regardless of its intent, even Mercedes' rivals admitted to being impressed. "Hats off to Mercedes for this kind of innovation, which is great to see in Formula 1," commented McLaren team principal Andreas Seidl.

"One of the things that gives me massive pride from working with Mercedes is to be part of a team that doesn't just turn the sausage handle each year, but is working out how we can work fast enough to bring these innovations to the track and make them stick," continued Allison. "This is fun but it's only the tip of an iceberg of similar stuff that's written across the car." **RT**



ABOVE The use of the DAS system caught rivals' attention

Photos: BTCC.net



Mercedes-AMG



Daimler AG

ABOVE The Formula E project initially placed a strain on resources

being applied to the Formula 1 electric machines this year as well. This is exciting to see; in the past, we've seen gains from the Project ONE development feed back into F1, now we are also seeing Formula E engineering and manufacturing technology feeding back into F1."

Project ONE that Cowell referred to is the powerful Mercedes-AMG two-seater hypercar that brings fully-fledged Formula 1 hybrid technology directly from the racetrack to the road. It

produces over 1,000 hp and reaches top speeds in excess of 200 mph. Featuring the same 1.6-litre V6 hybrid petrol engine as the Mercedes-AMG Petronas Formula One Team race car, the Project ONE's drive system also includes a total of four electric motors, capable of 50,000 rpm.

Reflecting on how motorsport technology is still very relevant to production cars, Cowell said, "I think the hybrid architecture of the F1 Power

Unit is the direction that the automotive industry is going in because there are benefits from recovering waste energy and we have shown that since 2014. So to be able to put the kinetic energy of a vehicle into a battery via an electric machine to slow the car down rather than using brakes that just put the heat energy into the atmosphere – it's something that we have been working on in F1 since the KERS days and it is a big part of Formula E as well. Then it's just the conversion efficiency of every single step – the combustion conversion efficiency and the reduction of friction, for example. I think we're also very good when it comes to using lightweight components and that has a knock-on effect on energy consumption because every car will use less energy if it is lighter.

"In addition, I think the automotive industry can also learn from F1 in terms of the development process, and the fast-paced, bold innovation. I think that's something that is useful not just to the automotive industry but all industries that are developing products." **RT**

BELOW The Mercedes-AMG F1 W11 addresses the cooling inefficiency of its predecessor, amongst other improvements



Making the best even better

James Allison, technical director of Mercedes-AMG, explains the work that team has done over the winter break

"**ON** top of the conventional fare of winter development we made three investments: One at the front, one in the middle and one at the back of the car. At the front we have accepted more structural complexity around the uprights and wheel rims in order to provide a higher performance assembly overall. In the middle of the car we have followed the pitlane trend by moving our upper side impact tube to the lower position and banking the aerodynamic gain that comes with this layout. At the rear of the car we have gone for an adventurous suspension layout in order to free up aerodynamic development opportunity.

"All three investments were improvements in their own right, but their real effect is to mobilise a raft of secondary aerodynamic gains both during the winter and, we hope, across the season to come."

Commenting on the biggest regulation change in F1 history next year, Allison said, "No team can ignore the size of the change that's coming in 2021. We've had an unusually large number of significant regulation changes over the last few years but all of them are minuscule compared with this. So necessarily we are spending a fair amount of our effort trying to figure out the best way to attack 2021 while ensuring that we simultaneously mount an effective 2020 campaign.

"Juggling these competing pressures is going to be a really big deal this year. One way or another, every F1 team wrestles with this dilemma in every season, but it is amplified in 2020 by the momentous scale of change brought on us by the 2021 regulations." **RT**

F1 signs UN Sports for Climate Action Framework

FORMULA 1 and the FIA have revealed that they have become signatories of the United Nations' Sports for Climate Action Framework, a commitment to sustainability that follows F1's November announcement that the sport will be net zero carbon by 2030.

The fact that the organisations have been able to become signatories is itself significant, with an organisation having to adhere to the following five principles before even being considered: Undertake systematic efforts to promote greater environmental responsibility; reduce overall climate impact; educate for climate action; promote sustainable and responsible consumption; and advocate for climate action through communication.

"By signing up to the framework, we express our intent to implement the principles enshrined in the Sports for Climate Action Framework and commit

to working collaboratively with our peers and relevant stakeholders to develop, implement and enhance the climate action agenda in sports," Formula 1 said in a statement.

"Last year Formula 1 launched its first-ever sustainability strategy recognising the important role that we must play in tackling climate change," added the sport's CEO Chase Carey.



ABOVE FIA president Jean Todt: "fully committed" to global environmental protection

"The actions we will take in the years ahead will reduce our carbon footprint and ensure we are net zero carbon by 2030. We are delighted to join the UN's efforts in this space and will be working closely with the FIA, teams and partners to ensure we deliver on our plans and implement meaningful change."

Jean Todt, the FIA's president, commented: "As an international Federation comprising 244 members in 140 countries and the leader in motorsport and mobility development, we are fully committed to global environmental protection.

"The signing of this UN Sports for Climate Action Framework reinforces the momentum that has been growing in our Federation for many years. From the introduction of the hybrid power unit in F1 to the creation of the Environment and Sustainability Commission, the entire FIA community has been investing time, energy and financial resources to the benefit of environmental innovations. We aim to inspire greater awareness and best practice in sustainability motor sport standards." **RT**

BTCC hybrid to hit the track this summer

BRITISH Touring Car Championship organiser TOCA has revealed that its introduction of hybrid power is running ahead of schedule.

Teams, partners and stakeholders were told of the series' progress during a meeting of the BTCC Hybrid Working Group in mid-February, where the future roadmap for the introduction of hybrid powertrains was further established.

The BTCC was the world's first major touring car championship to announce a roadmap for hybridisation when it launched the initiative in August 2018. It explained that every Touring Car in the series would boast hybrid power from the start of the 2022 season, with its integration being added to the current technical regulations.

Since then, TOCA has awarded the contract to Cosworth Electronics for the design, supply and servicing of the BTCC hybrid system, with the first hybrid BTCC test car set to hit the track in June, ahead of a public debut at the two-day tyre test at Snetterton in July. Rigorous testing and

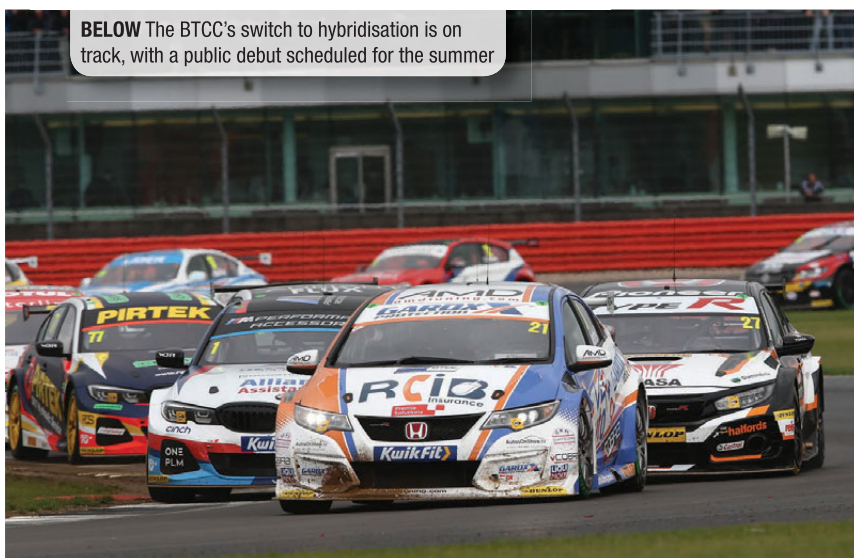
simulations will then commence to refine the nature of the hybrid delivery, as well as configuring the varying amounts of hybrid delivery and regeneration required to replace the current success ballast system.

"I'm incredibly pleased with the fantastic progress we are making on this project,"

said BTCC chief executive Alan Gow.

"One always assumes there will be some hiccups along the way, but so far... nothing. And that's great testament to the high quality of the technical partners involved – not just Cosworth of course but also Xtrac, PWR, Delta Motorsport, AP Racing and Goodyear." **RT**

BELOW The BTCC's switch to hybridisation is on track, with a public debut scheduled for the summer





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*World Endurance Championship.



ABOVE Formula E's Gen2 EVO racer will debut in FE's Season 7

Formula E reveals updated version of Gen2 racer

FORMULA E and the FIA have revealed pictures of an updated version of the second-generation Formula E racer. Dubbed the Gen2 EVO, the electric single-seater will debut in Season 7 when the racing series competes under the banner of the FIA Formula E World Championship for the first time.

The new version of the 'Gen2' car features a range of structural design changes, including a new front wing, dorsal fin, distinctive curved rear wing and updated

championship livery. The bodywork changes have been made midway through the four-year cycle of the current Gen2 car, and are designed to give the races a fresh, new look. In addition, the changes to the front wing and the removal of the wheel arches are designed to help Formula E become more "self-punishing" to reduce instances of car contact, addressing concerns that the current car is too robust and doesn't punish drivers for collisions.

Despite the update, the cars will

continue to use Michelin Pilot Sport all-weather tyres, which have been specially designed to work in both wet and dry conditions.

"The Gen2 already stands out as one of the most striking race cars to hit the track, and just as the name implies, the Gen2 EVO is another evolution of the distinctive design," said founder and chairman of the blossoming electric series, Alejandro Agag.

"As we did with the first-generation car, the Gen2 EVO has been given reprofiled bodywork to make it look more sleek and agile. Its futuristic design once again showcases Formula E as the category for innovation in both technological advances and appearance." **RT**

Volkswagen runs electric Golf concept

VOLKSWAGEN Motorsport ran a new electric competition prototype at the GP Ice Race in Zell, Austria as part of an eclectic line up of cars from the

marque, but little has been revealed about the machine.

The fully-electric Golf concept car was driven on the ice circuit by a number of

drivers, including American rallycross champion Tanner Foust, who also piloted his title-winning and now retired ICE Volkswagen Beetle Supercar.

VW's record-breaking fully-electric ID.R machine was on static display in the paddock, and is believed to have shared its four-wheel drive electric powertrain with the Golf, outwardly based on a WTCR bodyshell.

Prior to the ID.R's testing programme beginning before its record-breaking Pikes Peak International Hillclimb assault in 2018, Volkswagen previously ran a Golf touring car fitted with an electric powertrain for early development purposes.

Volkswagen has made a clear statement of its future intentions and announced in November that it would only focus on electric motorsport going forward. **RT**



ABOVE Externally a Golf, Volkswagen's latest electric concept is thought to share a powertrain with the record-breaking ID.R

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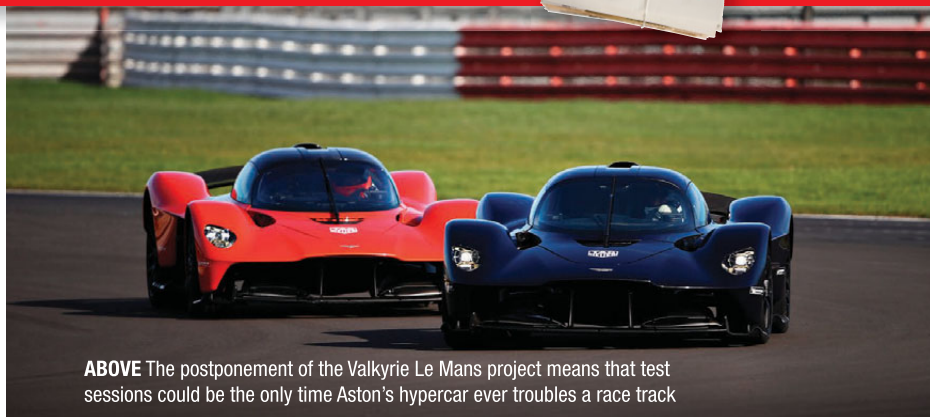


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ABOVE The postponement of the Valkyrie Le Mans project means that test sessions could be the only time Aston's hypercar ever troubles a race track

Aston Martin postpones WEC Hypercar entry

ASTON MARTIN has put on hold its development of a Valkyrie-based entry into the World Endurance Championship's upcoming Hypercar class. The marque cited January's announcement that the next generation of IMSA Sports Car Championship cars will be able to compete alongside Le Mans Hypercars in the WEC from the start of the 2021/22 season as the reason for the postponement.

The accord between IMSA and WEC promotor the Automobile Club de l'Ouest will see the replacement for the American DPi cars rebranded as LMDh. Like the DPi cars they replace, the LMDh cars will be based on LMP2 machinery, but will also include a spec hybrid system. Although technical details of the new class are scarce, it has been confirmed that the

four existing constructors, Dallara, ORECA, Ligier and Multimatic, have all had their licences extended.

The Hypercar withdrawal also follows the news Aston Martin is going to enter into F1 as a works team, after a significant investment in the company by the billionaire owner of Racing Point F1, Lawrence Stroll. Aston Martin's partnership with Red Bull will run until the end of this year, when the marque will replace the Racing Point name at the Silverstone-based F1 team.

"Aston Martin's ambition to compete for the overall victory in the 24 Hours of Le Mans remains undiminished, but it is only right that we reassess our position in light of a significant change in the landscape that was not anticipated when we committed last year," commented Aston Martin

president and CEO Dr Andy Palmer.

"We entered Aston Martin Valkyrie in WEC and at Le Mans with the understanding that we would be competing with similar machinery and like-minded manufacturers. The situation has changed, and it makes sense for us to pause and reconsider our options."

Responding to the news, the ACO stressed that although Aston Martin's decision was 'regrettable' the plan to harmonise the regulations between the WEC's Hypercar class and IMSA's LMDh category remained unchanged.

"While it is disappointing that a manufacturer that faces difficult times has to re-evaluate its commitment, I remain confident that the Hypercar platform is the right, long-term solution for the FIA World Endurance Championship," said president of the FIA Endurance Commission, Richard Mille.

"The FIA, together with the ACO, are very much committed to building a strong foundation for the new top class in the FIA WEC. With a consistent strategy in place, we are looking forward to this new, exciting era of sports car racing." **RT**

See WEC/IMSA convergence Page 36

Peugeot to continue in WEC despite Rebellion axe

REBELLION Racing will withdraw from motorsport after the 24 Hours of Le Mans in June, ending its current term in top level competition.

The announcement means that the marque will not partner Peugeot Sport in its return to the FIA World Endurance Championship, as was previously announced when Peugeot confirmed its motorsport return in November last year.

"After a full 13-year cycle in motorsport, the brand awareness of Rebellion has strongly increased and reached a very satisfactory level," said Rebellion Racing in a statement.

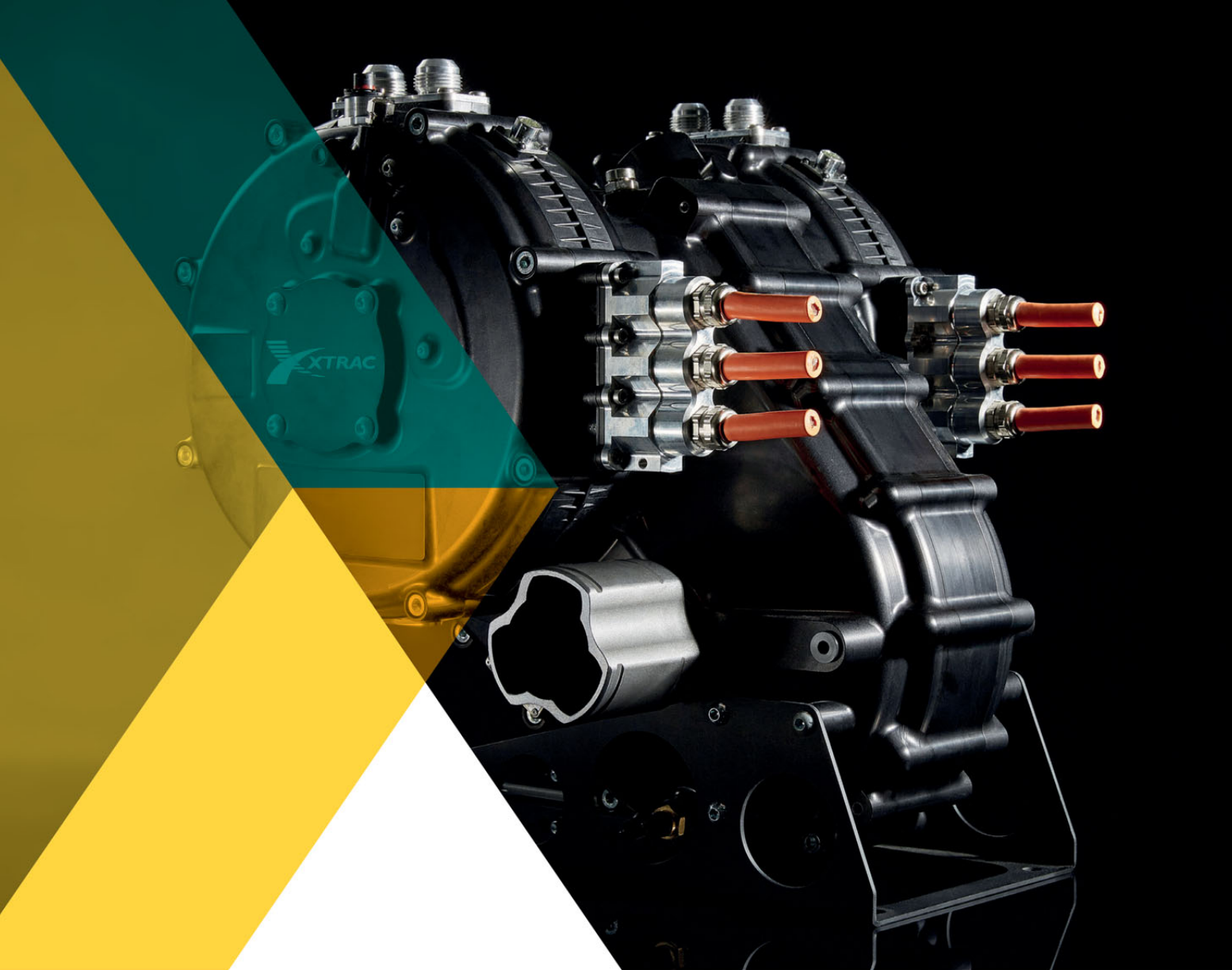
"As a private team, we are proud to have written a page in motorsport. I

am convinced that the Peugeot Brand's challenge in WEC will be a great success in the future, which I regret not being able to attend," added CEO of Rebellion Corporation, Calim Boudhadra.

Peugeot followed the news by saying the decision won't affect its plans, stating: "We are currently in the early stage of building up our technical project and we acknowledge Rebellion's decision that appoints us in a direction to modify the configuration of our operational system by 2022. Their decision to withdraw does not change Peugeot's programme in WEC." **RT**



ABOVE Rebellion has axed its motorsport plans



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Toyota begins testing new Yaris WRC car

TOYOTA Gazoo Racing has begun testing a brand-new Yaris World Rally Car in Finland, near to the squad's Tommi Makinen-owned base in Puuppola.

Juho Hanninen conducted the first public running of the new car, based on the new four-wheel drive GR Yaris road car, the standard version of which rally legend Per Eklund drove as course car on Rally Sweden last month.

It's believed that the new rally car is being developed for the 2021 season, with Toyota's new Yaris set to soon be on sale, along with 2,500 versions of the new GR Yaris.

That new GR road car could be considered somewhat of a homologation special, having two doors instead of four, four-wheel-drive, a wider track and panels made of more exotic materials as 'standard'.

The latest Yaris WRC is thought to have run for two days in Finland after the team's pre-event tests for Rally Sweden.

For its maiden runs, the car was fitted with similar aerodynamic components to that of the current reigning drivers' championship-winning Yaris WRC. Two diveplanes are

present on each side of the front bumper, slightly differing in shape to the current design, while the latest camouflage-clad car has a smaller air intake than the 2020 model. **TI**



ABOVE The new GR Yaris road car is almost a homologation special for the 2021 WRC car

Prodrive to develop car for Dakar 2021

BRITISH engineering firm Prodrive will embark on a two-car Dakar rally campaign from 2021 with a newly developed car, in partnership with Bahrain sovereign wealth fund, Mumtalakat.

The new Prodrive machine, specifically developed for the Dakar Rally, will compete in the top level T1 class. Two cars will be manufactured and operated by Prodrive, while also producing other customer cars

and offering a range of performance parts and body kits as accessories for clients.

Bahrain sponsored Carlos Sainz's Dakar-winning X-Raid Mini in this year's first Dakar event in the Middle East, which began in Jeddah, Saudi Arabia. "Prodrive has participated in numerous regional and international motorsports events throughout its 30+ years of operation, winning six FIA

World Rally Championships, five Le Mans titles and seven Middle East Rally Championships," said Mumtalakat CEO, HE Khalid Al Rumaihi.

"We're very proud of the rally's move to the region and in partnering with Prodrive, we expand Bahrain's significant motorsport heritage, having established the Bahrain International Circuit to host Formula 1 in the Middle East for the first time in 2004."

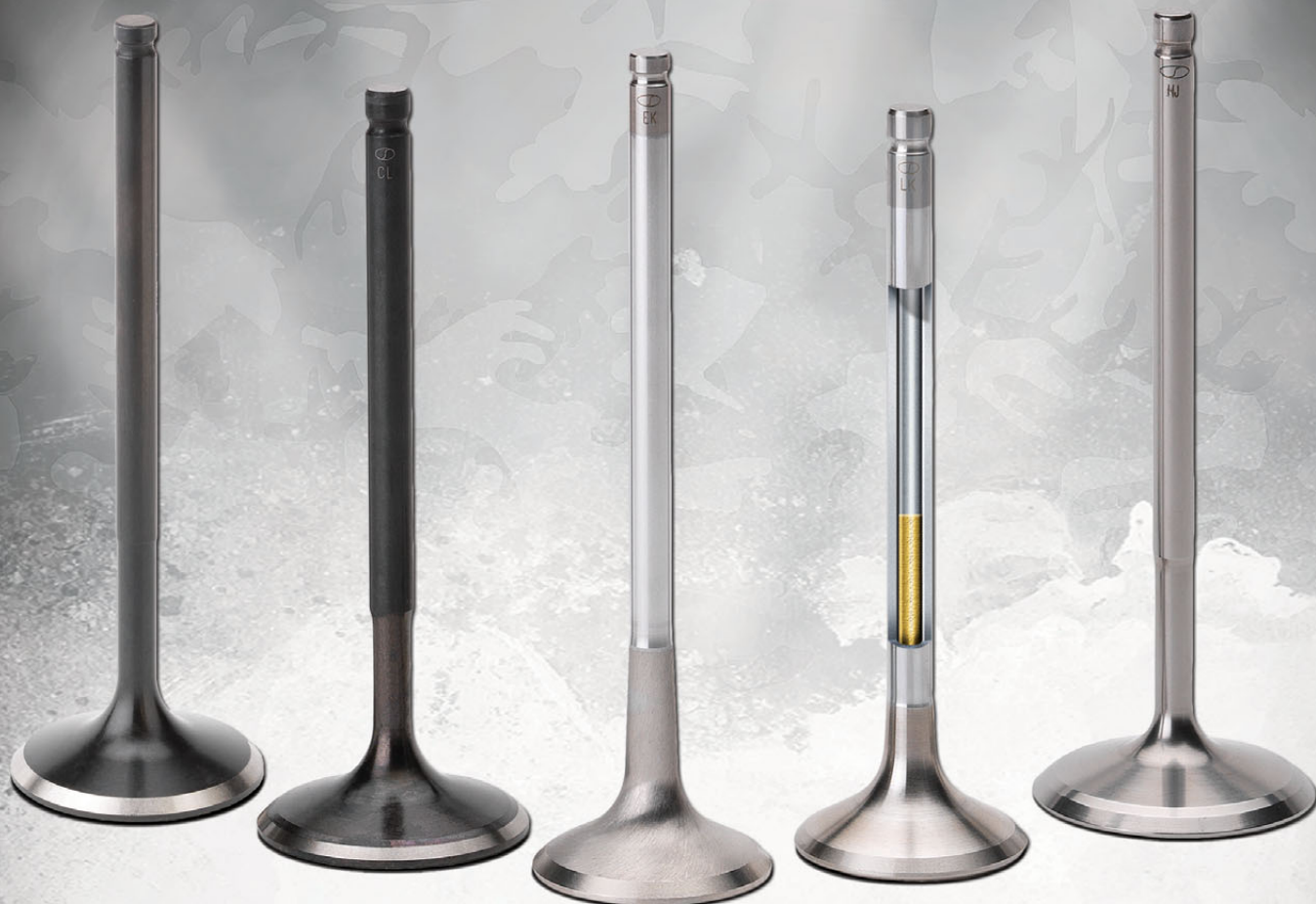
Prodrive chairman David Richards said the British firm is relishing the new challenge, having most recently developed the radical Renault Megane RS RX used in the World Rallycross Championship by the GC Kompetition team.

"It has been a long-held ambition of mine and Prodrive to compete in the Dakar Rally. To be able to do so with the Kingdom of Bahrain's sovereign wealth fund, Mumtalakat, and in Saudi Arabia, makes the prospect even more special as the Middle East is where Prodrive started its motorsport journey in 1984," he said.

"Dakar is a new and challenging project for Prodrive, but one that I and the whole team in Banbury are relishing." **TI**



ABOVE Prodrive will return to the Middle East, a region in which it experienced great success in its earliest days



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LEFT The Gulf Porsche 917s bang wheels at the start of the 1970 Spa 1,000 km, at that point the fastest road race in history. The iconic brand has ambitious plans for its return

Familiar name and logo return to motorsport

William Kimberley

AT a press conference in London in mid-February, Gulf Racing Fuels announced that it was returning to global motorsport across a number of disciplines. It will be offering a range of high-quality fuels supplying the race, rally, road and historic markets from amateur motorsport and aftermarket sales, to the highest levels of international professional competition and OEMs.

Its name, logo and colour scheme will be very familiar to readers over a certain age due to its success in endurance racing, and Le Mans in particular, in the 1960s and '70s. Although it continued to be involved in motor racing in the following decades, it was less high-profile and it virtually disappeared. Part of this was due to the Gulf Oil Corporation (GOC) ceasing to exist as an independent company in 1984 with new owners, when it merged with Standard Oil Company (SOCAL), both being re-

branded as Chevron in the US.

However, the Gulf brand still managed to live on, its logo appearing on various cars over the period before ending up with the Hinduja Group, a private Indian family business headquartered in London, that acquired the rights to the Gulf brand in 2015. Today, Gulf Oil International (GOI) is a vibrant oil marketing company with operations in over 70 countries. In the US, though, Gulf Oil still remains a subsidiary of Chevron, which has licensing agreements with various independent distributors to use the Gulf brand to sell oil products.

By 2008 the Gulf name had seriously returned to motorsport, sponsoring the Aston Martin Racing team which secured the GT1 category at Le Mans 40 years after Gulf's first outright win. The team then won the 2009 Le Mans Series for both the drivers and the team. The successful partnership has since seen multiple wins in both the American Le Mans Series and

in the World Endurance Championship, in both the GTE Pro and GTE Categories.

"An engine's overall performance is dependent on a number of factors, including what fuel you choose to run," said Mark Ticen, director of operations, Gulf Racing Fuels. "It is this understanding which the Gulf brand has perfected over more than a century of intense research and development.

"Our desire for innovation and passion for excellence will see Gulf Racing Fuels deliver a performance advantage to race teams, amateur racers and the aftermarket, through high-quality fuels and an unrivalled depth of technical expertise."

"Gulf Racing Fuels, as a division of Gulf Oil International, is excited to be taking its brand to the global motorsport marketplace," said Marc Wesler, Gulf Racing's director of sales. "We want to grow the rich tradition and history of Gulf's involvement across so many forms of motorsport. For years, Gulf has been synonymous with all types of motorsport competition and may possibly be the most widely recognised livery in the global motorsport paddock.

"One of our main goals and something that is really important to everyone at Gulf is that every fan of the next generation has the same opportunity to connect with the brand, to be there for personal triumphs, to be there when it overcomes bad days at the track and most of all to help create new, lasting memories. It's our objective to give every driver the opportunity to be part of team Gulf." **TI**

Supercars poised for shift to two-door racers

VIRGIN Australia Supercars looks set to make a permanent shift away from its traditional four-door sedan body shape, instead focusing on two-door models for the next generation ruleset.

The current Gen2 Supercars regulations are the first to allow two-door cars to compete, with the Ford Mustang becoming the first to run in 2019. However, the series' control chassis was designed around four-door variants and is still best suited to that body shape.



ABOVE The shape of things to come? Two-door cars like the Mustang could become the mainstay of the Supercars Championship

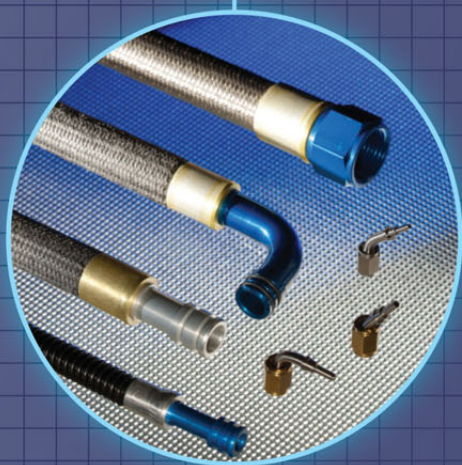
This looks likely to change with the third generation Supercars rules package, which will come into effect in 2022, and use two-door performance models as a base.

This change is dictated by the wider automotive landscape as manufacturers are focusing on producing SUVs rather than four-door sedans.

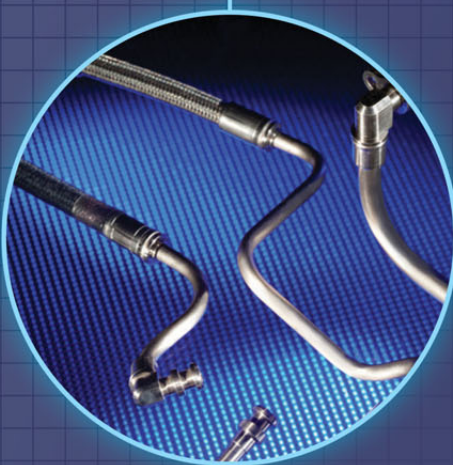
"The Gen3 [regulations] will be driven in a large part by the direction the manufacturers are going, because it's about maintaining and ensuring we've got market relevance," explained Supercars CEO Sean Seamer.

"From what we're able to see from manufacturer road maps, two-door sportscars – obviously the Mustang is the first of which – will be a core part of our DNA." **TI**

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NASCAR to ramp up testing for Gen 7 car

NASCAR has revealed its plans to ramp up testing of the next generation of its Stock Car in 2020, before the new racer makes its competitive debut in 2021.

The organisation has been working alongside the series' three manufacturers, Chevrolet, Toyota and Ford, with the aim of lowering the cost of competing in the series, enticing a fourth manufacturer back into the sport, and making the race cars more

relevant to the road cars they are based on.

Key to achieving these new goals will be the seventh-generation car. Although technical details about the new car remain scarce, some major changes have been revealed. Among them will be the switch from a traditional H-pattern manual gearbox to a new sequential unit, a move to independent rear suspension and the adoption of 18-inch wheels rather than the

15-inch rims that are currently used.

The engine is also expected to be an area of significant change, with the Stock Car series said to be looking to move to smaller and more efficient engines, with some suggestions that even hybrid powertrains are being considered. Although this would represent a radical departure from the traditional pushrod V8s, it is a move that would be popular with the manufacturers.

"We're all invested in these technologies from an environmental perspective, so we sat down with NASCAR and said, 'Why not?'" Toyota Racing Development president David Wilson commented, speaking to *The Washington Post*. "Why couldn't we add a form of electrification to the cars that we race?"

Wilson also noted that a move to hybridisation would likely entice new carmakers, such as Honda and Nissan, to the sport.

The next test will take place in early March, after which a second car will be completed, allowing following tests to examine the aerodynamic performance of the cars in traffic. **RT**



ABOVE The next generation NASCAR's hectic testing schedule is set to continue

Penske announces Indy 500 revamp

ROGER Penske has announced a comprehensive plan to revamp the Indianapolis 500 and the Indianapolis Motor Speedway, following his formal takeover of the sport and Speedway in January.

Chief among the changes to the Indy 500 include an increased prize pot, which will grow by \$2m to more than \$15m. The event's qualifying format will also change, with the return of multiple runs for the Last Row Shootout, which will be increased to 75 minutes. This will replace the previous format which saw each car limited to a single run and aims to increase the drama of the round. Qualifying speeds will also rise, thanks to an additional 45 horsepower from a boost in turbo levels.

A raft of improvements is also set to be made to the Speedway itself, which are designed to give fans a better experience. These changes will include the installation of more than 30 new video screens, and

the installation of the 'IMS Media Wall', a 100 foot by 20 foot video screen, and the introduction of a 5G network. In addition, there will be renovations to bathrooms, improvements to thoroughfares and a beautification project.

"This is the Racing Capital of the World. It is on par with some of the most historic

sporting institutions in this nation and across the globe," said Roger Penske.

"We're announcing a meaningful investment in our fan experience that will produce rapid results. It's part of a long-term plan to ensure the legendary status of the Speedway continues to grow and evolve for generations to come." **RT**



ABOVE Fans at the next Indy 500 will benefit from a raft of changes announced by Roger Penske

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HOW F1 TRAGEDY SAVED 100,000 LIVES

The whiff of fascists, Hitler and tabloid scandal will provoke headlines when *Mosley* premieres at the Manchester Film Festival this month. But **William Kimberley** says an even more fascinating story underpins this documentary on a man who ruled motorsport for more than a decade

THE world premiere of 'Mosley' may take place at the Manchester Film Festival later this month, but the script could easily do justice to a Hollywood blockbuster.

Chronicling the life and career of former FIA president Max Mosley, the new documentary is, as he concedes, a "warts-and-all" affair.

It features a segment on his controversial father, Sir Oswald Mosley, the infamous leader of the British Union of Fascists before World War 2. Nor does it shy away from the News of the World scandal that would eventually engulf Max, prompting his campaign for media privacy.

The trailer, which juxtaposes the glitter of F1 in Monte Carlo with those distinctly unglamorous newspaper revelations

in 2008, certainly lures you in. "Life is a battle and I generally only pick the fights I can win," says Max, as the radio proclaims, 'The Mosley name is in trouble again'. "The gutter press was intent on destroying me – and all the work that we'd done," Mosley reflects. "... I don't like being pushed."

Reminded of the trailer, he smiles when asked if picking battles he believed he could win was a function of being a barrister, or merely the instinct for self-preservation.

"That statement is qualified by the word 'generally!'" he reflects. "Unfortunately most of the big battles have uncertain outcomes, but that is not a reason for not undertaking them. I will always take on a battle if I think it necessary, even if there is a serious risk of losing."

It was only after production work was underway that the script transformed into the wider story of Mosley's life and career. The irony, however, is that the original idea at its heart – the quest for improved safety in Formula 1 after Imola 1994, and the remarkable transformation of road car safety that it spawned – featured a pretty formidable mix of ingredients anyway: speed, heroes, tragedy and an initiative that has saved countless lives. "It was going to be about how the Ayrton Senna and Roland Ratzenberger accidents in 1994 led to Euro NCAP and the whole revolution in car safety," reveals Mosley. "The shock of Imola made changes for safety in F1 politically possible. Until then, the teams had steadfastly resisted change. I wanted the safety programme to have a scientific basis rather rely on some retired driver's opinion so I asked Professor Sid Watkins to head a new group. I also suggested he investigate what governments were doing for road car safety because with 50,000 fatalities a year in the then 12 EU countries, I thought there must be massive national research programmes underway from which we might be able to benefit.

"Sid came back saying there had been no change since 1974. We then learned that the car industry had a powerful lobby in Brussels stopping any



ABOVE Ayrton Senna leads Michael Schumacher at Imola in 1994 on a day that changed not only Formula 1, but the whole course of automotive safety



ABOVE Max Mosley was no stranger to controversy during his reign as head of world motorsport



change. That was the catalyst for our Brussels office which David Ward agreed to run. With it, we achieved effective EU safety regulation and started EuroNCAP."

SAVING LIVES

Fast-forward 22 years and the road cars we drive, like the F1 cars that have just been launched, are safer than ever before.

2019 proved to be one of Euro NCAP's busiest-ever years, with 55 cars tested representing 26 different makes of car. Such a high number means that nearly all cars (92 per cent) sold in Europe last year carried a valid Euro NCAP rating, giving consumers valuable safety guidance on almost any model they are likely to consider buying. This is a far cry from the earliest days when Mosley, the-then FIA president, created what has become the gold standard in assessing new car safety features. It is estimated that almost 100,000 lives have been saved since Euro NCAP's tough crash safety tests were launched in 1997.

When Euro NCAP [European New Car Assessment Programme] was first established, the car manufacturers ►

absolutely hated it. The first tests exposed safety failings in top-selling family cars, forcing a fundamental rethink in the way vehicles were designed to prevent accidents and save lives. It meant that if manufacturers were to comply and achieve any sort of rating, money and resources would have to be spent.

"I took the view that first of all it didn't matter – it wasn't my money! – and secondly, whether we raised the standards through legislation or consumer pressure it would be the same for manufacturers in the long run," Mosley recalls of those early days. "Yes, it would be more expensive, but it would be the same for all of them; a level playing field."

Mosley realised that what was required was a key industry figure to "break the dam", which led to a meeting with Louis Schweitzer, head of Renault. "Schweitzer realised that the old-fashioned 'safety doesn't sell' attitude didn't really apply," says Mosley. "I'm sure he had a moral view as well so he decided to take the risk, get behind NCAP's new crash tests. Renault became the very first company to get a

Five Star rating for occupant protection for its Laguna in 2001. It was remarkable."

Renault's escalating reputation for safety shook the motor industry, swiftly overtaking that of even Mercedes and Volvo, recalls Mosley. "Mercedes took the attitude that they knew what they were doing and did not need us to help, but we crash-tested their then C-class and it was awarded only two stars. That got them going."

"I will always take on a battle if I think it necessary, even if there is a serious risk of losing"

Within weeks, sales of the Laguna increased and it became clear that safety did indeed sell. "The rest of the industry had to follow," says Mosley. "They didn't have any choice. Now most of the crash testing is paid for by the industry."

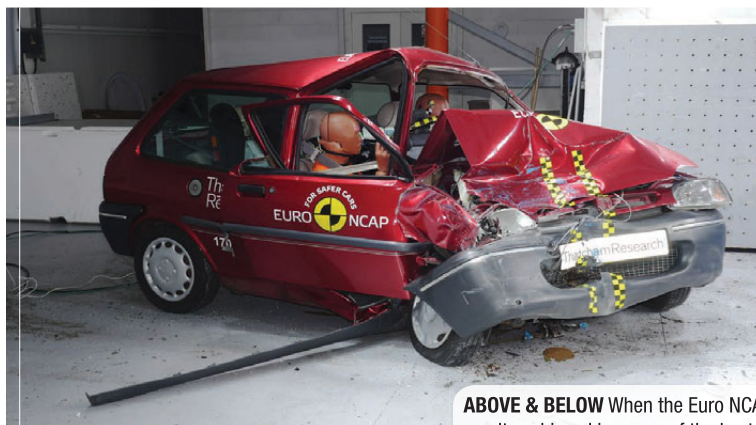
Safety had also become a major

concern in the world of motor racing, following the deaths of Ayrton Senna and Roland Ratzenberger at the 1994 San Marino Grand Prix. Among other discoveries following the accidents, the FIA, led by Mosley, realised that no significant safety legislation had been introduced for road cars since 1974.

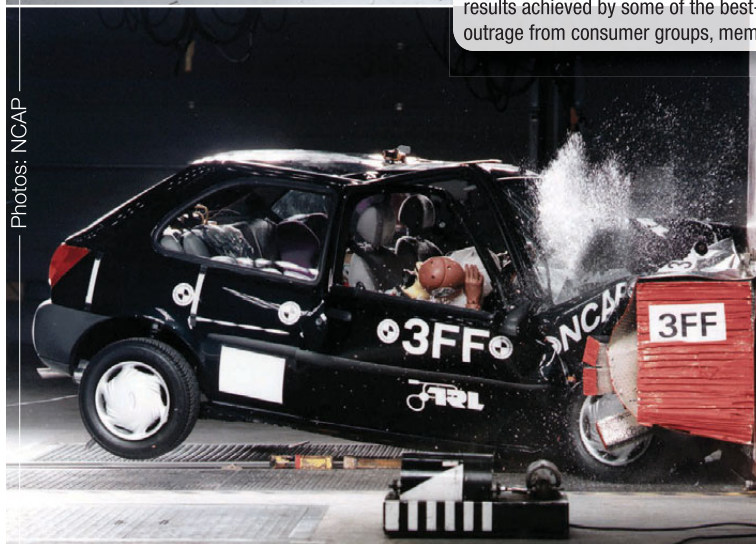
"Racing cars at the time were really dangerous but the governing body in those days had a completely different view," admits Mosley. "Their attitude was 'if you want to do it, take the risk', which seemed completely irrational. So later on, when I found myself in a position to do something about safety for road and racing cars, initially through FISA (which became the FIA) and then Euro NCAP, that's what I did.

"What was more difficult was in the FIA, where finding the initial funding for Euro NCAP meant taking money away from motorsport. We had people saying, 'Why are you spending that money on road car safety? Why not spend it on helping young go-kart drivers', for instance.

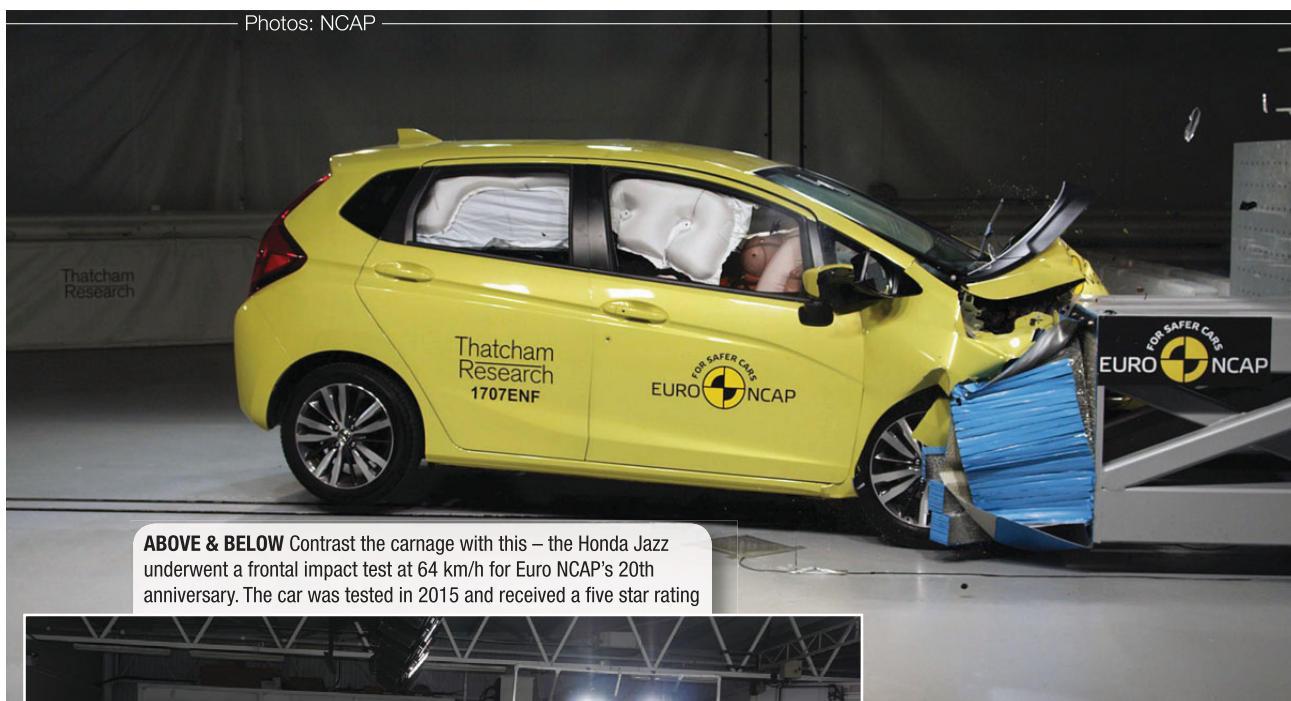
"I would say, 'Because it really, really



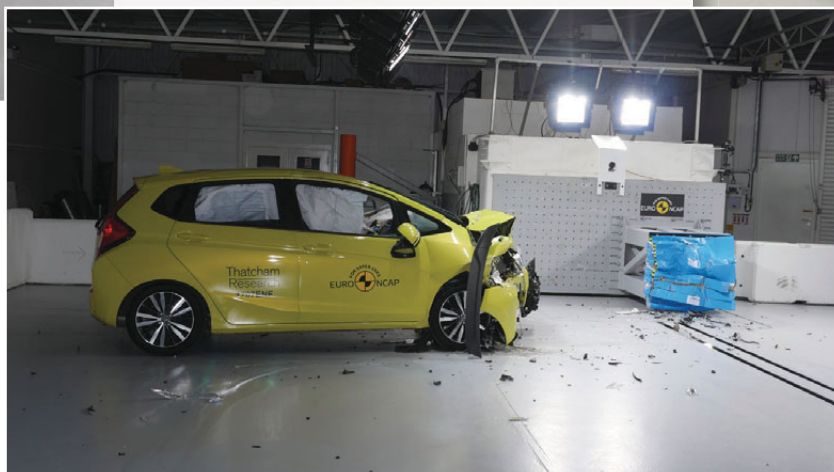
ABOVE & BELOW When the Euro NCAP tests first began in 1997, the poor results achieved by some of the best-selling family cars of the time sparked outrage from consumer groups, members of the public and the media



Photos: NCAP



ABOVE & BELOW Contrast the carnage with this – the Honda Jazz underwent a frontal impact test at 64 km/h for Euro NCAP's 20th anniversary. The car was tested in 2015 and received a five star rating



are not standing still. This year brings in new tests for crash safety and crash avoidance and, for the first time, for post-crash survival, with cars rewarded for features that allow for safe and rapid rescue of occupants. In 2022, the revised General Safety Regulation comes into effect with several new safety features becoming mandatory, although last year's results show that many of these technologies are already widely fitted on passenger cars as a result of Euro NCAP's demanding requirements over the last few years.

And it does not stop there: Euro NCAP will encourage car manufacturers to continue to offer the highest levels of safety to their customers and ensure that consumers can rely on its ratings for the best safety advice.

"From what started as a controversial programme, rejected by manufacturers, and supposedly aiming for unrealistic safety standards, Euro NCAP is now firmly part of the automotive mainstream," reflects Mosley, who was the first Chairman of Euro NCAP and became Chairman of Global NCAP. "Thousands of fatalities have been prevented, consumer demand for safety is high, manufacturers compete on safety rating results, and vehicle safety standards continue to improve.

"The consumer awareness model deployed so effectively by Euro NCAP ▶

matters.' Eventually, I rather gave up with the moral argument because it did not work. Instead, I started pointing out that being able to say we were saving thousands and thousands of lives on the road, as a result of motorsport, would help us politically."

As Mosley notes in his 2015 autobiography, if an accident on the magnitude of the 1955 Le Mans disaster occurred, 'we would risk politicians banning motorsport'. Motorsport technology and procedures could benefit road cars, and road car safety would keep motorsport relevant. With the support of several European governments, Euro NCAP was born.

Mosley won the argument and persuaded the FIA senate – not just a motorsport governing body, but also formed in the interest of regular motorists – to agree on a budget for road vehicle crash testing. "The first decent money

going into crash testing when we started NCAP was the equivalent of £1 million that we took, effectively, from the FIA sporting side," he says.

"The benefits would be two-fold: not only would a standardised crash test procedure be introduced, but safety techniques already used in the world of motorsport would give real-world relevance to the sport, which might otherwise come under even greater scrutiny should another high-profile death occur."

Mosley says his team's major achievements, while forming NCAP, and after becoming its first president in 1997, were establishing a strict set of crash standards that resonated with consumers – while keeping the industry on-side. "We therefore actually have the world of motorsport to thank, at least partly, for the formation of Euro NCAP."

The Euro NCAP crash test procedures



BELOW Roland Ratzenberger's Simtek follows Ayrton Senna's Williams on that fateful weekend

has not just fundamentally changed the European market, it has helped to catalyse other NCAPs across the world in middle and low income countries. Consumer pressure informed by crash tests is helping to make rapid changes in levels of safety in India, Latin America and the ASEAN region. Euro NCAP has truly had a global impact, a proud road safety legacy that has saved countless lives."

PASSING THE TORCH


Though it was Senna's death that catapulted Formula 1 onto the front pages, providing the catalyst for a safety revolution, Mosley stayed away from the Brazilian's funeral. Instead, he attended Ratzenberger's funeral, believing it important that motorsport remembered the other life lost on that dark weekend at Imola. A similar sense of duty compelled him to continue work on road safety initiatives even when his tenure as FIA president ended in 2009.

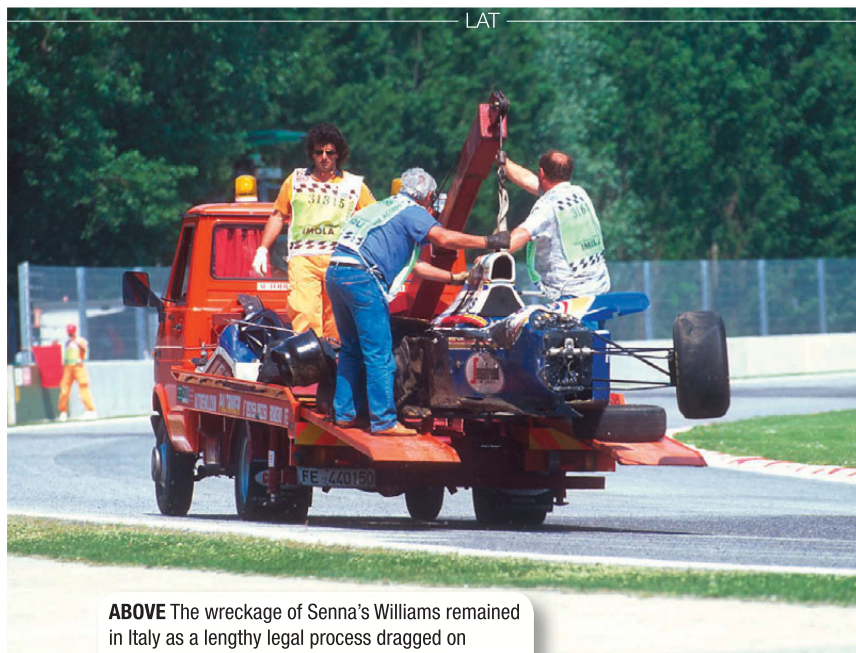
"My motivation had always been the thought of what each individual family goes through when someone is killed or seriously hurt," he explains. "It seems self-evident to me that if you can do something, you should. The FIA is not just

motorsport, it's also a federation of all the world's big motoring organisations. The president of the FIA is very well placed to influence road safety globally and I felt should do that to the best of our ability in addition to motorsport."

Indeed, Mosley only recently stepped back from active participation, having stayed involved in Global NCAP for a further 10 years after leaving the FIA.

It is a torch that he also entrusted to his successor, Jean Todt.

"I remember pointing out to him when he took over that 3,000 people a day die in road accidents worldwide and if he saved one per cent, that's 30 people a day," he recalls. "To me if you find yourself in a position like that, then it becomes a duty. I know that Jean agrees. He travels the world working for road safety." 



ABOVE The wreckage of Senna's Williams remained in Italy as a lengthy legal process dragged on



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RETURN OF THE MAC

McLaren is a team on the rise, but it's a long road from where it is now to where it wants to be. **Matt Youson** reports

SUPERFICIALLY, McLaren appears to have no great ambitions for its 2020 car.

Carlos Sainz summarised it best: "Hopefully, it's a car that's a bit closer to the top teams," he said, speaking at the launch of the MCL35. Given the storied history of McLaren, and standing upon a dais within the still-remarkable environs of the McLaren Technology Campus, that goal seemed a little underwhelming.

RIGHT The MCL35 features a reworked nose design and noticeably slimmer flanks than its predecessor

Formula 1, particularly F1 in February, is a sport given to bombast: the enthusiastic rallying cry; the call to arms and the promise – before a wheel has turned – of great things ahead. Sainz wasn't playing that game, but it would be a mistake to view his comments, or the general demeanour of his team, as lacking in motivation. Beyond the superficial, there's a

quiet confidence about McLaren at the moment: it's a team convinced it can maintain an upward trajectory – albeit an upward trajectory that, remarkable events excepted, is not likely to result in a tangible positional gain in the short term.

Back in 2018, McLaren's first year with Renault power, the team was finishing sixth in the Constructors' Championship, aided and abetted by Force India/Racing Point effectively forfeiting fifth position by entering administration. Last year, McLaren climbed to an entirely meritorious fourth.

While there existed a yawning chasm between McLaren and the Big Three of Mercedes, Ferrari and Red Bull, it in turn enjoyed a healthy gap over the fifth-placed works Renault team, and





Photos: McLaren

ABOVE The ambition for the new car is to further eat into the gap to the Big Three



earned the backhanded 'best of the rest' soubriquet with some comfort, scoring nearly 60 per cent more points than its engine supplier.

There exists a maxim that, for the customer team to beat the works team, the works team must be doing something wrong. In the case of Renault, that's almost certainly true – and the consequence of a mid-decade period of instability even more egregious than McLaren's – but it also requires the customer to be doing many things right. This was the case at McLaren last year but repeating the trick against a competitive F1 midfield that contains the ambition and economic power of Renault and a well-funded, resurgent Racing Point, is likely to be a stiffer challenge this time around.

McLaren CEO Zak Brown alluded to this in his opening remarks when introducing the new car: "The gap to third is still very big. I think we have to be realistic: we hope to close that gap [but] the first thing we need to do is not go backwards. That in

itself isn't easy because we've got great competition in the midfield."

STABILITY

In theory at least, 2020 should be a good year for 'not going backwards'. There is greater continuity in the technical regulations between 2019 and 2020 than there has been for over a decade and, with a massive regulation change for 2021 looming large, also a reasonable case for iterating from the existing design rather than attempting to remake the wheel.

Empirically, however, there's been a great deal of new thinking ahead of the 2020 season across the field, with McLaren's MCL35 in particular looking rather different to its predecessor, featuring a reworked nose design and noticeably slimmer flanks. According to technical director James Key, the new car is a bob each way: logical development on from the MCL34, mixed with new thinking in areas where that car was reaching the limit of its development potential.

"There are new concepts that we've looked at alongside what we learned from -34 as the year was going by," he says. "The bodywork is following a trend ►

I think we've seen increasingly with a very narrow sidepod, which is quite an exercise in packaging. We've done a similar exercise with the gearbox to match that philosophy [and] on the rear part of that, we've done a lot of work with suspension too. So, from the cockpit backwards is a very different approach to what we've had before. Equally, there's a lot of technology around the front which was only really possible to do with a new car. We felt there were opportunities we couldn't unlock on -34 with the geometry we had [but] having said that, it's all very much based around what we learned last year. -34 is very much the father of the concept as well.

"I'd say we've got quite a good baseline; it would be crazy to just go off on a tangent somewhere and make something completely different. It's more a controlled change, saying, 'OK, we know there's scope in this area but we do need to make a conceptual change to release it. That's the sort of approach we've had. The hope is that we can consolidate some of the

strengths of [2019's] car and improve them – but then look at other areas where we just didn't have any potential that we felt perhaps we should have.

"As you learn and as you generate your understanding, you recognise what you could have done to open up new avenues of development. So, there are some conceptual changes, and some of it is just taking what we know and trying to push it a bit harder with a new geometry."



ABOVE Gathering data on the car, which retains the high-mounted suspension philosophy

FOUNDATION

While the MCL34 was a solid foundation on which to build, it's worth noting that it wasn't a clear Class B champion from the outset of the 2019 season. Rather, it gradually dragged itself out of the pack with an upgrade programme that went deeper in the season than would usually be the case (thanks to the regulation stability) and, around those ►



ABOVE Narrow sidepods are a feature of the MCL35

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ABOVE & BELOW The team insists it has adopted a different approach from the cockpit back

major set-piece upgrades, an unusually intensive testing programme that saw McLaren's garage crew swapping floors and noseboxes at a higher tempo than is usually the case. Early problems on front-limited circuits were diluted after the first sequence of long-haul races with a big upgrade package for the Spanish Grand Prix. While race pace always looked strong, one-lap performance improved markedly in the second half of the season, to the extent that, in the final sequence of races, the team had the confidence to try Sainz on the types of extreme qualifying strategies usually reserved for the Big Three. He had a (failed) attempt at qualifying out of Q2 with a Medium tyre

“Outscoring your engine supplier requires the manufacturer to be doing something wrong, and the customer to be doing many things right!”

in Mexico, and (successfully) saved a set of Softs during Q1 at COTA.

“We’re still a second and a half off the front of the grid, so let’s not be too complimentary, we’ve still got stuff to do,” said Key at the time. “[The car] has its inconsistencies but what I think has been reassuring is that there’s been ups and downs but at most circuits we’re Q3 material and points-scoring material – and that’s obviously a big confidence

booster for everyone.”

Key, recruited from Toro Rosso, and team principal Andreas Seidl, from Porsche’s LMP1 programme, both arrived in the early months of the season, part of a rebuilding process that draws a line under McLaren’s unsuccessful Honda interregnum. The next set of changes on the horizon are going to be infrastructure-based. McLaren is in the process of upgrading ►



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ABOVE & BELOW The design extracts still more from a car that was already best of the rest last season



DEVIL IN THE DETAIL

When asked the [hundred] million dollar question about why F1's Big Three have managed to open up such a very large gap, Key is unequivocal in stating the ability to concentrate on details makes a big difference.

"We've got into this trend of talking about 'the midfield', and I don't quite know why," he says. "Suddenly there were three dominant teams, with the split

its wind tunnel at the MTC, after years of using Toyota's facility in Cologne. That is expected to be recommissioned next year. It has also announced its dalliance with Renault power will be short-lived, with a switch back to Mercedes engines for 2021.

Taken together, and in combination with the technical reset and cost-cap for 2021, there's a cautious sense of long-term optimism at McLaren and a belief that, after a turbulent few years, a corner is being turned. There remains, however, the rather knotty problem of the gulf to be bridged to F1's Big Three. While financial power plays a big part in that, culture and expectation have their role too.



The first thing we need to do is not go backwards"

"We've still got issues – there's still plenty of things to resolve at the moment," concedes Key. "We're aware of them, we can see them, but it's a case of how do you fix them? Some of that you can do with the new car, other things are longer term issues: processes of how we're thinking about stuff; how we're analysing things and so on. That will come in time. The 2021 regs drop straight into the middle of that process – which is pretty disruptive – but equally it's a good opportunity to close things up as well."

really opening up in 2017 and staying there ever since. We've chipped away at it, but it's remained.

"The aerodynamics of these cars and the refinement you can put into them is clearly quite fundamental to some of those differences, and if you are a bit limited with your tunnel, that could hurt – but there's a lot of fine detail in there as well.

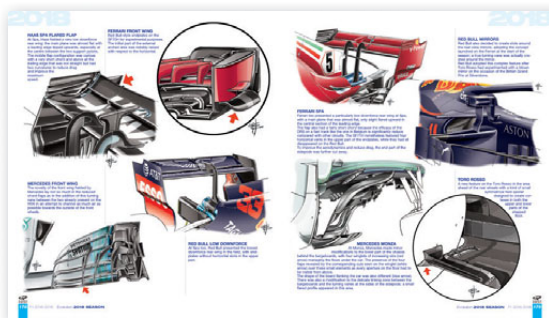
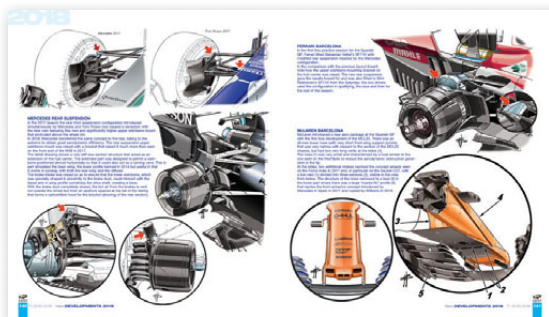
"We've still got plenty of competition around us and everyone is trying to do the same thing [bridge the gap], but it's not the work of a year, given the size of ►

Giorgio Piola

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it. If you look at the amount of hard work and investment that those teams ahead of us have put in over the years to get to that point, trying to replicate that in a very short period is very difficult. You have to look at it over a slightly longer term than a season.

"You have to start in the right way and build on that. You have to make changes to your car concept; to the way you're developing; to the shape of your team to a certain extent as well, to maximise what you're able to do. There are definite aspects of chipping away – but there are step-changes as well. You've got to work out what the hell they are doing to be a second and a half quicker. It's odd that there are a bunch that are really close and then a step to some other teams. What is it that they are doing that's different?"

"I think there's a few clear directions which are difficult to achieve, which, if you can unlock them, will begin to take you to where they are. It's definitely aero but there's a few other things as well: tyres;

“Some conceptual changes, and taking what we know and trying to push it a bit harder”

a little bit of power unit. From a chassis point of view, when you really look at it, you see a few fundamental things which, if you can unlock, you can make quite big strides. That's the process you have to go through. It's not easy but it's a great challenge to have.”

UPWARD MOMENTUM

While that process is ongoing, McLaren has a 2020 season to contest. The aim, as Sainz lays out, is to nudge closer to the top three and, by extension, maintain a gap over the chasing pack. It could be argued that the urge for the best of the rest to hold station and consider that a job well done is symptomatic of the state in which F1 finds itself – but it also reflects the fact McLaren, historic performance aside, punched well

above its weight last year. Consolidating that position would be progress.

For Sainz himself, a last lap, last gasp overtaking move at the season-ending Abu Dhabi grand prix secured sixth place in the 2019 Drivers' Championship, with only the five 2019 race winners ahead of him in the table. He's sanguine about his chances of repeating that personal milestone, acknowledging that he's targeting seventh this year – but there is not a hint of defeatism in the way he states this.

"I think everything is coming together a little better. We are growing as a team; we have a positive momentum going forward," he says. "If there is an opportunity to finish higher than seventh in the Championship, I'm going to take it... but it isn't going to be easy..." **LT**



ABOVE Quick work on the track but it's the changes away from it, like a wind tunnel revamp and new powerplant from Mercedes, that will help shape McLaren's next step

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THE DREAM UNION WE'VE WAITED FOR?

Gary Watkins examines the landmark agreement for the convergence of the top categories of endurance racing

A HISTORIC day for motorsport or a pragmatic move? Probably a bit of both. That's how the news that the next generation of IMSA SportsCar Championship prototypes will be able to race in the FIA World Endurance Championship from 2021/22

should be properly viewed.

The LMDh category – or 'platform' as it is being dubbed by both sides – will allow for a manufacturer or team to compete for outright victory in both the WEC and IMSA series with the same machinery. More pertinently, perhaps,

it permits the same cars to shoot for glory in all the big global endurance races, Daytona, Sebring and Le Mans. That undoubtedly makes the unveiling of the news by the WEC promoter the Automobile Club de l'Ouest and IMSA on the eve of one of those races, the Daytona 24 Hours in January, a momentous event.

The term common platform – that word again – and convergence have been trotted out glibly since. Whether they actually apply to what has happened is a matter of debate, but the latest accord means sportscar racing is closer to having one set of regulations across its top tiers around the globe than at any point in the past 40 years.

But the deepening of the existing ties between IMSA and the ACO, also organiser of the Le Mans 24 Hours, has a pragmatic slant. The WEC's new LM Hypercar division received a massive fillip when Peugeot announced it would be returning to international sportscar

Adrenal Media/WEC



racing last November, but for all the tortuous gestation of the class, it has yet to gather the momentum that series insiders were predicting when the ideas for the category were being formulated back in 2018.

The WEC was arguably in need of additional manufacturer representation more than IMSA, even before Aston Martin postponed its entry into the LM Hypercar division with the Valkyrie in February. The British car maker's move has left the world series with just a single OEM in Toyota for its maiden season in 2020/21 running to LM Hypercar rules, not counting niche marque Glickenhaus.

The Aston statement confirming that it was putting off its return to the pinnacle of sportscar racing for an undisclosed period cited the uncertainty over the future of the rules as a result of the LMDh announcement. David King, president of Aston Martin Racing, said that the marque's decision was a result of the LMDh announcement undermining the

business case of the Valkyrie.

He explained that Aston's business model involved selling Valkyrie race cars: "The Valkyrie is an expensive race car because it comes from a road car that costs £2.5 million. Now those privateer teams, based on what we think other

THE BACK STORY

The unveiling of the LMDh platform is the latest twist in a long-running tale of the ACO and the FIA's efforts to replace LMP1, and before that, to evolve and enhance a category that dates back deep into the

“Sportscar racing is closer to having one set of regulations across its top tiers around the globe than at any point in the past 40 years”

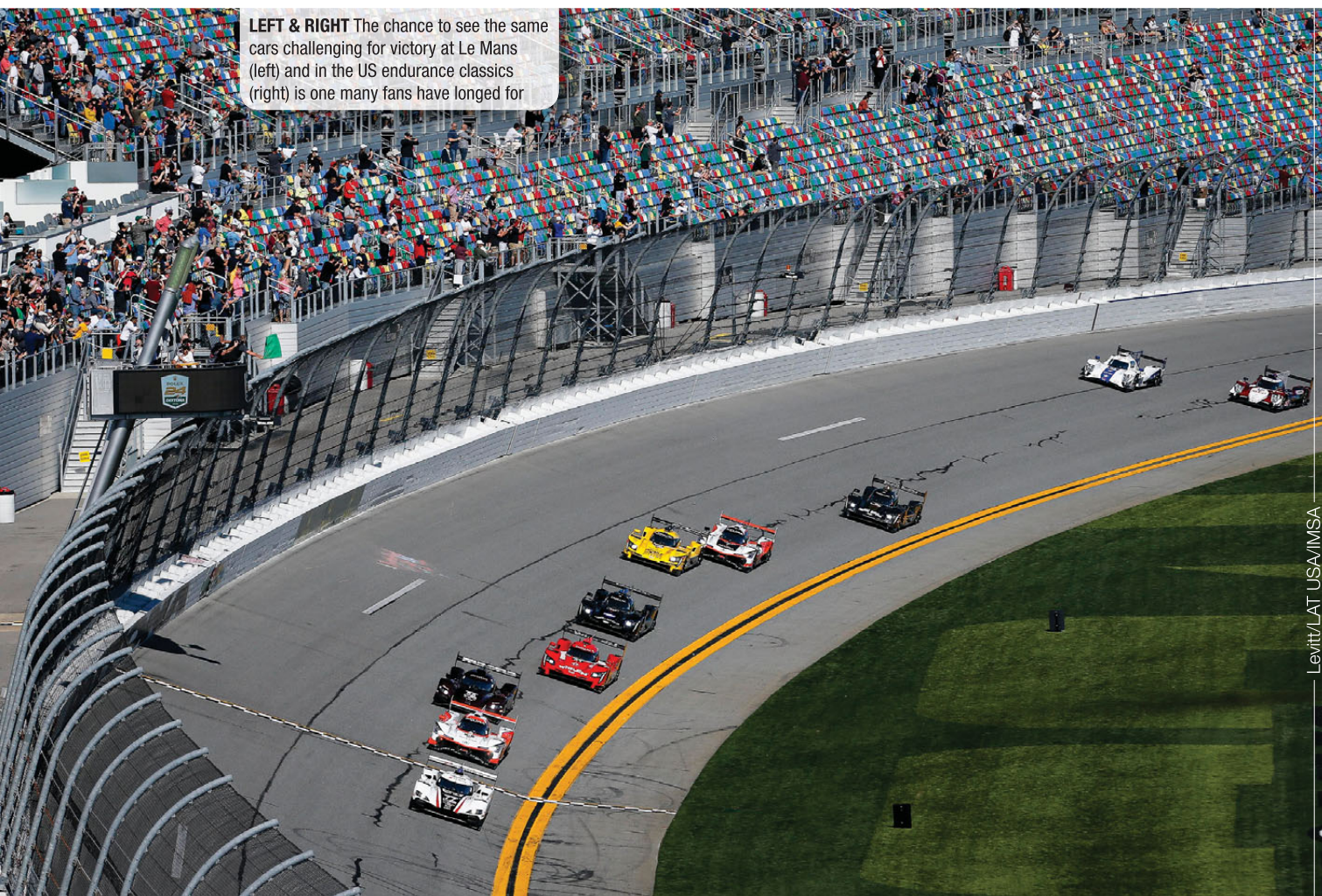
competitors are going to do, are going to be able to buy premier-branded LMDh cars that are much cheaper.”

IMSA has a trio of brands competing in the Daytona Prototype international division right now, Cadillac, Acura and Mazda, but it has long been predicting more are on their way. The chance to race the same car on two platforms could be what is required to convince the waverers to take the plunge.

1990s. Don't forget that it was as recent as June 2017 that the ACO announced plans for an 'electric kilometre' for a new breed of P1 machinery. Hybrids would have to complete one kilometre on electric power only after each refuelling stop.

That plan went down the plughole inside a month. Porsche had sat around the table with Toyota and agreed the new rules. That's Porsche Motorsport and the bosses of its LMP1 squad; the board of

LEFT & RIGHT The chance to see the same cars challenging for victory at Le Mans (left) and in the US endurance classics (right) is one many fans have longed for



Levitt/LAT USA/IMSA



Levitt/LAT USA/IMSA

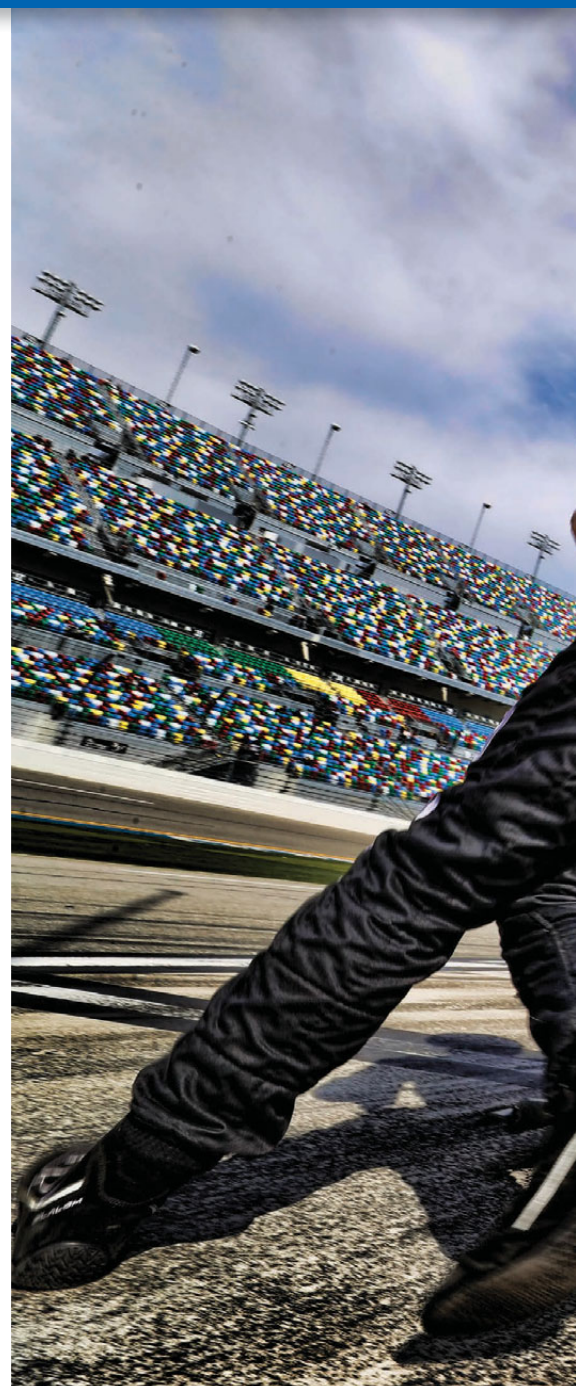
ABOVE Landmark moment: Pierre Fillon, ACO President, and Jim France, IMSA Chairman, sign documents introducing the LMDh category. They are joined by Gérard Neveu, CEO of the FIA World Endurance Championship, John Doonan, IMSA President, and IMSA CEO Ed Bennett

the company had other ideas. The German marque had long since made clear its intent to start producing electric cars with its Mission E concept of 2015. Its ambitions towards electrification were at the heart of its decision to quit LMP1 in favour of a switch to the FIA Formula E Championship in time for the start of season six late last year.

The ACO began to hint at a future involving DPi machinery as long ago as its Sebring round last March. That was when it went public on what was happening with its hypercar plans. The rules for prototypes resembling “hypercars, supercars, luxury GTs or concept cars” had been published the previous December, but a group of manufacturers, Aston,

Ferrari and McLaren, got together to argue that rules devised to reduce the costs of competing in the premier category of the WEC had not gone far enough. They questioned the €20 million annual budgets for a two-car team, which had been revised down from an initial €30 million, predicted by the rule makers.

That led to a major reworking of the rules after lobbying from the gang of three. Road-based machinery would be allowed to race alongside the prototypes, and that meant the introduction of the Balance of Performance to equalise what could be very different types of machinery, both hybrid and non-hybrid. With the concept of the BoP on its way to being enshrined in



ABOVE Aston Martin blamed the impact of convergence on its ability to sell customer cars for its postponement of the Valkyrie WEC entry

the rules, the door was at least half open to allow cars from IMSA's premier division to join the WEC. The ACO and the WEC even admitted as much.

Talk of allowing the next generation of IMSA contender, dubbed DPi 2.0 in North America, to join the WEC never went away against a backdrop of limited interest in the LM Hypercar rules over the second half of 2019. There was also clearly concern within the ACO about Aston Martin's commitment.

The British marque formalised its intent to be on the grid for 2020/21 this September in the wake of the confirmation of the two-tier hypercar rulebook last June. Its announcement, and that of Toyota,



ABOVE The successor to the current DPi cars will incorporate hybrid technology. Crucially, it will be a spec system

were carefully timed to follow on from the ACO's traditional race-week press conference. The revised rules got the go-ahead because there was a manufacturer ready to sign up with a road-based machine, and Aston made its commitment once it got the rules it wanted.

Aston made a lot of noise at Le Mans, but suddenly went quiet; there was little news coming out of its headquarters in the months that followed. The "full-steam ahead" platitude was repeatedly trotted out and the involvement of Multimatic Motorsport in the programme was only tacitly confirmed when the Canadian-based organisation was described by Aston boss Andy Palmer as a "go-to partner". In

fact, Multimatic, which has longstanding links with the marque, is playing a key role in the development of the road-going Valkyrie and was – and maybe still is – heading up the race programme.

The ACO hinted at its unease about the strength of Aston's commitment to join the LM Hypercar ranks in the statement it issued after the British marque's own. It described the move as "perhaps not unexpected" and alluded to the financial difficulties the brand had been facing as its share price dipped, as well as the cash injected from a group led by Racing Point F1 team owner Lawrence Stroll. That will result in his operation being rebranded as Aston Martin for the 2021 season.

At the same time as Aston's commitment appeared to be wavering, McLaren piped up and stated that it would only consider joining the WEC's premier division if it could run DPi 2.0 machinery. That was significant, because the British sports car builder had been involved in the rules discussions from the very beginning. Chief executive of McLaren Racing Zak Brown suggested that the LM Hypercar regulations were out of reach financially for his organisation.

He put an annual LM Hypercar budget at \$40 million. Budgets for a DPi programme are generally reckoned to be some way south of \$20 million for what is a continental rather than a ►

global campaign with machinery not incorporating hybrid technology.

Aston's travails and McLaren's enthusiasm for yet another rules shift obviously played a part in the thinking of the ACO. But there was also an internal power struggle involving the French organisation and its wholly-owned Le Mans Endurance Racing subsidiary that runs the WEC, as well as the FIA.

Exactly who within each of those organisations was in favour of creating some kind of common platform that reaches across the Atlantic isn't entirely clear. It can be said with some certainty, however, that WEC boss Gerard Neveu, CEO of Paris-based LMEM, was certainly in the pro camp.

WHAT IS LMDh?

It appears for the moment that a category that takes its name from the first letters of the Le Mans and Daytona 24-hour races, with the 'h' hinting at the words hypercar and hybrid, will be more or less DPi 2.0 rebadged. And it might not even end up being rebranded in North America. IMSA chairman Jim France is reportedly a fan of keeping the DPi moniker in some form.

A firmer indication of the rules, perhaps even their publication in draft form, is

planned in the week of the 'SuperSebring' IMSA/WEC doubleheader on March 20/21, but it seems unlikely that they will deviate significantly from the ideas IMSA had in mind for DPi 2.0, which was always due to come on stream for 2022. The core principle is of a manufacturer being able to take one of the off-the-shelf LMP2 chassis, fit its own engine into a clearly defined 'box' without altering the wheelbase, and then give the thing a brand identity with its own styling cues.

The initial idea for DPi 2.0 had been for the cars to be based on the current generation of LMP2, but LMDh machinery will be developed out of the cars built to the next rules cycle. A key component of the January announcement, but one that has been overlooked, was the confirmation that the four constructors licensed to build P2 machinery under the present rules have had their deals extended to cover the next regulatory cycle now due to start in 2022. That means ORECA, Dallara, Ligier and Multimatic, which originally partnered with Riley Technologies, will be chassis suppliers for the new P2 formula just as they are for the existing rule set that came into force at the beginning of 2017.

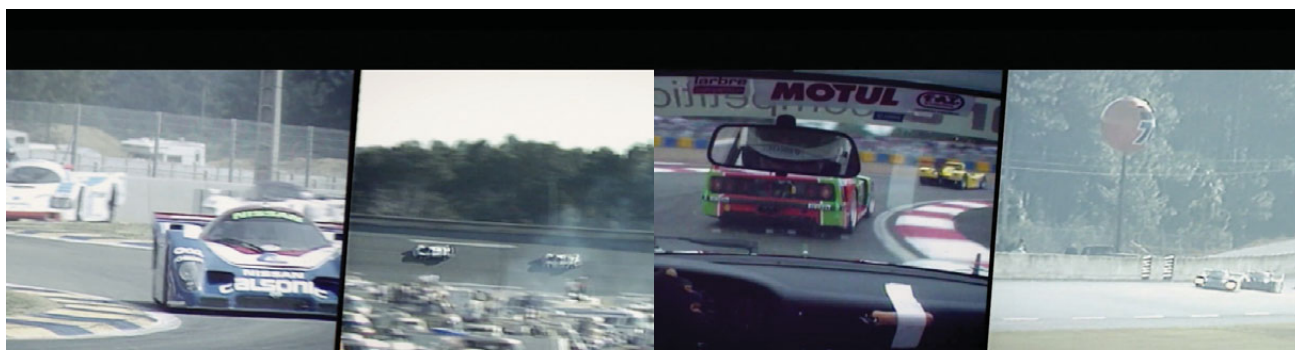
The key difference between DPi mk1 and mk2 is that the new formula will

incorporate hybrid technology. This was always on the agenda for the DPi 2.0, but with costs at the forefront of the minds of both the rule makers and the factory participants, it will be a spec system common to all the cars.

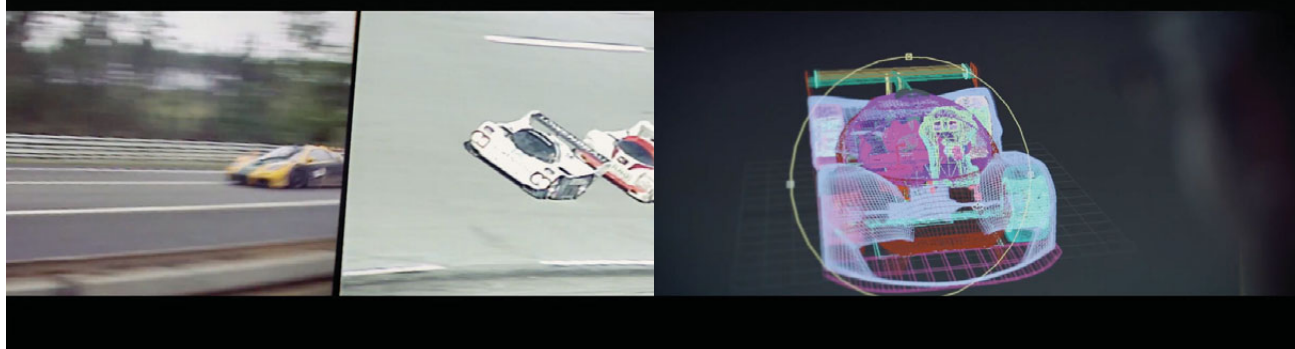
There appears to never have been any discussion of it being anything other than a rear-axle kinetic system. A power level of no more than 100 kW or 134 bhp is envisaged, which compares to the 300 kW maximum permissible output from the two energy-retrieval units allowed in LMP1 at the moment. The LM Hypercar prototype regulations as they stand limit hybrid power from the single front-axle kinetic system of a prototype to 200 kW or 268 bhp. A road-based machine could in theory have multiple systems if they are found on the street car.

The scope for styling or branding of the car will be extended under the new rules in comparison with the DPi regulations that allowed for only the nose and tail sections to be changed. How this can be achieved with the fixed greenhouse of a proprietary chassis is unclear, but IMSA is reputed to have what one interested party described as "some impressive renderings".

The cars will also incorporate the latest safety rules already found in the LM Hypercar prototype rules published in 2018. ►



ABOVE & BELOW A video released to mark the convergence agreement celebrated the rich history of Le Mans and IMSA. But the future, accommodating LMDh and Hypercar, remains far from clear





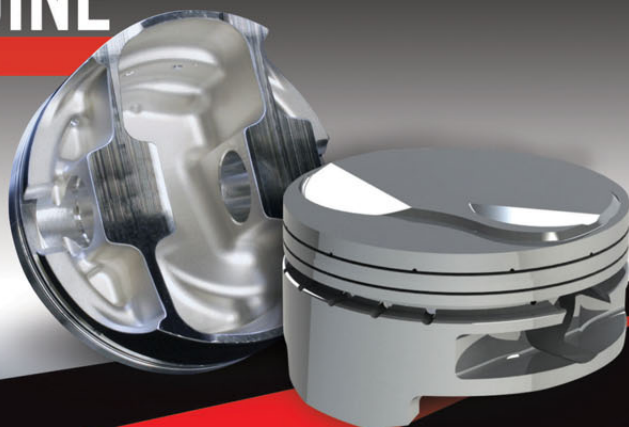
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ABOVE IMSA's core principle remains that of a manufacturer taking an off-the-shelf LMP2 chassis, fitting its own engine and adding brand identity with styling cues. News that the existing four chassis suppliers have had their deals extended went almost unnoticed

A ONE OR TWO-WAY STREET?

There is confusion over whether cars built to the LM Hypercar rules will be welcomed in North America from the start of the 2022 season. Even new IMSA president John Doonan struggled to get his story straight on this one as the media descended on the big cheeses who'd appeared on stage for the Daytona press conference.

Initially, he stated that it wasn't the intention to allow LM Hypercars to race in IMSA. After ACO president Pierre Fillon suggested it was a possibility, Doonan backtracked. It appears, however, that the agreement between the two parties is primarily aimed at putting LMDh cars on the WEC grid rather than LM Hypercars under starters orders in IMSA.

MANUFACTURER WELCOME

Support for the LMDh initiative was pretty much unanimous in the wake of Daytona, with both Toyota and Aston even joining in.

Toyota's line, via a spokesman, was "if this move brings more manufacturers to the top level of endurance racing, we welcome it while waiting for more details". Toyota Motorsport GmbH technical director

Pascal Vasselon had said something similar last year, pointing out that it wasn't a big jump to welcome cars built to another set of rules into the WEC if a BoP mechanism was already in place. He did say, however, that the "BoP casts a shadow" over the LM Hypercar division, while suggesting that discussions on how to remove it somewhere down the line had already started. The LMDh announcement will surely nip that in the bud.

Aston Martin Racing said it was "pleased that the future of sportscar racing's top class has been secured". It then added a prescient, "we look forward to working closely with all parties to ensure that the hypercar vision retains its proper position within global sportscar competition".

The three marques involved in IMSA's DPi class all gave a warm welcome to the big news, while holding fire on any commitment to compete.

General Motors director of racing Mark Kent, whose remit encompasses the Cadillac DPi programme, said that the brand "congratulates IMSA and the ACO on their announcement of a convergence of the top class of prototype racing".

"We are encouraged at the prospect of an international formula for the future of prototype racing," he continued.

"Once we obtain further details, we will evaluate if our participation aligns with our company's future."

Mazda and Acura more or less offered the same sentiments.

"Good news for the industry" is how Porsche factory motorsport boss Pascal Zurlinden described the alignment. "Does it mean that Porsche is coming?" he added. "We can't comment because we don't know the regulations."

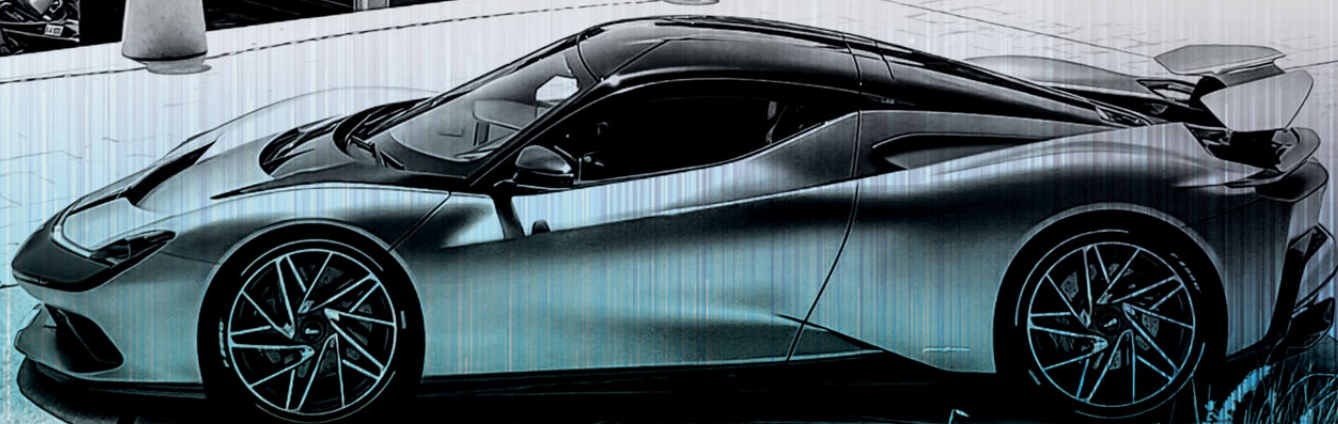
Ferrari GT racing boss Antonella Coletta called the chance to race the same car in the WEC and North America at a budget that wouldn't be significantly greater than what it is currently spending in GTE Pro as "perfect for us". He did, however, put a significant caveat on its return to the prototype ranks for the first time since it developed the 333SP IMSA World Sports Car for 1994. It wants to be able to build its own monocoque.

Coletta insisted that a Ferrari wouldn't be a Ferrari unless it had a Ferrari monocoque. A "total Ferrari" is the term he picked, though that is misleading. He explained that the Italian sports car builder would be happy to use components from a proprietary P2 chassis, just not the tub.

"We hope to [be able to] have a Ferrari chassis, this is a need," he said, claiming ►

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The long and winding road

How sportscar racing's regulations have changed course

NOVEMBER 2016 Rules freeze put in place until the end of the 2019 season after Audi's withdrawal from LMP1. Move delays introduction of new safety rules and an increase in maximum hybrid energy from 8 to 10 MJ with the addition of a third energy-retrieval system

JUNE 2017 Innovative rules package announced for 2019 during Le Mans week. Includes an electric-only kilometre after every refuelling stop and active aerodynamics

JULY 2017 Porsche drops the bombshell that it will be quitting LMP1 in favour of Formula E at the season's end

SEPTEMBER 2017 The WEC, the ACO and the FIA reveal post-Porsche rescue package and announce that they will be starting again on a new set of regulations for the top class

MARCH 2018 Round table talks commence as the drive for new rules begins

JUNE 2018 ACO and FIA reveal their plans for a new category for prototypes styled after hypercars that will reduce costs dramatically

DECEMBER 2018 New rules published after being signed off by FIA World Motor Sport Council

FEBRUARY 2019 A group of manufacturers approach the ACO and FIA arguing that costs will remain too high

MARCH 2019 A change of tack is revealed: real hypercars to be allowed to race against the prototypes

MAY 2019 Further machinations result in another initiative dubbed GTE Plus backed by Porsche and Ferrari

JUNE 2019 New rules confirmed, Aston and Toyota confirm plans

NOVEMBER 2019 Peugeot announces plans to return to the WEC sometime in 2022

JANUARY 2020 LMDh common platform revealed at Daytona

FEBRUARY 2020 Aston Martin reveals it is postponing its LM Hypercar entry

in mid-February that discussions were still open on the matter. "By definition we make a Ferrari."

Peugeot also appears to be lobbying for changes to the DPi 2.0 concept as it segues into LMDh. Jean-Marc Finot, motorsport boss of Peugeot parent company PSA, admitted that the company was reviewing its decision to go down the LM Hypercar route and that there were a number of points to be resolved before the end of March.

"Our reference for the programme is the hypercar regulations, but we are looking at the LMDh regulations," he said. "It could be interesting but there are some conditions to be fulfilled for it to be interesting."

"The first one is to have perfect equity between both. That means it is mandatory for LMDh and LM Hypercar to have the same weight, the same aero specification and the same power. If we don't have that, it would be difficult to manage the BoP."

That appears to be a fairly fundamental condition. Aligning the power outputs of the two types of car might not be an issue, but doing likewise for their minimum weights would be. At present an LMP2 car weighs in at 930 kg and the minimum set down for the LM Hypercars is 1,100 kg.

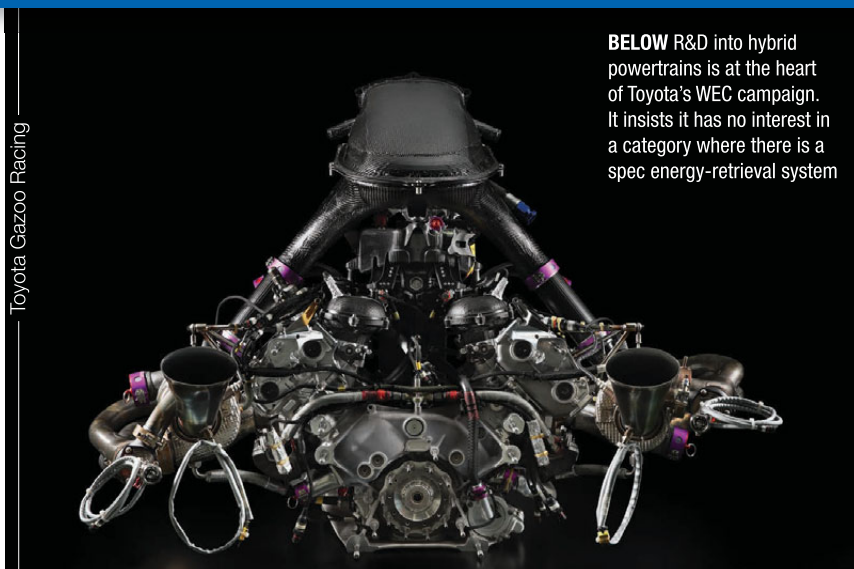
What scope there is for changes to the tenets at the heart of the philosophy of DPi isn't clear. IMSA and the ACO were only saying

"If no other brands join Toyota, the future of WEC's top class would appear to lie with LMDh"



ABOVE Peugeot's decision to go LMDh or Hypercar could be a pivotal one for the latter category

Toyota Gazoo Racing



BELOW R&D into hybrid powertrains is at the heart of Toyota's WEC campaign. It insists it has no interest in a category where there is a spec energy-retrieval system

that there was a lot of hard work to do in the two months between Daytona and Sebring and are keeping quiet in between times.

Privateer teams also welcomed the creation of the LMDh platform. Wayne Taylor Racing sealed a second consecutive Daytona victory 48 hours after the IMSA/WEC announcement and then its boss described taking Cadillac back to Le Mans as "unfinished business". Wayne Taylor was one of the partners in the 3GR operation that masterminded the GM brand's 2001 and '02 Le Mans campaigns with the Northstar LMP900 cars.



BEYOND HYPERCAR AND LMDh

The ACO has outlined a vision to create one set of rules some time in the middle of this decade. IMSA appears onside on this one, too.

"The dream is to have only one category with the same design and the same performance," said ACO president Pierre Fillon. "The target is to have only one class in the end."

Doonan reckoned such a scenario would "be a dream come true".

"I would say everyone up here to today [on the stage during the IMSA/ACO press conference] hopes that the ultimate outcome is one, single formula," he said. "Over the next few years we are going to see a convergence."

How that might be complicated by the ACO's planned class for hydrogen fuel-cell cars, due to come on stream in 2024, isn't clear. Fillon has talked about an intention for these zero-emission prototypes to compete for overall victory from the get-go, though it is unclear whether the technology will have advanced sufficiently to allow this.

IS THIS THE END OF HYPERCAR?

The ACO didn't feel the need to stress that the LM Hypercar division had a future in Daytona; LMDh was billed very much as a complement. Yet it did in the immediate aftermath of confirmation of Aston's postponement of its plans.

Fillon insisted that "the ACO/IMSA convergence does not impact this category".

"As far as the next top category of competition, Le Mans Hypercar, is concerned, we continue to believe and remain utterly convinced that a

manufacturer has its rightful place there," he went on. "To run at Le Mans and in the WEC, at this level of technology and budget, is an undeniable opportunity for a manufacturer to demonstrate its competitiveness."

Even if Peugeot opts for an LMDh, there is nothing to suggest right now that the LM Hypercar route will be closed, or at least that part of the class allowing for lookalike prototypes. Series bosses have privately pointed out, quite rightly, that the absence of road-based hypercars will make balancing the prototypes and LMDh machinery less problematical.

What's more, the category can't be canned so long as Toyota is the only OEM scheduled to be on the grid next year, and it is a manufacturer that has no interest in building an LMDh.

"We are racing to develop technology and to improve technology, so it is true that for us it is not interesting to purchase an LMP2 chassis, to purchase an off-the-shelf hybrid system," said Vasselon. "We fully understand that this is the right approach for other manufacturers, [but] for us definitely no."

How Peugeot will be influenced by Aston's decision isn't clear – the French manufacturer has stated that it will make a call on which way it goes at the end of March. Despite its forthcoming WEC programme going hand in hand with the launch of a line of 'Peugeot Sport Engineered' hybrids designed, according to Finot, to "show electrification offers a pleasure of driving", having to use a spec energy-retrieval system wouldn't be a game changer.

"What is interesting in this championship is the freedom of design in the aerodynamic specification and to demonstrate our skills in terms of electrified powertrain management," said Finot. "If the components are the same, it will not be a big issue; it will not be a decision criterion."

Yet should Peugeot choose against developing an LM Hypercar, it is difficult to see where it would leave the category in the long term. Should no other major brands decide to join Toyota in going the more expensive route, the future of the top class of the WEC would appear to lie with LMDh. That would make the Daytona announcement the historic moment that the participants are claiming. **RT**

A TRANSMISSION PERIOD

Supplying transmissions to an entire grid of snarling electric racers presents a number of problems, but as **Alan Stoddart** finds out, one company is ready with the solutions



ABOVE Despite being a standard unit, the P1316 is still carefully optimised

THE World Rallycross Championship's transition to electric powertrains is proving to be a more complicated one than anticipated. In February 2018 its promoter IMG announced that the series was set to make a straight swap to electric cars in 2020. However, the process was beset by difficulties. Initially it was just a revised start date, to offer manufacturers 'additional time for development' but by April 2019, a lack of commitment from those manufacturers meant the plans were reversed.

The upshot of this reversal was that

strategy was changed, and instead of WRX becoming an entirely electric series, the series' adoption of electrification would be more gradual. It would begin with a support category, dubbed Projekt E, joining at select events in 2020, with electric cars being allowed to compete against ICE supercars, using an optional spec powertrain, in 2021. This electrification is being achieved with the help of Austrian engineering firm Kreisel, which won the contract to supply and service the spec powertrain. For the transmission portion of the powertrain however, Kreisel turned to Xtrac, and with good reason.

"We've been working on electrification of motorsport for quite some time, generally with the factory teams for things like LMP1 and Formula E, where we designed very high-technology transmission systems, which are highly integrated within the electric machine," explains chief executive Adrian Moore.

Alongside motorsport, Xtrac has also made great inroads with its Integrated Lightweight Electric Vehicle (ILEV) transmission offerings for high performance road cars. The first of which was the P1227, which was designed as a tech demonstrator, and was used by several OEMs who could buy the axle off the shelf, reconfigure it in different ways, so with a limited slip differential or open differential for example, and use it in their own technology demonstrators. Xtrac would then move to a full programme and make a bespoke e-axle for their production cars.

So, the transmission-maker was heavily involved with very bespoke motorsport work, as well as an off the shelf system for road cars, but one area in which Xtrac did not have an electric presence, which it did for internal combustion engined motorsport, was in making standardised products for individual series.

"We are really well known for our standard products," says Moore. "So, in IndyCar for example, we have been

BELOW Because the electric powertrain is a drop-in solution, 2021's Supercar grids needn't look any different



supplying the standard transaxle for 20 years, we also do the same for LMP3, and for Australian Supercars. We have really good expertise in supplying standard products to an entire grid of cars.

"But what we didn't have, and what we could see was coming, was a more standardised electric racing car coming, that was the natural way it was going to head, so we obviously had a good look at electric rallycross."

Xtrac and Kreisel teamed up as soon as the FIA put out the invitation to tender for the e-WRX powertrain. The result was a neatly packaged transmission, called the P1316 e-axle, that uses some standardised parts to reduce costs, but housed in a completely bespoke casing to suit the motor and housing. The limited-slip differential is of a multi-plate ramp type, with adjustable pre-load. The unit's output flanges are explicitly designed for the application, so the driveshaft lengths can be optimised for different vehicle types if needed.

The use of Xtrac's own XM023 material for some key applications means that the e-axle comes in at just 21 kilograms.

The P1316 has an overall ratio of 7.90:1 and can be used with motors that have a power rating of 250 kW, and an input speed of up to 15,000 rpm. Lubrication of the unit, which is essential to its efficient running, is handled by an internal rotor pump with pressure feed to all critical areas, a semi-dry-sump oil pickup to minimise churning losses and optimise the e-axle's efficiency.

This technology is only part of the equation, with Xtrac's spec parts expertise also critical to the success of the transmission.

LEVEL PLAYING FIELD

"It's the fact that we can supply a whole grid of cars with a very high quality, and more importantly very uniform quality product and that we are experts at ensuring parity across all competitors," comments Moore.

"It is so important to be completely fair across all competitors."

But that isn't to say that the technology isn't crucial, particularly given the new challenges that are presented by the

unique nature of electric rallycross.

"It's a very interesting load case and duty cycle," adds Moore. "If you look at Formula E, which I suppose is the pinnacle of electric racing, you have got a series that has insufficient energy to run flat out for the whole race and cars that are challenging to optimise the performance of, that is one of the reasons it is so competitive."

"Our job in Formula E is to make those cars as fast as we can, so we have expertise in what load cases go through transmissions like that and what their duty cycle is."

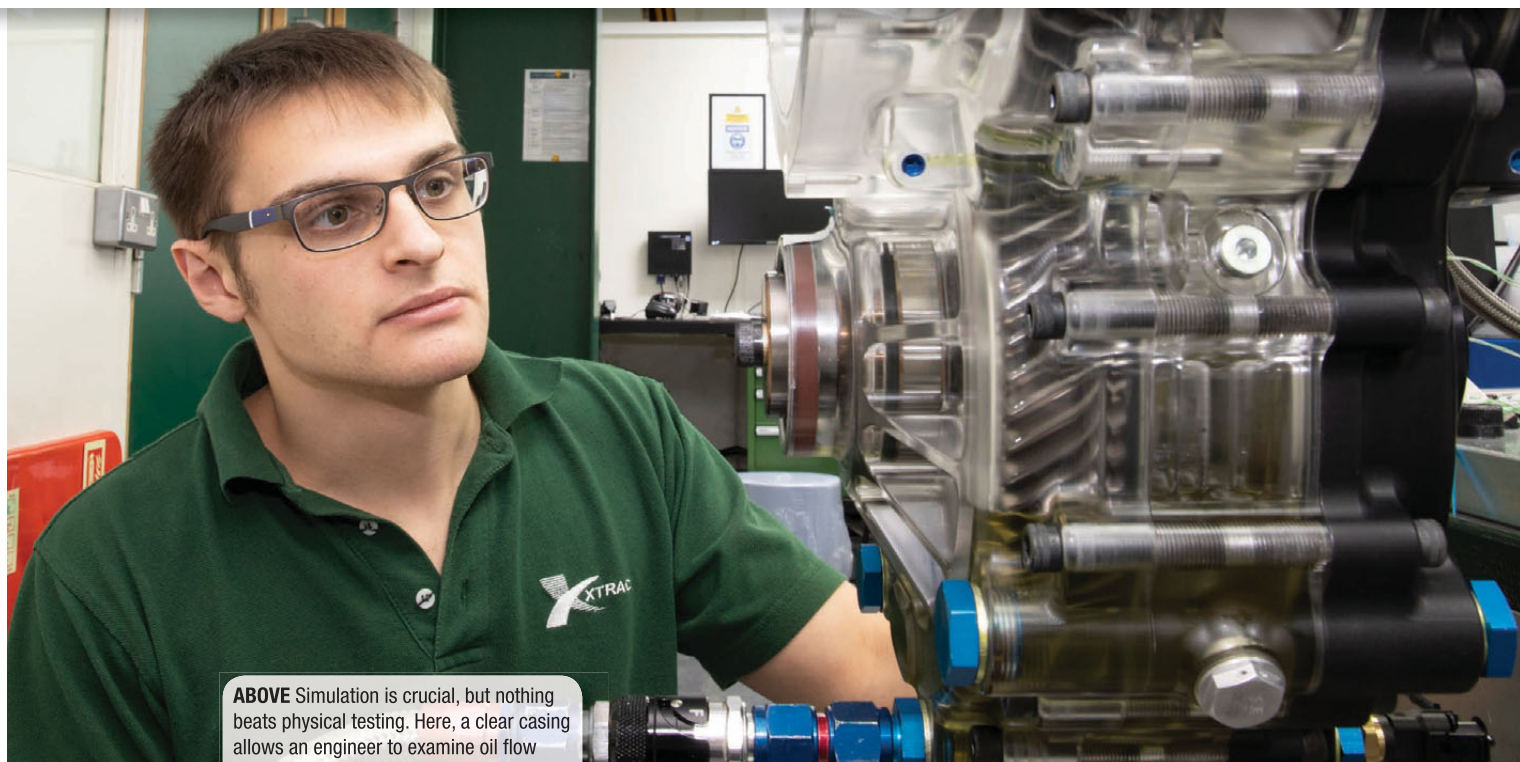
"When you look at rallycross, you have an abundance of energy, because the races are so short, you have very little grip and very high shock loads, so it is a completely different application in terms of the duty the transmission will see."

"So, it is really trying to hone in on what kind of duty cycle we are trying to achieve with the transmission, what standard parts we can use which help get the costs down, and help with spares prices and make the spares freely available."

Although Moore emphasises that FIA contracts aren't given out solely on a cost basis, he explains that it has been a key concern. Because of this focus, Kreisel is able to offer the powertrain kit for 300,000 euros, with an additional 100,000 euros for four years of support, which is actually cheaper than the internal combustion alternatives. ▶



ABOVE Although Xtrac has experience with electrification in other series, Rallycross's unique loads require new solutions



ABOVE Simulation is crucial, but nothing beats physical testing. Here, a clear casing allows an engineer to examine oil flow

Impressively though, Xtrac has still been able to offer a highly optimised design, and has avoided falling into the trap that some companies which win a standard part supply contract fall into, of allowing the weight of parts to creep up because of the lack of competition.

The level of technical development that has gone into the P1316 is also likely to bring benefits further in the future, as the new transmission serves as a platform which could, one day, take on additional duties in other series.

"We are already involved in the hybridisation of the British Touring Car Championship, which, when it launches will be the first hybridised whole vehicle series at that level, and obviously that is a big step for the electrification of motorsport," says Moore. "But our e-WRX transmission could be broadly suitable in future touring car applications as well."

"In fact, that would really see history repeating itself, because if you go back to the early days of Xtrac in the '80s, our first touring car gearboxes were really just the rally gearboxes with some different gearing in them."

"There are obviously some different requirements, and differences in things like top speed, but there is nothing to stop it being used in other applications as well."

What's more, the move in motorsport led by electric rallycross to increase standardisation of the electric powertrains, and in turn reducing the costs of competition, could well have an impact on

the wider automotive world; the opposite of the current state of affairs, suggest Moore.

"We are already very heavily working in the electrification pipeline of automotive hybrids and electric vehicles, and at the moment, motorsport is to some extent following the automotive world really."

CHANGING TIMES

"This has been the case for a while now. Formula E has been established for a good few seasons by now, and obviously Formula 1 has been hybridised for a while, but they are all at a very high technology level and reasonably free in terms of

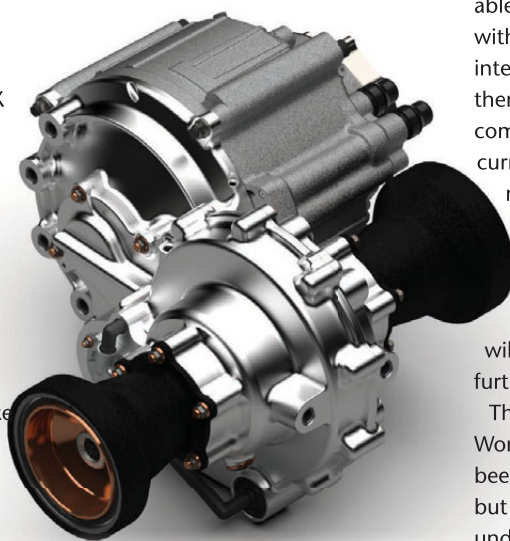
regulation. In LMP1 and F1 in particular, very high technology is allowed.

"But it will change, technology is becoming more restricted to keep the costs down. It then goes across a whole grid of cars to bring down the costs even further, and then you will gradually just see over time the electrification of more and more motorsport. That is if the industry can solve the big issue, which is the battery cost."

"Battery technology and cost availability is still the big challenge to electric motorsport."

e-WRX is going to see the light of day next year, when manufacturers will first be able to race the Kreisel spec powertrains with Xtrac e-axes in competition against internal combustion engined rivals. Before then, however, on Xtrac's side, it must complete the first prototypes which are currently underway and subject them to a rigorous testing schedule. This will first be done at the company's in-house transmission test rig, where the duty cycles of rallycross will be simulated, after which the complete powertrain will move on to on-car testing, where further optimisation will be undertaken.

The journey to the electrification of the World Rallycross Championship may have been more difficult than initially hoped, but now, with the technical process well underway and a firm commitment to start racing next year, the world will finally get to see what a standard electric package, at the top level of rallycross, can do. **LT**



ABOVE Although designed for rallycross, with some minor changes the P1316 could easily be used in other disciplines, such as Touring Cars

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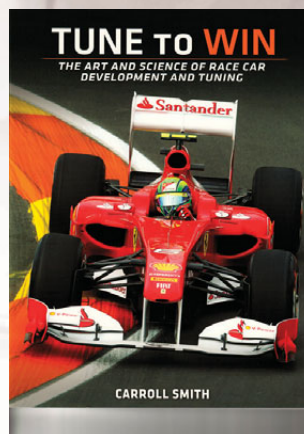
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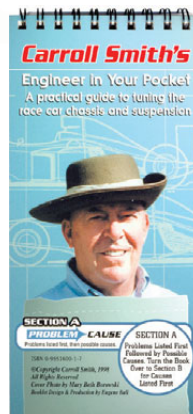
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INTO THE UNKNOWN

Hal Ridge finds out how Prodrive is approaching the fulfilment of a long-held ambition: competing in the Dakar Rally

NOT only has legendary British motorsport engineering firm Prodrive achieved success around the globe, but it has done so in an expansive range of events and disciplines. Be it overcoming some of the world's greatest tracks in circuit racing, the most challenging terrain that stage rallying has to offer, or the high-tempo bump and grind of rallycross, the Banbury squad has seen it all. Well, almost.

Under the watchful eye of engineering guru David Lapworth, the man who has overseen many of Prodrive's most successful creations, behind closed doors in the UK the firm is currently developing a brand-new car for an event it hasn't contested before: the iconic Dakar rally.

The new project is a collaborative effort between Prodrive and the Bahrain Mumtalakat Holding Company, the sovereign wealth fund of the Kingdom of Bahrain. As yet details are scant beyond the fact that two cars will initially be built and run from Banbury, before further customer cars are produced.

While Prodrive's stellar CV places it well

for taking on a new challenge at the legendary event, it's one that hasn't been underestimated by Lapworth.

"The first challenge for us is balance of performance," he says. "I don't mean in the GTE sense, but in the sense the terrain at Dakar is so varied: how do you strike the right balance between prioritising the dunes over the rocky sections, over the rally-type tracks?"

"Before we got down to the real nitty gritty, we started to judge the balance of performance between two-wheel drive and four-wheel drive. Where do they gain? Where do they lose? All those judgements about how you prioritise what I would call the normal performance factors for any race car or rally car, things like centre of gravity, weight distribution, ride height, cooling vs performance, all those things."

Unlike many divisions in high-profile motorsport – World Rallycross aside – the regulations for the Dakar's headline T1 category are fairly open. As Lapworth references, that is even down to the number of driven wheels. ►





“There’s no one ‘quick win’ because we’ve had a bright idea that no one else has ever thought of”

ABOVE Prodrive International, a new joint venture, is developing a car for one of rallying’s ultimate challenges

“We’re not going to be a Brabham fan car; it turned out to be more about a hundred details”

Creating a four-wheel drive concept has obvious traction benefits, but is limited to 275 mm of suspension travel, while a two-wheel drive machine can have unlimited suspension length. The four-wheel drive cars also have a higher weight limit, a figure arrived at via an engine capacity calculation, but in layman’s terms, there is around a 600 kg difference.

While regulations state that the engine has to be based on a mass-produced unit, but is thereafter free, the four-wheel drive machines are mandated to have a smaller air restrictor. The two-wheel drive buggy-based concepts also benefit from remote, on-board tyre inflation and deflation, to better deal with finding traction in the hardest of terrains.

“It’s judging what the best compromise for each condition is and putting those all together,” notes Lapworth. “Although we’ve got years of WRC experience, WRC at least tends to put the conditions together rally by rally. Snow in Sweden, rough gravel in Greece and Tarmac in Corsica. A stage of Dakar is massively varied. It’s quite a difficult call when you don’t have much data to go on to choose that right balance. We had to do a lot of work to try to understand where

the sensitivities were and how they balanced out on a very varied route.”

With a clean sheet creation, the open nature of the T1 regulations could lead to the assumption that Prodrive has had free rein with the Dakar project, in a similar way to the radical Renault Megane rallycross Supercar it developed for the GC Kompetition squad ahead of the 2018 season.

In fact, with restrictions on wheelbase,

roof height, minimum weight and a requirement on fuel capacity, Lapworth says the rules have significantly shaped the new machine’s fundamental design.

“Once you apply the constraints of what is involved, you start to realise it’s actually pretty tough. Decision by decision, it turned out to be more about a hundred details, than easily coming up with radical ideas,” he reflects. “Because the Dakar is such a breadth of terrain and the cars are so big and heavy, although there doesn’t seem to be that much regulation, it’s surprising how little there is left to play with.

“We came to a conclusion that it’s ▶

BELOW The company’s WRC experience will help, but the Dakar’s terrain changes from one extreme to another within the same stage



BELOW The Middle East is familiar territory for Prodrive, having begun its motorsport journey there in 1984



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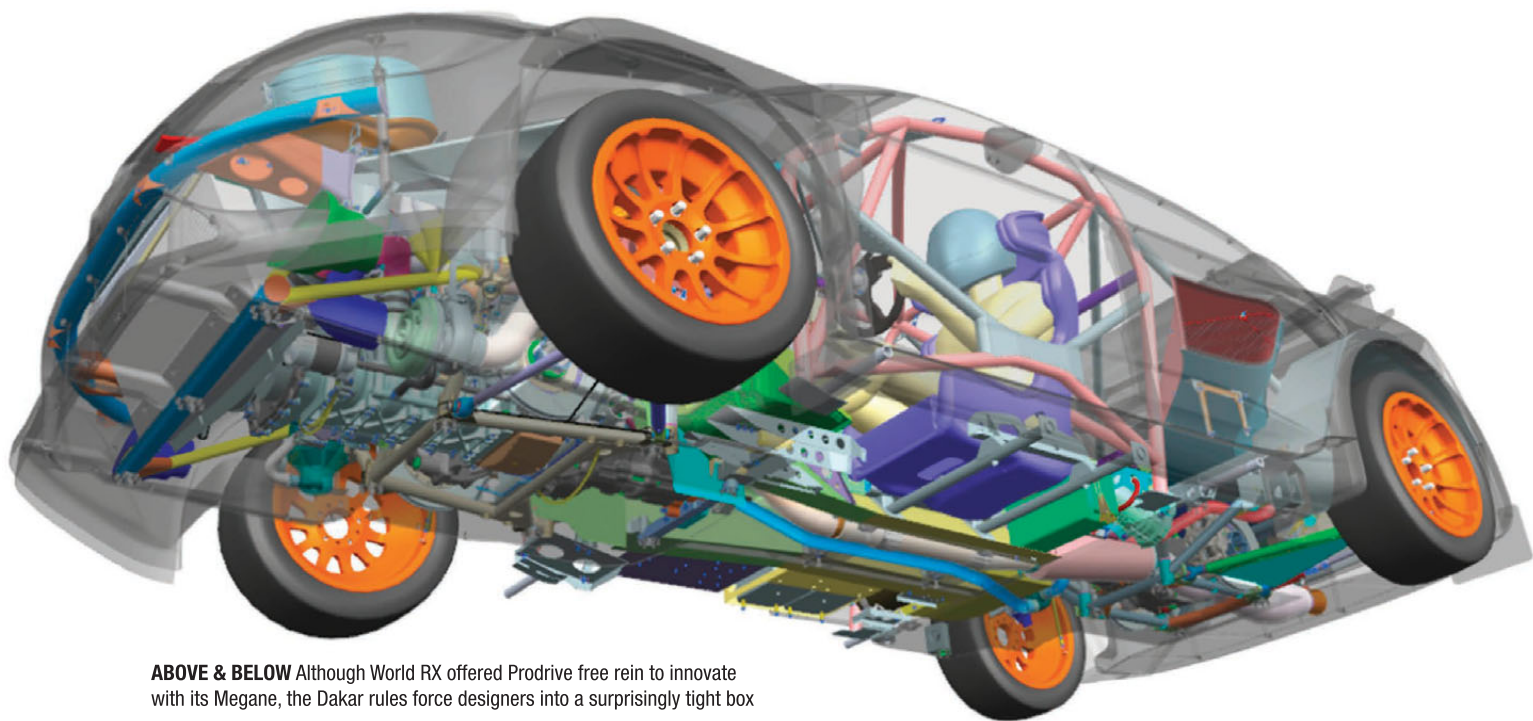
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ABOVE & BELOW Although World RX offered Prodrive free rein to innovate with its Megane, the Dakar rules force designers into a surprisingly tight box

not about coming up with some radical idea: we're not going to be a Brabham fan car; it's about trying to make sure that we choose the right engine, the right transmission, getting the suspension geometry right, with the right targets for all the suspension and so on, rather than any one quick win because we've had a bright idea that no one else has ever thought of. We certainly couldn't see any major opportunity to do something radical."

One thing that could play in Prodrive's favour though, is the Dakar's recent move from its traditional home to the Middle East and Jeddah, Saudi Arabia. Of course experienced rally-raid squads like X-raid and Toyota took part in January and will have gleaned a degree of data, but it's understood that the route will change significantly ahead of the 2021 event. In any case, it's not like in the WRC where the same stages are run year-on-year.

"The downside is there are even more unknowns [of the event being in Saudi Arabia]," he muses. "But on the other side, it's fair to say the Middle East is pretty familiar territory for us. We've done plenty of rallying in the Middle East, so we have a pretty good idea of what it's like. We felt that in terms of trying to guess what the conditions are like, at least we're on a level playing field."

Deep in the archives of Prodrive's past, its first ever event, at the Qatar

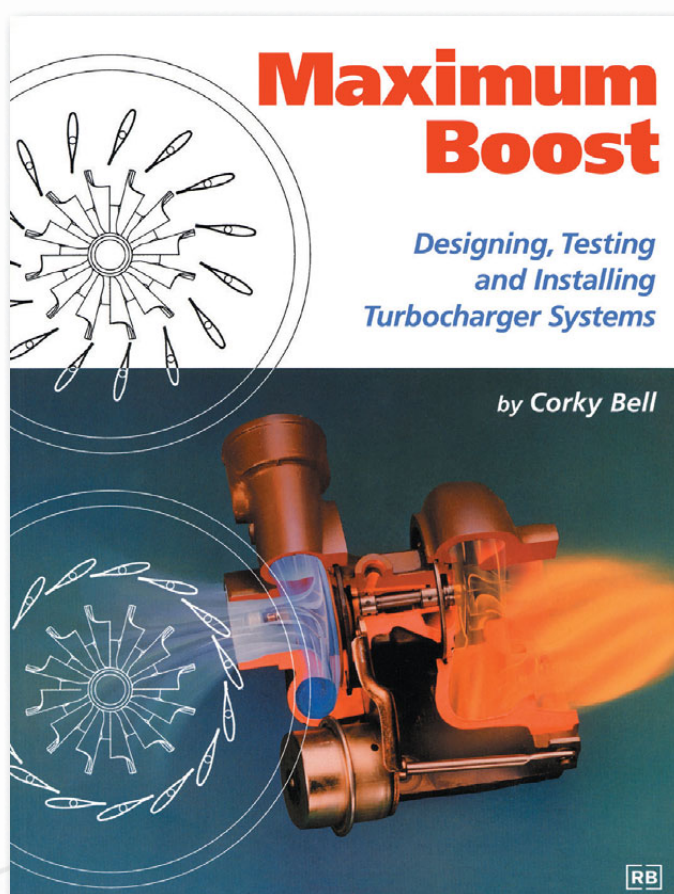
International Rally, resulted in victory on January 27 1984, with a Porsche 911 SC RS piloted by Saeed Al Hajri. While the currently nameless new car for the latest venture into the Arabian wilderness is a fresh challenge, Lapworth admits some

route knowledge would help sway the design: "You don't know what percentage of dunes or gravel tracks; you don't know what you're going to be faced with stage by stage or averaged out over the rally. That's the biggest unknown."►



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Prodrive Legends rekindles glory days

In addition to tackling new challenges, Prodrive has responded to increased demand to cater for iconic cars from its past

PRODRIVE recently created a new arm of its firm, Prodrive Legends, dedicated to the authentication, restoration and support of competition cars created within its walls since 1984.

In total the company has built more than 1,100 race and rally cars, while its record stands as having competed in nearly 1,200 events as a works team, winning more than 300 of them and finishing on the podium nearly 500 times.

Of the more than 700 Subaru rally cars, including nearly 100 Impreza and Legacy Group As and 160 Impreza World Rally Cars that Prodrive has built over the years, they are mainly for private customers, not works teams. In the 1980s the company also built 40 BMW E30 M3s and, more recently, nearly 50 Aston Martin racing cars based on the DB9 and a further 180 on the previous generation Vantage.

"We have been increasingly getting people come to us to check the provenance of the cars we originally built, so we offer a fixed price service to do that," says Paul Howarth, director of operations – motorsport, who heads up the new operation. "However, we are now offering to restore them too as we have the people, knowledge and facilities to get them back to their original condition and livery as they were when they originally ran with us as Works cars. We're working on our first cars now, which includes a Solberg Impreza WRC and rebuilding engines for the DBR9s which are starting to race in historic."

"If a client would like to own and compete with an original Colin McRae World Rally Championship car, we can advise on the purchase and rebuild it to precisely the specification that Colin raced that very car in – using factory records and many of the same technicians – as it was in-period, when their car was driven to victory by one of the great heroes of motorsport."

"We have created Prodrive Legends to give collectors and investors the opportunity to meticulously and faithfully restore these cars to their original glory and realise their potential."

"Quite simply, there is nobody in a better position to rebuild a Prodrive car – we literally know them inside out and many of the people we have on the Prodrive Legends team built the cars originally. Many of these cars have become highly desirable to collectors and so the market for ex-Prodrive Works cars has grown significantly." **RT**



ABOVE Who better to restore a Subaru than the tech team behind its rise to iconic status in the first place?

BACK TO THE FUTURE

While that uncertainty must be incredibly frustrating for those sitting in a design office on the side of the M40, in some respects it's almost like the good old days. The Safari Rally returns to the WRC this year, but let's face it, it isn't going to be the challenge that was presented to European teams heading to the event in the 1980s. As such, with data acquisition such a fundamental part of modern motorsport vehicle design, while of course Prodrive's boffins will deploy all of their knowledge to build the best machine possible, they need to create something capable of overcoming whatever is thrown at it.

"The other difficult thing to call is the sort of balance between the reliability and performance," says Lapworth. "Things like cooling margins, strength of suspension components, bodyshell and so on, versus



BELOW Bahrain sponsored the winning car in this year's inaugural Dakar Rally in the Middle East. Next season it will compete with its own team



low mass, low centre of gravity and all the rest of it. Striking the right balance between out-and-out performance and safety margin and so on."

As has become expected, Prodrive is being very astute and playing its cards close to its chest about the entire Dakar programme. That includes where it is currently at in the design

and manufacture process, but it can be assumed that it's pretty far down the line, especially as the journey to the Middle East is only seven months away.

"At the moment I'd say we're almost bang on where we said we wanted to be at this time," reports Lapworth. "I always talk about spending the time to sharpen your axe. You know, the thing about

chopping down a tree and spending half the day sharpening your axe – with one of these projects, judging how you balance when you make the call, 'Okay, we have to stop doing the research now, we have to stop doing the simulations, we have to stop playing around with different concepts; we need to get on with the design, finish the design, get on with the production, then we need to get on with testing.' Making those calls when you're doing the first one is difficult. When you're an F1 team and you've done the same process for 30 years, it comes as second nature, it's a relatively straightforward process, but with a completely new project it's been quite a delicate line. We won't know if we've got it right until the end."

Based on its previous endeavours, it's highly unlikely that Prodrive will have done anything other than be very close to getting it right first time. **TI**

Photos: Red Bull



ABOVE Finding a compromise between a car that works well on the dunes or WRC-type terrain is essential

A TALE OF TWO WHEELS

X-raid is back to winning ways on the Dakar Rally with the MINI John Cooper Works Buggy. **Chris Pickering** discovers the secrets behind the success

If there's any environment in motorsport where you'd expect to find four-wheel drive cars leading the way, it's surely the Dakar Rally. With 5,000 km (3,100 miles) of special stages, ranging from boulder fields to sand dunes, it would be enough to defeat even the most hardcore road-going SUV. And yet, the MINI John Cooper Works Buggy that won this year's event is resolutely two-wheel drive.



ABOVE Victory vindicated X-raid's decision to develop a two-wheel drive MINI John Cooper Works Buggy

That's not a new thing, of course. Peugeot dominated the event for much of the last decade with its two-wheel drive family of 2008 and 3008 DKR models. But X-raid's decision to develop the two-wheel drive Buggy in 2017 was significant, because it came from a company that already had a very successful four-wheel drive programme with the MINI John Cooper Works Rally (referred to by the team simply as 'the MINI').

This background gave the team first-hand experience of the sometimes-contentious performance balancing measures that exist in the Dakar rules. There have long been concessions for two-wheel drive cars, including greater suspension travel, larger wheel diameter and reduced weight limits. For a long time it was assumed that these would not go far enough to overcome the four-wheel drive cars' inherent traction advantage, but not everyone was convinced.

"Around 2013, I said to the FIA that they would have to do something to stop

the two-wheel drive cars if they didn't want to see them winning," recalls X-raid team principal Sven Quandt. "At the time everybody was smiling, but I said, 'You'll see, someone will come with a really fast two-wheel drive car and win'. In the end, it didn't even take two years for Peugeot to do exactly that."

The next few years did see a series of attempts to curb the two-wheel drive cars' advantage. In particular, the decision to increase the wheel travel on the four-wheel drive cars from 250 to 280 mm helped significantly. Nonetheless, it was felt that two-wheel drive still offered the better balance, so X-raid began working on its own rear-wheel drive buggy.

"There are three key incentives for adopting two-wheel drive," explains Quandt. "The first benefit is the wheel travel, which is basically unlimited on a two-wheel drive car (the only real constraint is the angle of your driveshafts). Next, you have a significant reduction in weight – from 1,850 kg to

1,580 kg. Plus, two-wheel drive cars can carry a tyre inflation system, which allows you to adjust the tyre pressure from inside the cockpit."

The general consensus is that these attributes all combine to give the two-wheel drive cars a slight benefit overall. However, their advantage is by no means unassailable, Quandt explains: "You can lose a lot of time when you get stuck – and you will still get stuck. In a four-wheel drive car it might take five to 10 minutes to get free. Anything under 10 minutes is virtually impossible with two-wheel drive and it could be as much as half an hour. That's the biggest disadvantage. Also, if you're on a twisty stage it can be harder to put the power down. Ultimately, it's the person laying out the route who decides which type of car should do best on that particular stage."

The general rule of thumb is that two-wheel drive cars tend to do well as long as they can maintain a high average speed. Not surprisingly, it's when the ►



ABOVE External aerodynamics play an increasing role in the design of Dakar cars

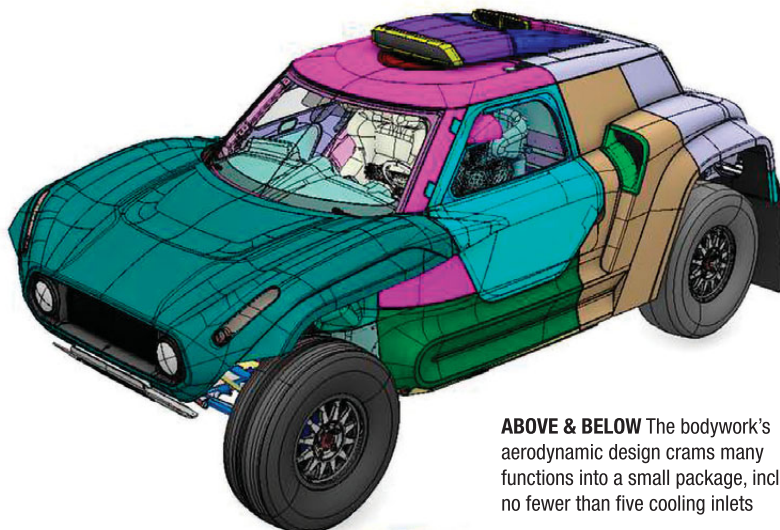
car begins to lose momentum that four-wheel drive comes into its own. This year, for instance, the two-wheel drive cars tended to fare slightly better on the second week of the Dakar. It would most likely have been the other way round on the first week, Quandt points out, had the four-wheel drive teams not struggled slightly with unrelated problems.

A NEW LAYOUT

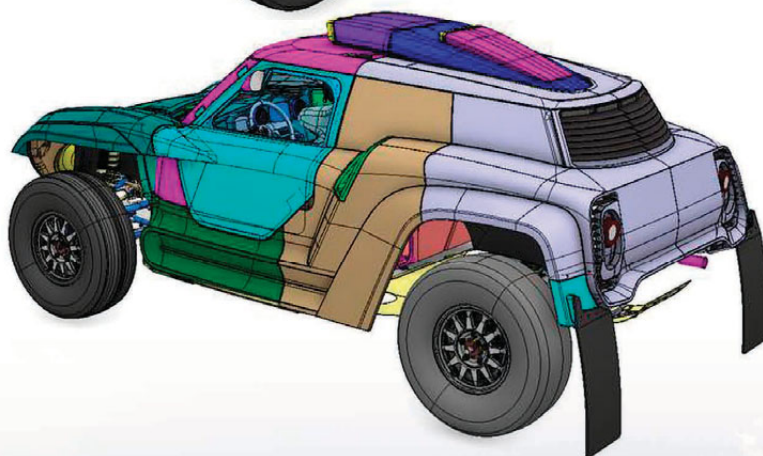
The Buggy is a significant departure from the four-wheel drive cars (which X-raid also continues to run). Both are based around spaceframe chassis, with the only real link to the road-going MINIs being the styling of their carbon-Kevlar bodywork, which comes from French composites specialist Faster Racing.

Aside from the switch to two-wheel drive, one of the most significant changes is the decision to move the engine from the front of the car to the back. When you think about it, this is an obvious choice – it eliminates the need for a propshaft or a transmission tunnel, it reduces frontal area and it places a significant chunk of mass close to the driven wheels.

Structurally, the two chassis follow a similar concept. Both use a tubular steel spaceframe, fabricated by the team's longstanding technical partner CP Autosport. What's more, they tend to be reinforced in similar areas to cope with the loads. The front ►



ABOVE & BELOW The bodywork's aerodynamic design crams many functions into a small package, including no fewer than five cooling inlets



“It's too soon for a hybrid or hydrogen vehicle. But it might be possible in 2022 or 2023”



ABOVE Ride height can be adjusted over a range of nearly 50 mm, offering a low-slung setup or extra clearance

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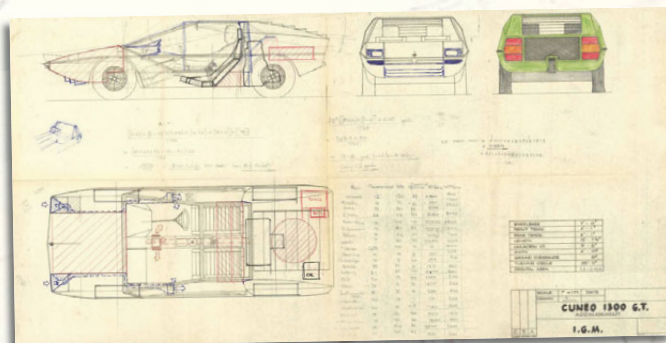


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ABOVE The weight of the giant BF Goodrich balloon tyres might hurt, but they help absorb a lot of the impacts

“Small details matter. Last year we had a fault with the tyre inflation system. It was a part that cost a few euros”

structure around the suspension pick ups, for instance, is very similar, despite the Buggy's rear-engined layout.

Both use the same double wishbone concept for their suspension. There are detail changes to the geometry – not just to accommodate the Buggy's greater wheel travel, but also to tune its anti-dive and anti-squat characteristics. Another departure is the use of a single Reiger damper on each wheel, as opposed to the twin units seen on the MINI.

“We had wanted to run single dampers on the old car, but with the weight [of the vehicle] it simply wasn't possible,” notes Quandt. “With the Buggy we were able to save 70 kg by running single dampers – which is a big advantage – and we don't need to carry as many spare parts on the support vehicles.”

The structural design of the suspension is actually simplified somewhat on the Buggy. That may sound somewhat counterintuitive, given the big wheels and tyres, which weigh 50 kg combined (as opposed to 35 kg). However, those giant BF Goodrich balloon tyres help

to absorb a lot of the impacts. More importantly, the cars themselves are significantly lighter.

Compared to the MINI, the Buggy's wheelbase is slightly longer, with the front wheels pushed right out to the nose. Consequently, there is now almost no overhang at either end. This gives the

Buggy fantastic approach and departure angles. The ride height can be adjusted over a range of about 50 mm, to give a comparatively low-slung Baja setup or to raise the car up for extra clearance. The damper settings can also be changed to compensate for additional fuel load, but generally the changes are kept as small as possible. “Due to the character of the events it needs to be a well-rounded car that's happy with a wide range of conditions. We change very little from one stage to another,” notes Quandt.

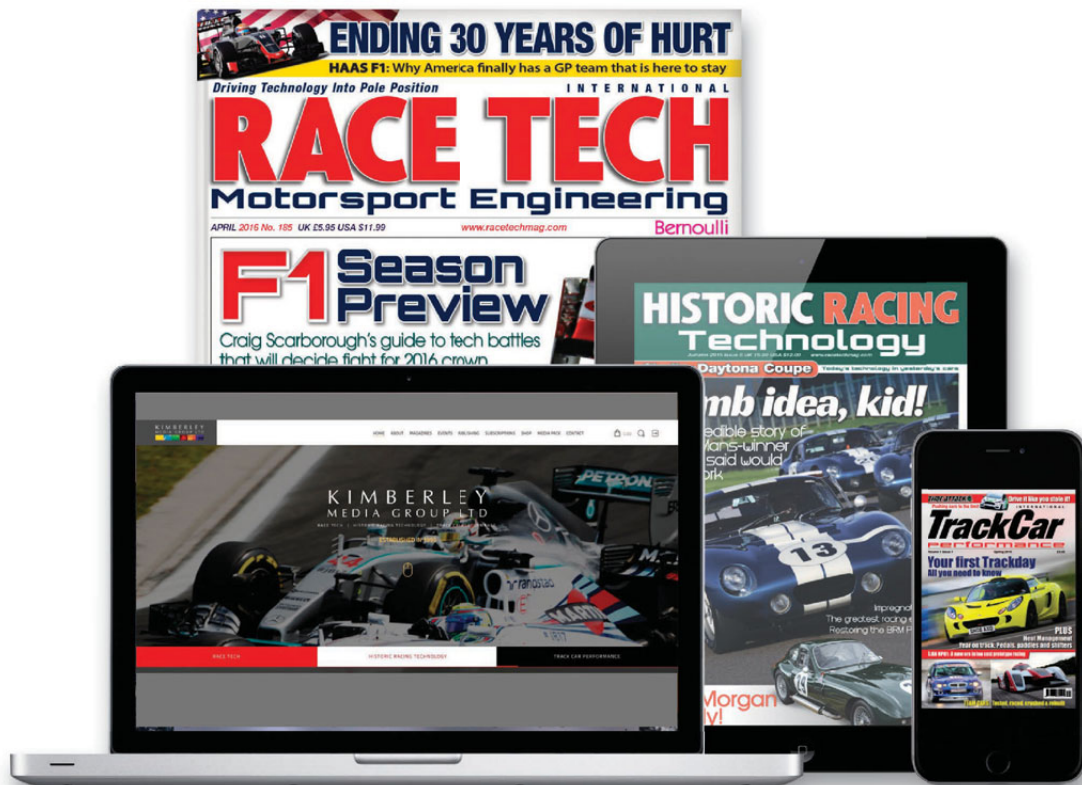
POWERTRAIN

One aspect that's very similar is the engine. The unit used in the MINI was prepared by Alpina, while the Buggy engine comes from BMW Steyr, but both are based on the same BMW 550d production diesel engine. Internally, they are essentially unmodified, with the stock reciprocating assemblies and the standard 2,993 cc capacity. The biggest difference is the turbocharger layout, with twin turbos on the MINI and a single unit on the Buggy. Other hardware changes include different fuel injectors, a new oil pump and a bespoke exhaust system from Akrapovic.

Conventional logic states that a twin turbocharger configuration would tend to give better drivability, but that doesn't necessarily translate into the world of rally raid competitions. Here, the extra low-rpm torque provided by a twin turbo engine can actually become a hindrance on a loose surface. ►



ABOVE Some 70 kg is saved by running single dampers



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"We used a twin turbo setup on the Buggy for the first year, but we realised that it was too heavy," comments Quandt. "What's more, we were getting wheelspin even in fourth gear. Why carry around a second turbo if you can't use it? After we changed the Buggy we also changed two of the MINIs over to single turbo."

The throttle mapping is also substantially different between the two cars. On the four-wheel drive MINI it's more aggressive, while the Buggy uses a slightly softer throttle map to reduce wheelspin. The single turbo offers less torque, but produces slightly more power. Officially, both engines are rated at 350 bhp (at 3,500 rpm) and 770 Nm (at 2,150 rpm).

Both cars use the same AP Racing clutch, but the driveline is completely different from there onwards. The Buggy's transaxle is custom made by Xtrac to the team's own design, while the MINI uses a customised version of an off-the-shelf Sadev gearbox. Both are six-speed units, with GKN driveshafts.



ABOVE A lot of controls are crowded into a small space, but stricter rules governed navigational aids this year

KEEPING COOL

Cooling on the Dakar is not as problematic as it once was, but it remains a significant factor in the design. X-raid's earlier cars all use 'visco fans', driven mechanically from the engine with a viscous coupling. The team's engineers had previously looked at using electric fans, but it proved impractical. For the Buggy, however – with its engine at the back and the radiators at

the front – there was no other option. This required a completely different approach to the thermal management of the car.

Aerodynamicists from Bavarian company KLK Motorsport were drafted in to work on the development, which was carried out entirely in CFD. The design they came up with allows the car to run with electronically-controlled fans, which consume less energy overall than the old viscous design. "It's something we never ►



ABOVE The danger of a two-wheel drive package is that a large amount of time can easily be lost if a car gets stuck in the dunes

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ABOVE Reliability is crucial, with cars carrying the minimum of spares once they leave service

would have done if we hadn't switched to two-wheel drive [with the engine at the back]," notes Quandt. "But it works so well that we've now applied the same system to the latest version of the MINI."

External aerodynamics are playing an increasing role in the design of Dakar cars too: "Back in the days of the BMW X3 CC and even at the start of the MINI programme it wasn't really something that we looked at especially closely. Now, it's a much more important aspect," he notes.

The Buggy's roofline is fractionally lower and the windscreen is far more steeply raked than that of the MINI. Overall, the bodywork is a very neat piece of aerodynamic design that crams a lot of functions into a small package. Outwardly there only appear to be two air inlets into the engine bay – the snorkel air intake behind the cockpit, and the smaller scoop piggybacked behind it – but, in fact, there are no less than five different inlets. "The aerodynamic development was a big learning curve for us," admits Quandt. "We would never have thought to use some of the ideas that have worked really well."

INSIDE

Building a rally car is just the start. Next you have to cram it full of equipment. Two trip meters are used. Both are normal rally-style units, although from this year the teams are allowed to use

GPS sensors to provide an input. The vast majority of the navigation, however, is still based on compass headings, distance travelled and the notes in the printed road book. Only when the car successfully gets to within a pre-set radius of the waypoints laid out by the organisers will the GPS system activate and display an arrow to guide the crews. Away from the waypoints, the GPS deactivates and can only be accessed in an emergency.

Since 2005, all Dakar vehicles have

“The cars tend to get lighter and lighter when you're fighting for the victory as you take out more and more things that you don't need”

carried a Sentinel unit. This is a vehicle-to-vehicle system that allows a driver or rider approaching a slower vehicle to warn them that they are about to overtake. Without this system, the car or bike behind can easily be hidden in a dust cloud. It also allows racers to flag up a stranded or broken down vehicle.

Each car typically carries around 30 kg of spare parts, plus approximately 10 kg of tools. There's also a compulsory medical kit, distress flares and seven litres of emergency water, on top of the crew's normal drinking rations. A sand shovel and two tow ropes are also included.

Deciding how much to carry is a tricky balance. Too little and you may risk a small

breakdown becoming a retirement; too much and the weight becomes an issue. For the Buggy, X-raid has gone with the bare minimum: a spare driveshaft so the car can continue to operate if one breaks, a few spare sensors and a small toolkit.

"In the MINI we carry a lot more parts," says Quandt. "The reliability has been really good – it has a reputation for being built like a little tank – but we're still a bit superstitious. We carry a spare driveshaft, even though we don't really need it; with a four-wheel drive car you can lock the differential and keep going with a broken driveshaft. The Buggy is different. Even on the marathon day we don't take a lot. The cars tend to get lighter and lighter when you're fighting for the victory as you take out more and more things that you don't need."

Ultimately, everything on the Dakar comes down to reliability, and it's the sheer scale of the rally that makes it so tough, with 7,900 km (4,900 miles) in total and some 5,000 km (3,100 miles) of special stages. "You can do a full day's testing and everything looks fine, but then you do a five-day cross country event or 12 days on the Dakar and suddenly it's a very different story," comments Quandt. "Usually it's the small details. Last year, for example, a fault with the tyre inflation system cost us the chance to fight with Toyota. It was a part that cost a few euros."

RETURN TO THE DESERT

The Buggy was introduced a few months before the 2018 Dakar Rally. Since then, the technical regulations and the ever-contentious balance between two-wheel drive and four-wheel drive have remained relatively stable. What has changed, however, is the location of the rally, which has moved 13,000 km and swapped hemispheres, from South America to Saudi Arabia.

"We loved the South American events, but in all honesty this is a return to a real Dakar," comments Quandt, who competed in the event as both a driver and a co-driver before going into team

management. "It's more challenging in a lot of ways. You have longer stages – the Empty Quarter in Saudi Arabia is so big that the only thing that really limits the length of the stages is the number of people who can finish before it gets dark. There's also plenty of variety in the terrain. The Northern portion around Jordan and the Red Sea has everything from sand dunes and boulder fields to winding tracks; further south, after Riyadh, there is camel grass, followed by flat-out sections of desert that are very similar to the high-speed stages through Mauritania on the old African route. It has everything."

The other major difference is the climate. Although the South American route took the cars high up into the Andes, it did so at the peak of the Southern Hemisphere's summer. January in Saudi Arabia, however, can be far colder. One stage this year even had snow just a few days after the rally had moved on. Despite this, the teams received a very warm welcome: "Everywhere we went, people were very welcoming and very inquisitive about the event. The first thing they always said was 'welcome to Saudi Arabia', even the police and the military."

Saudi Arabia is contracted to host the event for at least five years, which should offer some stability. There are no imminent rule changes on the horizon, either,

although the advent of competitions like Extreme E does beg the question of whether there might eventually be a move towards hybrid or fully electric vehicles.

"I think we will eventually see those technologies, but the question is when," says Quandt. "If someone was to turn up with a hybrid or a hydrogen vehicle in the next one or two years, I'd say it was very soon and I wouldn't be so sure it would last. But in 2022 or 2023, I think it might be possible. This is the sort of technology that I think we should only show when it's ready. We wouldn't do the industry any favours if we turned up with a new technology and it broke down."

At present, X-raid is busy running both the Buggy and the four-wheel drive MINI. The Buggy, in particular, is a relatively new addition and doesn't look set to bow out

any time soon. Quandt says he'd love to see something like a hybrid or a hydrogen fuel cell car for the next generation, but that's still some way off.

"We had four years without a victory [in the Dakar] and some years where we weren't even able to fight at all. That was too long for us, so we're happy to be back and we want to concentrate on the current cars for now," he says. "If we wanted to start a major new project [like a hybrid or a hydrogen fuel cell] I think we'd have to take a step back and maybe take a break for a year."

So there might not be any radical changes from X-raid in the next few years. And with the team now back on the top spot of the podium that's probably a shrewd move. For now, at least, the two-wheel drive MINI John Cooper Works Buggy rules the roost. **TT**



ABOVE The Buggy's wheelbase is slightly longer than the MINI, with almost no overhang at either end for improved handling

BEYOND MISSION H24

Chris Ellis believes the ACO's H24 initiative, bringing hydrogen-powered racecars to the Le Mans 24 Hours, should go further still

NEW regulations for the World Endurance Championship will soon come into force. They are spearheaded by a new class of 'hypercar', which should help to restore the original objective of Le Mans: proving which is the fastest road car round a track. 'Endurance' is just one of the qualities a car needs to impress those watching a 24-hour race, so the FIA Endurance Committee has issued this edict: 'Aerodynamics cannot take precedence over aesthetics', and the new regulations reflect this.

However, with the objective of containing costs, the new hypercar regulations specifically discourage the development of innovative powertrain components, and don't encourage, yet, the use of sustainable fuels produced using 'renewables' – solar, wind, etc.

The good news is that the rest of a typical hypercar should provide a fine platform capable of supporting a wide range of alternative powertrains and sustainable fuels. So this is the basic idea behind my suggestion for the creation of a new category, 'Formula R' – tight rules governing most of the car, but real room to innovate and *directly compare the results* when it comes to powertrains and fuels.

In parallel to this hypercar revolution, the ACO and FIA have launched 'Mission H24', introducing hydrogen-powered

racing cars to the 24 Hours of Le Mans in 2024, when a special class will be created for a zero-emission race. The initiative is designed to show the feasibility of fuel cells running on compressed hydrogen, with the suggestion that liquid hydrogen might also be allowed.

In some respects it is a motorsport 'moon-shot' and that is reflected in the ACO's assessment that "Mission H24 is not unlike the Apollo programme launched in the United States in 1961 and which,

after a series of test flights, achieved its goal of putting men on the moon in 1969. Similarly, there will be several milestones to reach before hydrogen-powered cars can race at the 24 Hours of Le Mans in 2024.

"Hydrogen is a public-interest choice: it is a global challenge that addresses some of the major issues of our time, such as urban air pollution, and the need to find new sources of fuel to replace conventional hydrocarbons."

Although the ACO's hydrogen initiative



ABOVE Electric taxis were the future as far back as 1897!



ABOVE The H24 project aims to speed up research and development on the use of hydrogen, with the ultimate aim of taking it from track to the road to achieve zero-carbon mobility

is a welcome one, it is for me too limited technically. Hence my suggestion that we should introduce 'Formula R'.

Packaging the large hydrogen tanks needed to provide sufficient endurance is one of the biggest obstacles designers need to overcome for H24 to succeed. It's an issue mirrored in the wider automotive sphere too. The need to provide such large cylinders to achieve the endurance required is just one reason why using a fuel with a much higher energy density is

preferable in almost any road car. And it's obviously desirable in a racing car.

The image of Audi's h-tron quattro shows the space needed for the hydrogen cylinders in a large SUV concept. The Toyota Mirai, Honda Clarity and Hyundai Nexo saloons have a similar layout, with even more of a space problem.

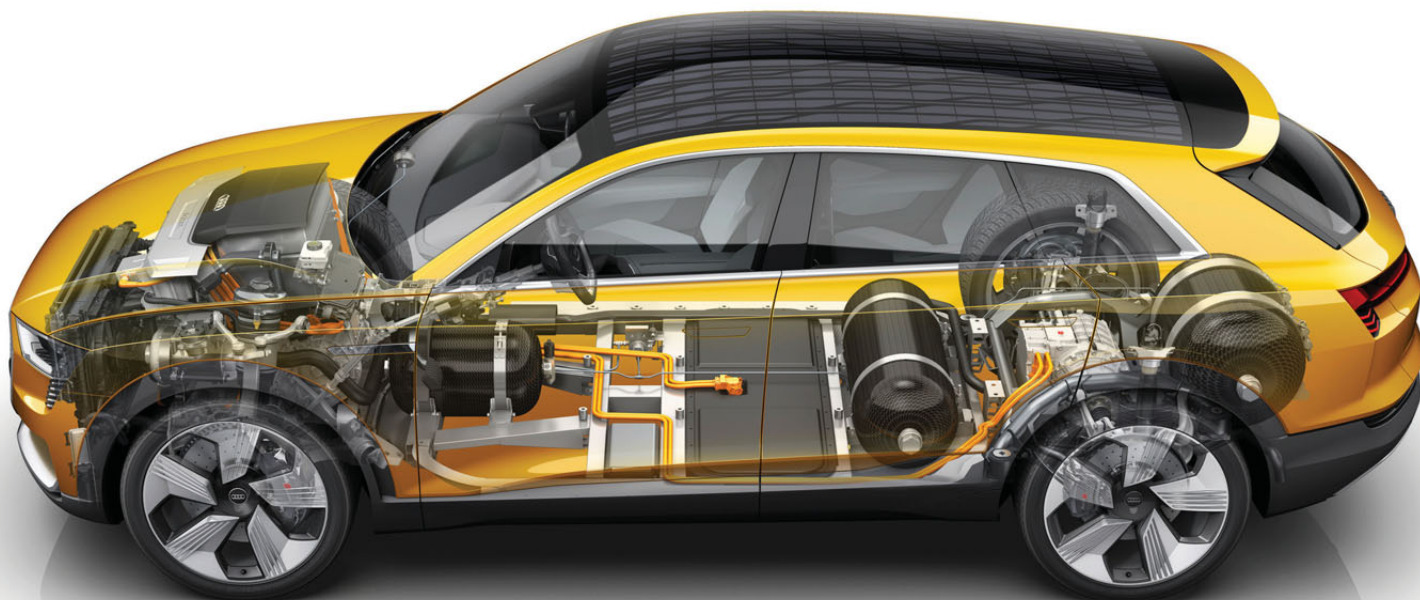
The resulting reduction in luggage space and rear headroom usually generates criticism in road tests, making high-density sustainable liquid fuels an obvious

attractive alternative. However, there is plenty of unused volume available under the beds of big trucks, so the economic advantage of compressed hydrogen when produced using solar with a bulk price of under two cents per kWh should make heavy-duty road vehicles the main global market for the direct use of hydrogen.

Liquid hydrogen has proved its effectiveness in space, where specific energy is paramount and cost matters little. But, even for large aircraft, it will require more storage volume than jet fuel, implying more drag and higher energy use. Also, the extra cost of liquifying it, and keeping it liquid, will undermine the simplistic arguments for it. And of course compressed hydrogen requires even greater volume, making it impractical in the air.

SUSTAINABLE FUEL

So, despite the fact that a renewable liquid fuel will inevitably cost more than 'green hydrogen' to produce because hydrogen will be just one of its two key ingredients, the value of the space saved will help to reduce the total lifetime costs in most light-duty vehicles. The BBC has just started its build-up to COP26 (the United Nations Climate Change Conference in Glasgow this November), and has already conceded that there is a strong case for compressed hydrogen rather than batteries in big trucks and buses. However, it does not seem to have realised, yet, that the lifetime cost of *untaxed* E85 in France ►



ABOVE Audi's h-tron quattro concept demonstrates the packaging issues facing designers

in a 'flexifuel' Ford Kuga is *already* only a small fraction of the total cost of running it, if it averages some 12,000 km a year. Say 500 euros per year.

Now cut that to around 300 euros, if it's powered by a fuel cell running on E85 or better. The BBC is still selling the idea that 'most cars should be electric', even if it has stopped advocating 'stick a battery in everything!' Hopefully, the media will soon explain that, by 2025 in France, most new 'family cars' could be powered either by batteries or run on a sustainable fuel. And my guess is – most owners will choose the convenience and lower overall costs of the latter...

But all of this needs proof, which is where Formula R could provide an ideal platform to establish the best, multiple, solutions, and demonstrate them side-by-side. In the end, it is likely to be the cost-per-mile over the life of the vehicle which will determine how each application is fuelled. This proved the case over a hundred years ago, when battery cars were selling almost as well as cars like the Ford Model T, then capable of



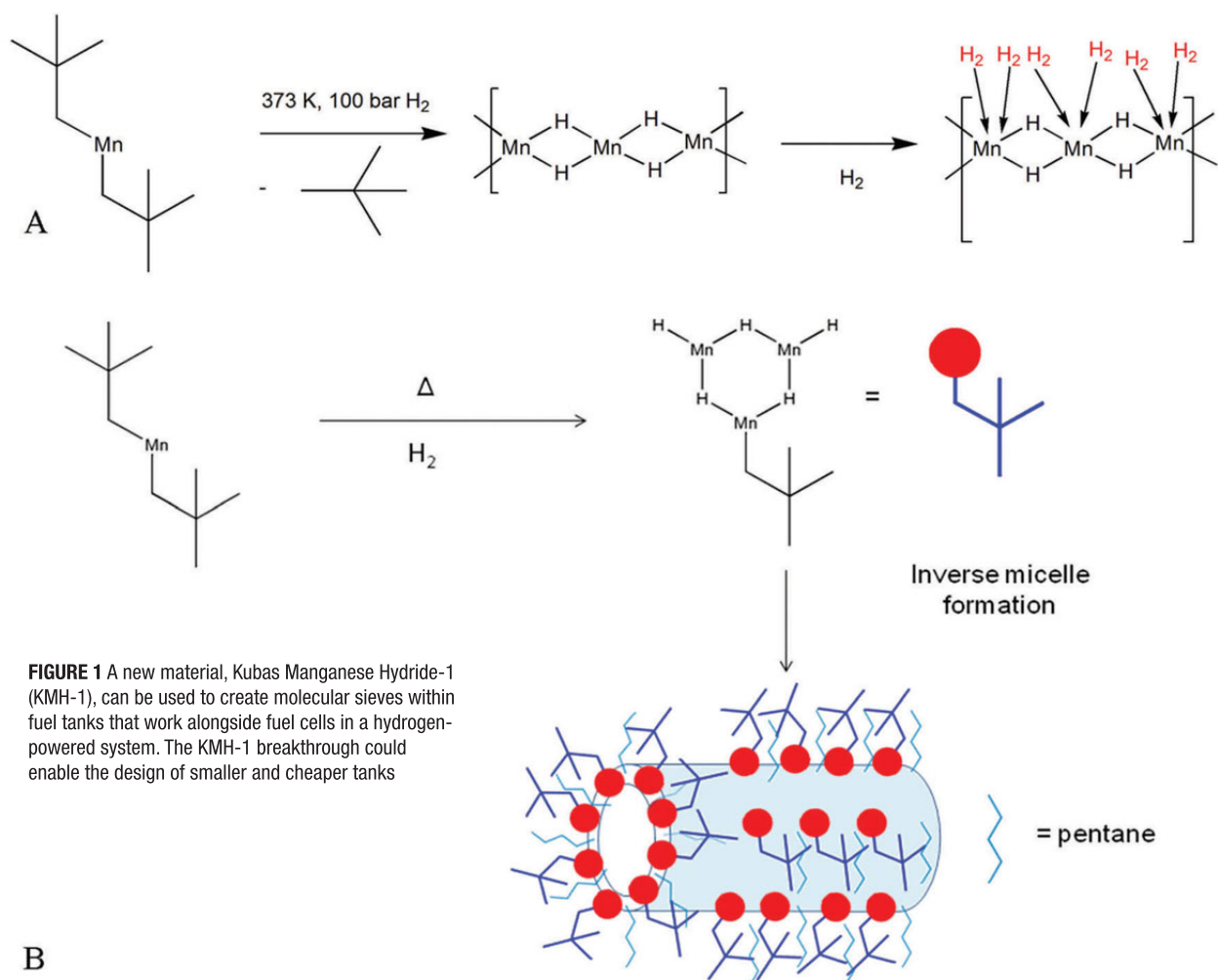
BELOW Refuelling of the hydrogen-powered LMP2HG betrays the difficulty of packaging the large cylinders. Recent technical breakthroughs offer the tantalising prospect of a radical downsizing of the storage tanks

running on ethanol or petrol.

Much though we tend to think of electric cars as futuristic, they were considered 'the future' as far back as 1897. Walter Bersey's electric taxis – featuring a top speed of 9-12 mph! – were the first self-propelled vehicles for hire on London's roads. And those early battery cars were almost as energy-efficient as modern BEVs. However, the arrival of cheap, untaxed, petrol swiftly resulted in battery-powered

cars disappearing from showrooms.

The battery lobby in the UK is happy to claim the running-cost advantages of cheap, untaxed, electricity over heavily taxed petrol, but doesn't seem to realise, yet, how low the cost of sustainable, untaxed, 'R85' will become. Already, E85 is half the price of diesel in France. Hopefully, the rest of Europe, including the UK, will follow soon. And then impose Road Usage Pricing (starting with new ►



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ABOVE Green GT's experimental LMP2HG has already shared the circuit – and pit lane – with conventional cars in the European Le Mans Series

than the residual value of the car when the battery eventually failed, or its range fell below 80%. And why would governments need to spend billions on recharging infrastructure if Big Oil was happy to upgrade existing filling stations? So here's a forecast: the 'end game' for many types of vehicles will be 100% sustainable fuels. What we don't know, yet, is – how much will be 'green hydrogen', and how much will be liquid fuels made from 'green hydrogen' and carbon dioxide extracted from the air? Let's begin to find out.

FORMULA R PROPOSALS

So what might Formula R look like? Ideally, the cars should conform to the WEC regulations for hypercars in all aspects except the powertrain. This would enable attention to be focused on developing technologically advanced powertrains.

For these 'hypeRcars', there should probably be an absolute limit on peak power, as there is for WEC from September. However, rather than adopt the complex power-limit curve relating instantaneous total power to engine rpm, the hypercar limit might simply be set at 580 kW. In WEC, the torque at each driveshaft is measured to calculate the combined power of the engine and the MGU-Ks (if fitted) – see Appendix 4b of the WEC regs. The power limit for hypeRcars should be measured in the same way, but should probably remain

electric vehicles, in 2023?) to level the playing field, and keep the massive taxes on cars flowing to help pay for the NHS – and reduce traffic congestion.

So a key role of Formula R could be to provide a 'training field', to prove which 'players' to pick, for which roles. 'Stick a battery in everything!' is an attractively simple mantra for politicians, but the readers of this magazine know better. There may be a big role for batteries in light duty vehicles, but when things get serious, other solutions (some of them liquid, naturally!) may prevail.

Here's an example of a novel way to store hydrogen which might soon feature in Formula R. Kubagen, a UK-based start-up, has discovered a new material that allows hydrogen to be stored in only a quarter of the volume of a conventional 700 bar cylinder. It works by exploiting a chemical process called Kubas binding that distances the hydrogen atoms within an H₂ molecule, without the need to split the molecule. (See Figure 1.)

The process works at room temperature and at only around 120 bar. The material also absorbs and stores excess energy, so external heat and cooling is not required. The big reduction in volume promises to solve one of the key problems in using hydrogen in passenger cars, and should also make bulk static storage substantially less expensive. Formula R may become an ideal way to prove it.

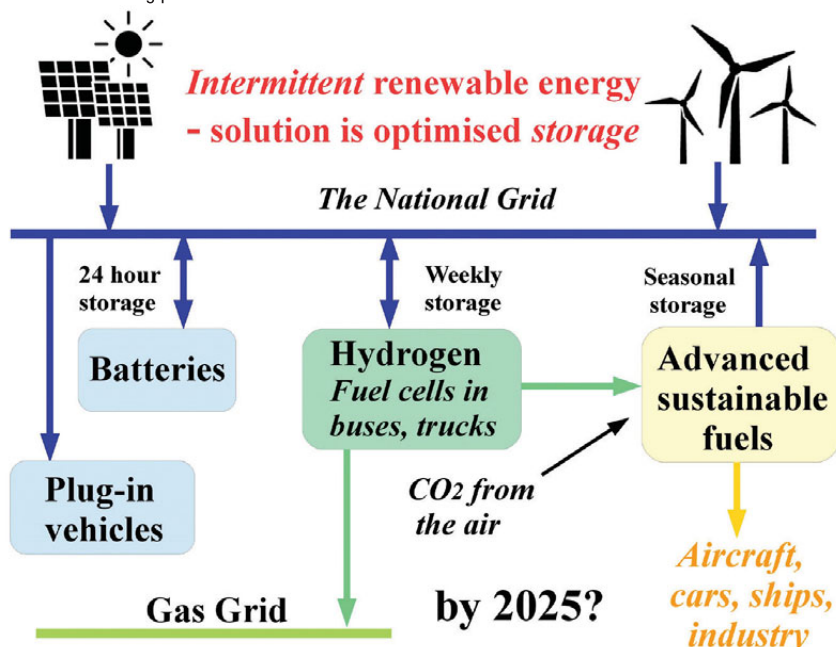
ECONOMICS WILL OVERRIDE ECONOMY

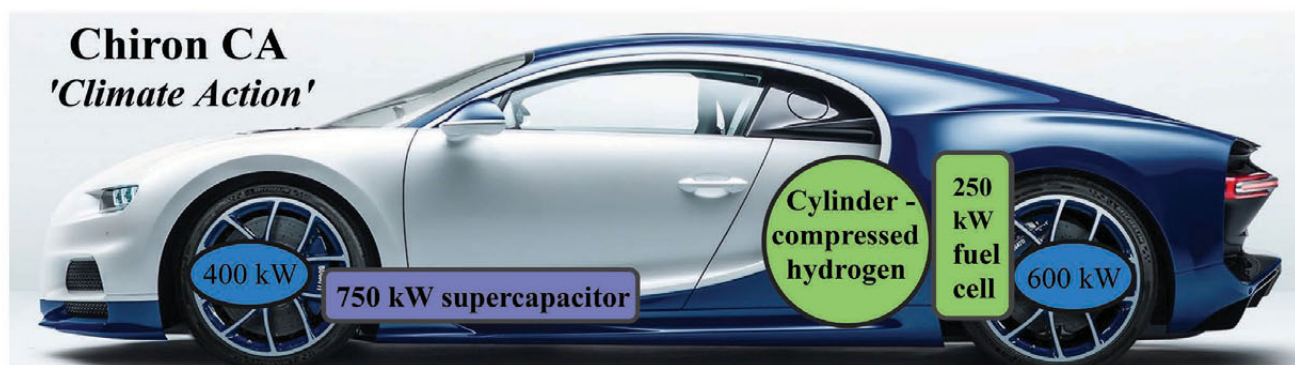
One argument frequently used by battery-only proponents against sustainable fuels is based on the fall in

overall energy efficiency as electricity from renewables is used in the various processes needed to produce a 100% sustainable fuel. This would make sense if the original source of energy was finite, like all fossil fuels, but sunshine is almost infinite, and free at source. So the real test is how much a 100% sustainable fuel will cost to produce in volume, supported by the additional value of almost instant and widely available 're-energising', and a small, light, low-cost, 'energy store' (usually called a fuel tank), which will normally last the life of the car.

Here is a simple test – if your car could run on a widely available net-zero-CO₂ fuel which cost half the price of diesel, why would you want an electric car? Especially if the BEV's battery cost more to replace

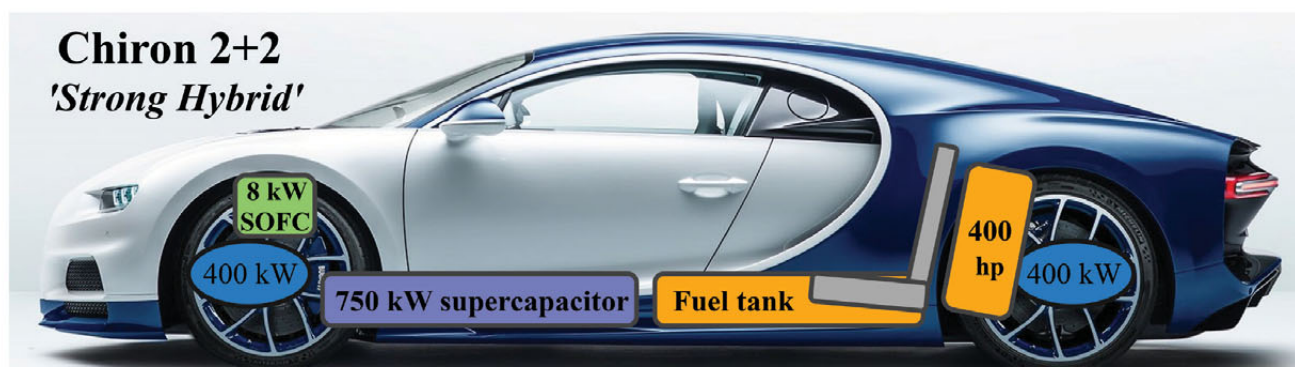
FIGURE 2 The big picture





1,000 kW, only 1,600 kg, 170 mph continuous cruise, 60 to 180 mph in 10 secs

FIGURE 3 Above, the obvious hydrogen configuration. Below, a 2+2 becomes feasible if a sustainable liquid fuel is used



1,050 kW, 170 mph continuous cruise, engine-off in town, 2+2

the same at all speeds. So hyperCars may be able to accelerate faster than 'ordinary' hypercars, if there is 'adequate' ERS power available, although their sustained top speeds will probably be similar. Which should suit most potential owners just fine.

There should be no limitations on the technology of the ERS, so any combination


hp at 10,000 rpm, and supported by two 150 kW MGU-Ks (one front, one rear), everyone might be delighted.

Or Ilmor might want to show everyone how effective a 5-stroke engine could be, running on sustainable E85... Perhaps using a transverse straight-six? With space for a large hydrogen cylinder between it

70% efficiency will dominate eventually, in the air, on the ground and at sea. But let's prove it, and help make it happen as soon as we can.

So, after each race or demonstration, the first six(?) cars could be checked for fuel consumption at a steady 130 kph, and tested for emissions, and the results could then be published online. And compared with the equivalent numbers for a 'conventional' WEC hypercar...

Should Formula R be the 'morning race', before each Formula 1 GP, or a sub-class of WEC? Or both? I sent Ross Brawn a draft of this, so you know my initial preference.

Bottom line: as electricity from solar continues to fall towards one cent per kilowatt-hour under the Sun Belt (which covers some 60%, and rising, of the world's population), the cost of producing sustainable fuels capable of powering most new cars built from 2021 should soon reach a price directly competitive with diesel, before tax. It is now up to governments to determine the taxes which will guide the motoring public to make the right choices. Formula R could inform them, and help them back the right 'horses'. 

“Formula R could provide an ideal platform to establish the best solutions and demonstrate them side-by-side”

of batteries, flywheels and supercapacitors will be allowed, subject to mandatory safety checks during homologation, before the cars are permitted to race. 'Power unit' technology may similarly be free, potentially allowing Pat Symonds to prove that two-stroke engines might be a future option in Formula 1. Or Cosworth might want to demonstrate that a 5-litre V12 running on hydrogen would be a real crowd-pleaser. Fitted with electric superchargers to ensure an over-abundance of air to minimise NOx, consequently delivering, say, 'only' 500

and the cockpit, for those who still prefer compressed hydrogen?

To emphasise the practical penalty of compressed hydrogen, Figure 3 shows two imaginary Chirons, one using compressed hydrogen, while the other is a 2+2, with a 400 hp transverse straight-six running on a 100% sustainable fuel.

Formula R is likely to develop into a 'Battle of the Fuel Cells' on the one hand, and 'Hydrogen versus Sustainable Liquid Fuels' on the other. Right now, I am guessing that SOFCs running on various types of 'renewables' at over

CREDIT CRISIS



Given that it is cheaper to buy Carbon Credits than to develop innovative technology, **Sergio Rinland** wonders which route F1 will pursue to become Net Zero Carbon

LAST November Formula 1 and the FIA announced a plan to be Net Zero Carbon by 2030. A tall order to achieve in only 10 years!

Now, the two have revealed they have become signatories of the United Nations' Sport for Climate Action Framework. It is a big commitment and stronger than just the statement of intent of the November announcement. I applaud the initiative; it was long overdue.

The task ahead is like climbing Everest! Motorsport, and Formula 1 in particular, has an enormous carbon footprint, but not from the cars racing at the tracks: that is close to negligible. The carbon footprint of the cars on a racing weekend, on average, is in the order of 3.0 to 3.5% of the carbon footprint of just the transporters.

The list of big CO₂ contributors is large, starting with logistics and continuing with spectators attending races and the manufacturing of Formula 1 cars. Asking the participants of the sport to spend obscene figures to reduce 10 or 20% of the actual racing cars' contribution is barking at the wrong tree – unless it is well explained that by doing so, Formula 1 is contributing to the development of CO₂-reducing technologies for the automotive Industry at large.

We have estimated that the lorries produce an average of 350 tons of CO₂ per European event. If we have 13 such races, that makes 4,550 tons of CO₂ per season. We also have nine flyaway races, with an average of 5,500 km distance. Each race involves moving six Boeing 747s with at least 600 tons of equipment, at the expense of 1,110 tons of CO₂ per leg. That makes a contribution of a minimum of 20,000 tons of CO₂ per season.

To this we need to add the freight transported by sea: 1,000 tons per race contributes another 4,000 tons of CO₂

per season.

Hence logistics has a CO₂ contribution close to 30,000 tons of CO₂ per season. That compares to the weekend contribution of 20 Formula 1 cars at 12.6 tons per race, making a total, for 22 races, of 277 tons of CO₂ per season: 1.0%. Now, you tell me where you would look to reduce F1's carbon footprint?

HUNT FOR REAL CULPRIT

This does not include the team personnel and drivers flying to 22 races, or the spectators, because in that sense motorsport is not dissimilar to football or any other international sport. Neither does the tally include the contribution of manufacturing all the components in a season to field two cars per race. That makes for a considerable amount, but still negligible when we compare it with other industries.

There are plenty of suggestions of technologies to reduce that 1%: two-stroke engines, e-fuels, more electrification, hydrogen fuel cells, etc. All these solutions, if we consider the state of those technologies today, counting Life Cycle emissions (not well-to-wheel, as that is misleading!), would still contribute a fair

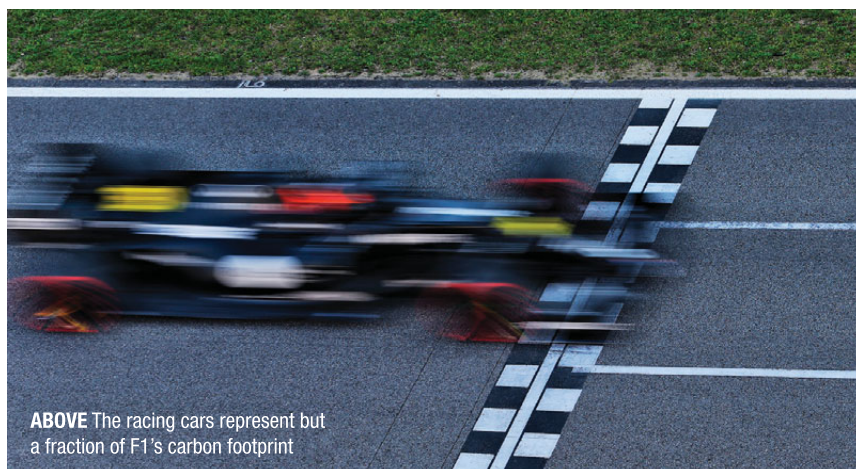
amount of CO₂ – it just changes where and how the CO₂ is emitted.

Extracting lithium and cobalt for batteries, manufacturing those batteries, producing the hydrogen for e-fuels or for fuel cells and some other processes for those technologies, today are still very environmentally damaging. On a positive note, developing the technologies for when those activities reduce the carbon footprint would be a great contribution.

The problem with all of these ideas is a job for the communicators and for marketing. Only now are we really hearing about the 50% efficiency that engines have been running for six years, with technologies transferred to the automotive Industry; how many years will it take to communicate that the real culprit of climate change from F1 is logistics and not the race cars themselves?

Here we enter the minefield of image and perception. If we bang on about how efficient F1 cars are and their contribution to the automotive Industry, we are giving the impression that F1 and the FIA *really* care about the environment. In reality, this is more about image and perception, like stickers on the side of a car.

Announcing that by 2030 F1 will be Net Zero Carbon does not mean it will be zero emissions. After all, one way to be Net Zero Carbon is to buy Carbon Credits. At the current value of trading, it will cost F1 only a fraction of what it would cost to develop any of the technologies mentioned above. Given that F1 is run by savvy business people, it doesn't take long to work out how they could achieve the 2030 Net Zero Carbon target. The bottom line is that however much CO₂ emissions are reduced from the F1 cars due to very expensive technologies, it will do little to reduce the carbon footprint of the sport at large. **LT**



ABOVE The racing cars represent but a fraction of F1's carbon footprint

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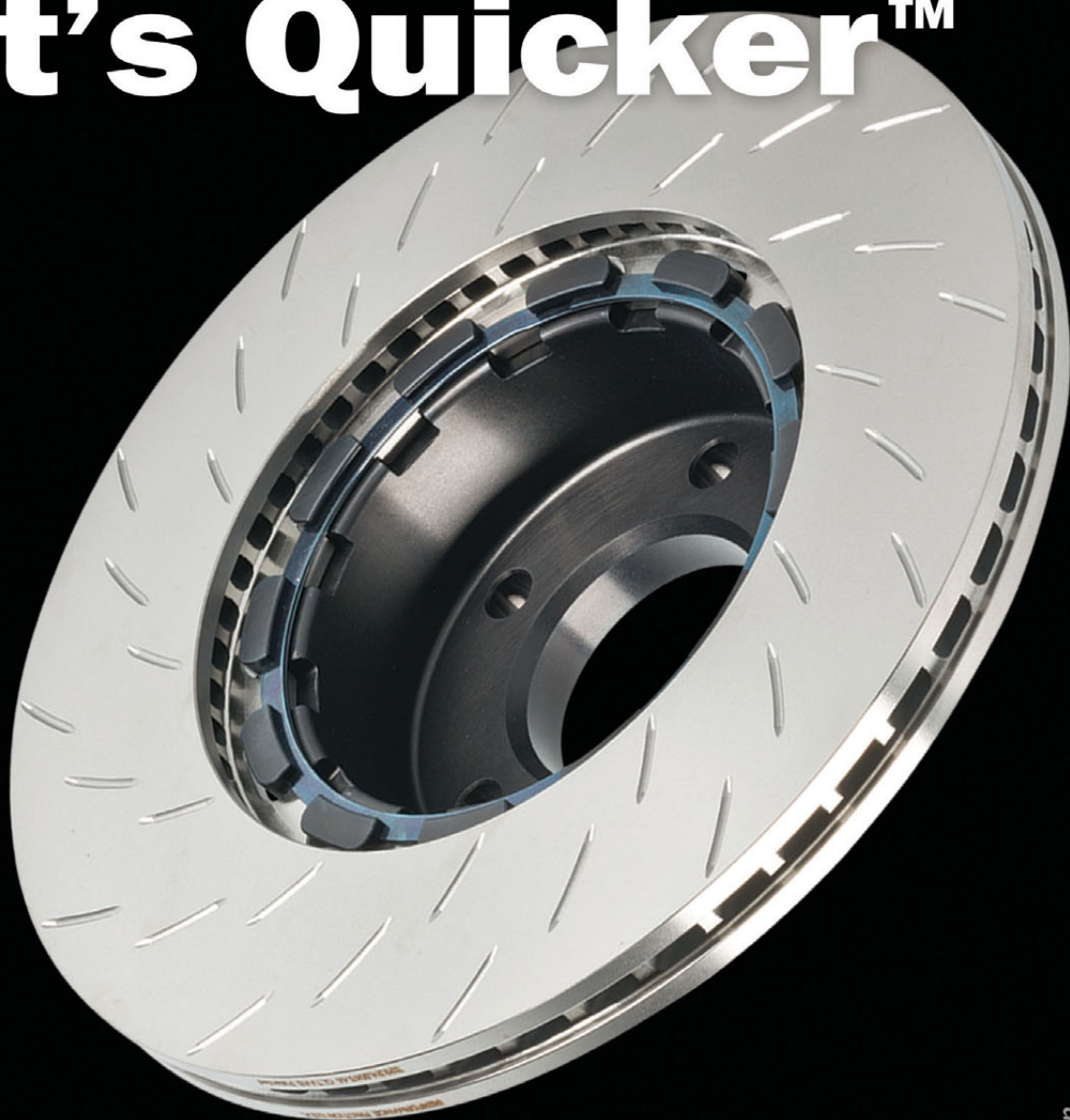


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