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The EV stock car causing shock and awe



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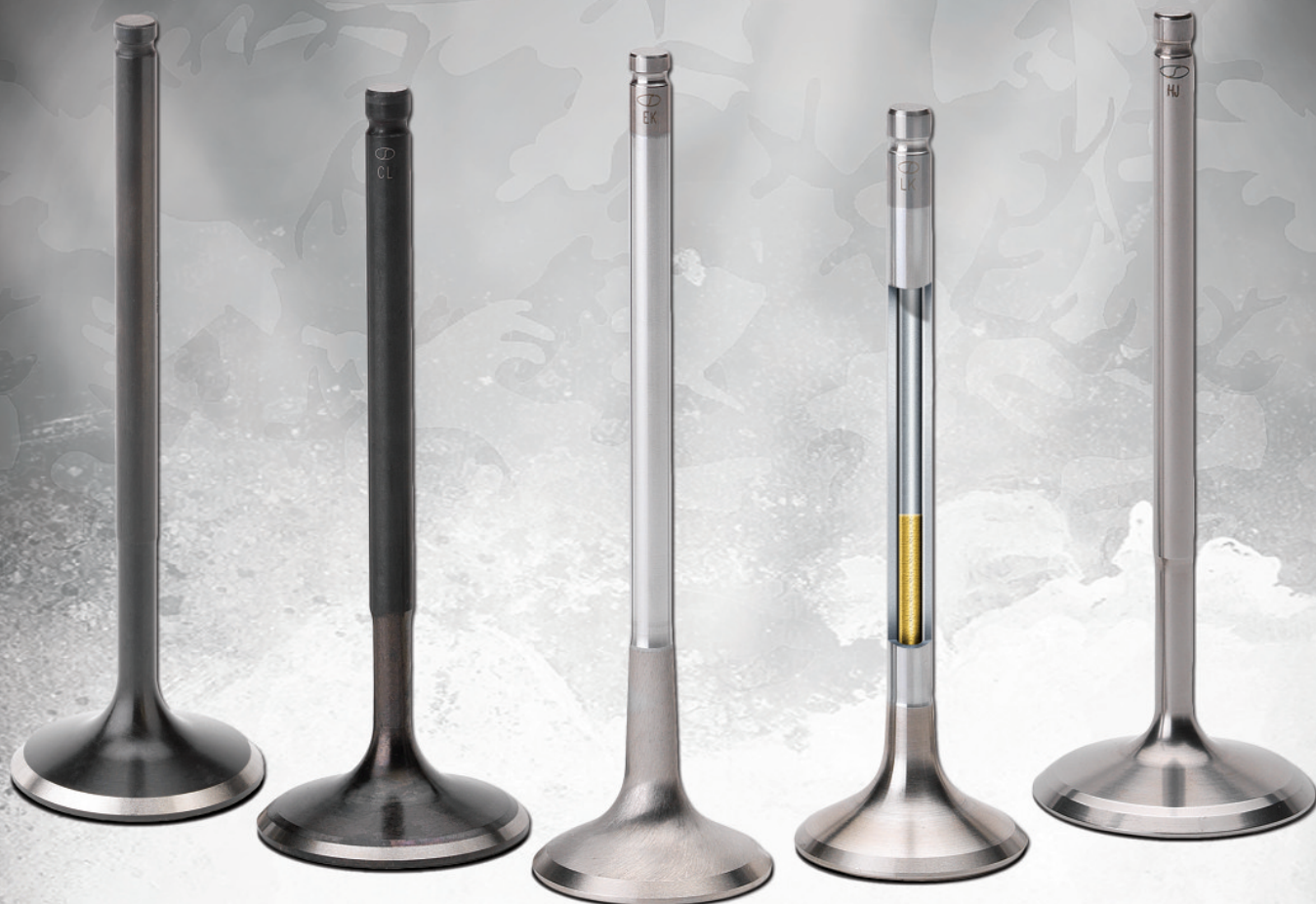
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TEN YEARS? WOULD YOU HAVE GIVEN FORMULA E 10 RACES?

MY generation was fortunate to grow up during a golden period for electric racing. Its distinctive sound and smell were mesmerising, the racing exhilarating and the cars involved bountiful.

It was called Scalextric!

The engineers of the future will have grown up experiencing Formula E. I wonder which of us got the better deal?

This month marks exactly 10 years since that very first, nerve-shredding Formula E race in Beijing. If the backdrop of China's national stadium, the Bird's Nest, was other-worldly, then so was the racing.

Ten years? I wouldn't have given it 10 races!

As many of you recall, William Kimberley – for so many years the heartbeat of this magazine – was an exceptionally shrewd judge of things and I will always remember our conversation in the wake of the very first Formula E public test. "Honestly mate, it was embarrassing," he reported. "The cars were pathetic: like a load of old buzzing milk floats!" We both agreed there and then that this new-fangled Formula E would never amount to anything!

In a sense, William was right. The cars were completely alien to anything we had witnessed before, and the series nearly *did* go under within just three races. But he was wrong too, because 132 ePrix races later, the formula is still here and boasts a hugely impressive array of manufacturers.

Some of those OEMs had to be dragged kicking and screaming towards electrification and the technology has undoubtedly proved not only disruptive but divisive. Race Tech deals with some suppliers who still want

nothing to do with the subject; others have marketing departments who can't wait to tell the entire world they have embraced it.

Love it or loathe it, motorsport's engineers have had no choice but to learn about electrification. Race Tech, inevitably, has reflected that transition. This issue is a case in point. Our lead news story is with a man whose role at the FIA during the creation of Formula E necessitated breaking the uncomfortable news that the entire car would need to be swapped at the mid-race pit stop.

Elsewhere, you can read of the trials and tribulations of one of the series' founders (Mahindra); also the thoughts of the motorsport director of Symbio, the hydrogen mobility company whose fuel cell technology has been instrumental in the gestation of Extreme H. Then there's NASCAR's EV – a hot potato if ever there was...

Sergio Rinland's column is well worth a read too. Sergio is a man whose experience of electric racing straddles both sides of the divide. A regional Scalextric champion while growing up in Argentina, he went on to make his name during Formula 1's hedonistic ICE days – then caught the EV bug.

We wish him a quick recovery! **RT**



Mark Skewis
EDITOR

10 YEARS ON...

WHY FORMULA E MATTERS

A decade on from that historic first race round the Bird's Nest stadium, **Andrew Charman** asks Frédéric Bertrand – who spent 10 years at the FIA creating and developing Formula E, and now runs one of the teams – why the electric series works

MAHINDRA team principal Frédéric Bertrand is effectively the gamekeeper-turned-poacher.

Prior to his appointment in November 2022, Bertrand spent a decade at the FIA, during which as Director of Formula E and Innovative Projects, he oversaw the growth of the category – from an innovative start-up in 2014 that few thought would survive more than a couple of seasons, to its current status as a successful FIA World Championship competed in by a slew of major OEMs.

Speaking exclusively to Race Tech, Bertrand says that from the start in positioning itself as an all-electric series Formula E addressed extremes – employing technology that people either very much dislike, or conversely very much like.

"We had to agree at the start that there would be pros and cons, just because of the technology – in any other category this would not exist, you put a little electric in and you have no issues; you go full electric and you have nowhere to hide. From the beginning it was accepted as different and people had opinions, some of which might be very black and white," Bertrand says.

Conversely, this very difference from the norm gave those behind Formula E what Bertrand describes as "quite a lot of freedom" in making proposals that

were definitely unexpected, especially at the start with drivers obliged to use two cars for each race due to the limited range of the batteries. "The first time this was proposed to an FIA World Motorsport Council meeting, with quite conservative people around the table concerned with maintaining the pure DNA of motorsport, they looked at me strangely," he admits.

“I said to Toto Wolff, ‘The goal is to electrify you, not to electrocute you’... And finally Mercedes came”

"I remember talking to manufacturers, such as Toto Wolff at Mercedes, and using the example of cricket in India, making it entertaining with big crowds, and if we manage that with cricket why can't we do it with electric cars? I said to him, 'The goal is to electrify you, not to electrocute you'... And finally they came."

Today Bertrand believes Formula E has played its role in creating what are very good times for motorsport. "F1 is probably at its best, still increasing and going in a good direction. (We have) a strong World Endurance

RIGHT Prior to that first race around China's Bird's Nest national stadium in September 2014 – 132 ePrix races ago – not many people gave the series much chance of survival

BELOW EV sales may look uncertain globally, but Formula E goes from strength to strength



Championship. Formula E was down after COVID – this was something very difficult when we wanted to race in cities and were more impacted than anyone else – but it has survived, showed strong character not to collapse at that moment.

“We needed to restart the curve, to prove again that we can be there, becoming a challenger again. Now with the Gen3 car getting to the right level and the Gen3 Evo coming, the vision on what will be Gen4, we have come back to being one of those top three motorsport categories in which we have something strong.”

Formula E was conceived at a time when the transition to electric road cars first gained prominence, but the growth of the series is continuing at a time when the electric switch is looking less certain, global EV sales stalling. So does Formula E still need that road car validation? Bertrand is not so sure.

“Sometimes you wonder how much it should keep ▶



FIA/Formula E



FIA/Formula E

the name Formula E? It could become Formula Whatever because of the quality of the show, showing the DNA of motorsport – which is to improve technologies and promote new ones and go faster with something that is always a little in advance of what people are used to using.

“The quality of our drivers, the quality of the teams has improved – they are definitely not the same type of teams you had at the beginning of the championship. You could race with £4-£5 million at that time and today while the budget cap helps to keep things down, it’s at a different level.

“With the budget cap you can spend roughly £30-£50 million as a team, and as a manufacturer more or less the same level on top. Even spending £30m, perhaps £40m for some of the big teams, when you look at some other series we are still one of the

“You put a little electric in and you have no issues; you go full electric and you have nowhere to hide”

cheapest World Championships.

“Presenting such a show in terms of racing and with its calendar, (the series) keeps its position as a little bit of a disruptor. For me the day Formula E becomes something traditional and too standard, we will lose it.”

Bertrand’s views are echoed by Nyck De Vries, the 2020-21 Formula E champion who has returned to the series as one of Mahindra’s drivers after a brief and ill-starred flirtation with Formula One.

“Few people gave (Formula E) a chance of surviving and 10 years later we are still around,” De Vries tells Race Tech.

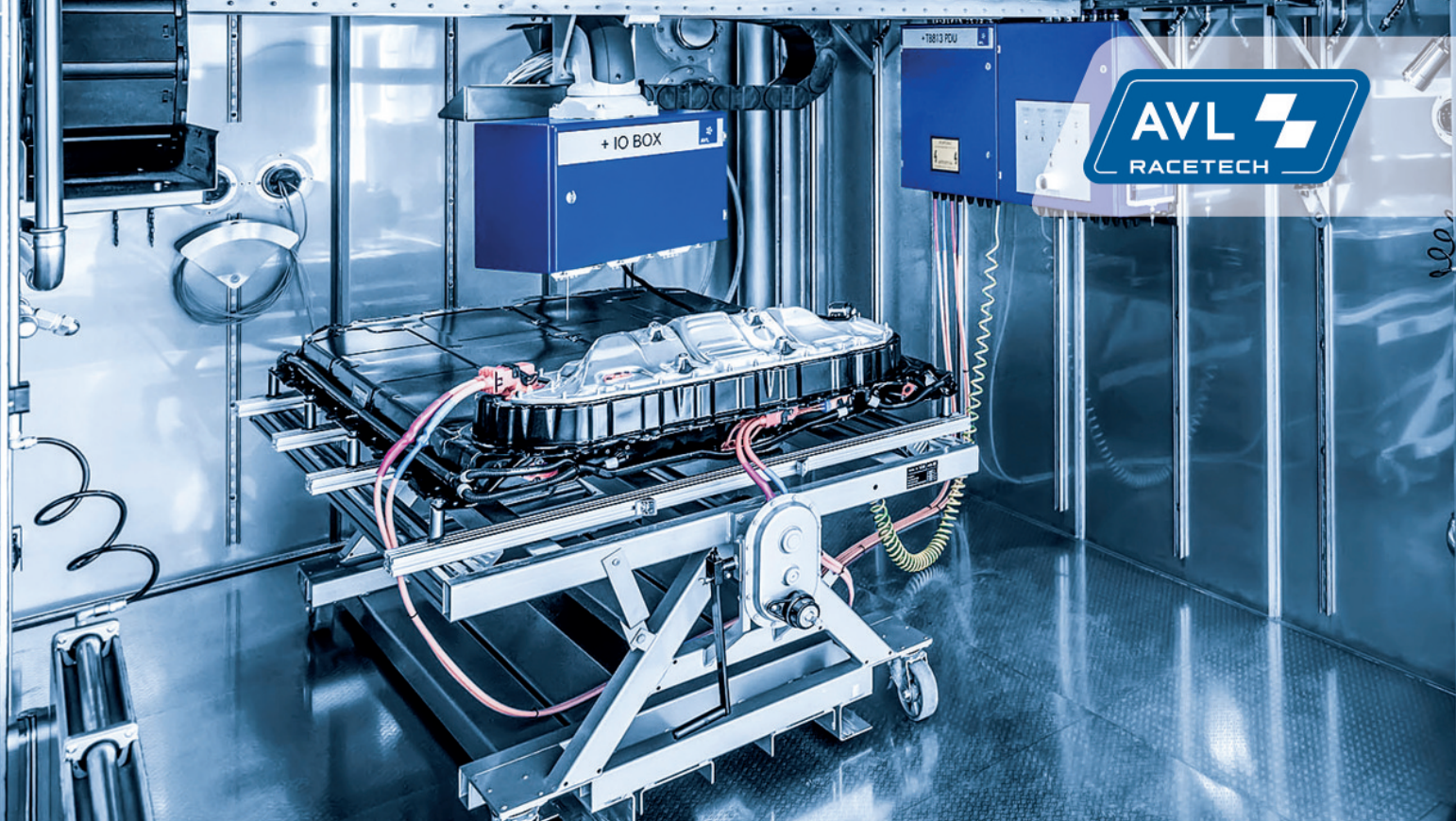
“Many manufacturers have come, some have left, some are still there, I think whoever has created (the series) and has been behind it from the beginning deserves some recognition. It required huge courage to do that.”

De Vries believes that Formula E’s growth was accelerated by the global focus on climate change. “I would say especially from Season 4 onwards it had huge momentum with globally electrification being a hot topic. COVID and everything hit the championship a little bit but at the end of the day it’s still here and it’s still growing. In terms of racing quality it is becoming an established championship amongst the other professional series that are out there.” **RT**

BELOW Porsche, for whom Pascal Wehrlein clinched this season’s drivers’ title, is just one of many manufacturers in the series that come with a halo effect



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“Nice guys don’t win!” Jordan questions Audi’s Sauber gambit

FORMER F1 boss Eddie Jordan has questioned Audi’s tactic of entering F1 with Peter Sauber’s Hinwil organisation, claiming: “Nice guys don’t win!”

Audi has already culled the new Sauber management structure once, removing Andreas Seidl, the head of F1 operations, and chairman Oliver Hoffmann. In their place, the German giant has recruited Mattia Binotto from Ferrari and Jonathan Wheatley from Red Bull to become the two leaders of the Sauber Motorsport AG management team.

“Experience and ability will help us to get a foothold quickly in the tough competitive world of Formula 1,” insisted Audi CEO Gernot Döllner of the reshuffle. Nevertheless, in spite of Binotto’s arrival, outgoing Ferrari driver Carlos Sainz effectively delivered a vote of no-confidence when he opted to join Williams, rather than Sauber.

Audi intends to split its attack between its own engine facility in Germany at Neuburg and Sauber’s Swiss base. As COO and CTO, Binotto will be the interface between the two development teams. Critics of the plan – including Race Tech columnist Sergio Rinland – point out that the UK’s Motorsport Valley, from which most teams operate, has a far larger talent pool from which to draw than its Swiss counterpart.

Ferrari’s 2008 Constructors’ crown is the most recent example of a team based outside of the UK

ABOVE Audi’s plan to enter with Sauber has been criticised

claiming F1 title glory.

Bar the 2008 Canadian Grand Prix, during its alliance with BMW, Sauber has not won a race in Formula 1 since its first entry at the 1993 South African Grand Prix. By the summer break, Sauber was also the only team yet to score a point in 2024.

Jordan suggested Audi’s decision to enter through Sauber, operating from Switzerland, was “fundamentally wrong”.

“I adore Peter Sauber [team founder] as a person, but nice people don’t win anything,” he said during the Formula For Success podcast. “The unfortunate thing is that Peter hasn’t won anything in terms of winning Grands Prix.


“To build a car, to run it out of Switzerland, with manufacturing, it’s a big, big, big ask,” said Jordan. “When did you last see a Swiss or a German [based] team win a world title?

“We saw what Toyota did. They came in, they tried to do it that way and then it didn’t work. And the amount of teams that has done, it’s cost fortunes.

“I have to say there is no better way to run a race car than through Britain and particularly in that area of Northampton, Oxfordshire and various other places. They’ve just got such a wealth of knowledge. They’ve just got such a mindset of being able to win or to achieving or getting the best.

“And the suppliers in the region understand the complexities and the timeframes that people are on there. Whereas, you know, you go out and you order a piece of machinery to be done in Switzerland. They will give you a timeline of maybe needing four days, four weeks, four months and there’s nothing you can do.

“Whereas if you’re in the UK, you would just sit on top of that supplier and say, ‘If you don’t do this, you just don’t get any more work. So you better drop everything and do it.’ And they work night and day to get it done.

“So that’s the philosophy that there is a racing culture, it’s in the DNA, and I think what Audi are doing is fundamentally wrong.” 

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Recaro fights insolvency...

RECARO Automotive GmbH is battling to escape the clutches of insolvency.

The brand has become a byword for high-quality seats across the motorsport, automotive and leisure industries, but filed for insolvency last month. It has nearly 200 employees.

The German company, headquartered in Kirchheim unter Teck, says it encountered

significant financial difficulties due to extreme price increases in recent crisis years and the loss of a major contract. The effects of legacy products and business operations impacted the development of new product offerings during a regional reduction in vehicle purchase spend.

Its local court of Esslingen approved

preliminary self-administration and appointed attorney Holger Blümle from the law firm Schultze & Braun as the preliminary custodian. The international consulting firm Baker Tilly is providing legal advice throughout the process.

Insolvency payments will secure employees' wages and salaries. The company plans to maintain full production during the insolvency proceedings to continue fulfilling all existing orders and new customer inquiries. The shareholders have emphasized the importance of the organization in the region for the group and have pledged their support for the restructuring efforts.

The insolvency proceedings are limited to Recaro Automotive GmbH and do not affect any other group companies. The financially distressed, traditional Swabian company intends to strengthen its position both locally and globally through this process, under judicial supervision and with the support of Baker Tilly.

A meeting with Germany's largest union last month was aimed at securing a route forward and the company says it is working with employees, suppliers and customers to secure its future. **RT**



ABOVE Recaro is a go-to supplier for many race teams

... but BBS still racing strong

ALTHOUGH the German BBS Autotechnik GmbH company has also filed for insolvency, this will not impact the brand's racing activities.

A worldwide presence on the motorsport stage, the BBS brand has been co-owned for more than a decade.

The German factory which has hit trouble has been under the ownership of the Turkish ISH group, which acquired BBS Automotive GmbH last December. Plagued by a history of financial problems, it is the supplier of BBS cast and flow-formed wheels.

However, BBS Japan, which owns the motorsport department – which it supplies with aluminium and magnesium forgings – is a separate entity.

BBS of America manages the NASCAR program and the wheels are produced by BBS Japan, while BBS Motorsport GmbH

manufactures race wheels for Formula One. None of these companies are impacted by the insolvency of BBS Autotechnik GmbH.

“Fortunately, we are a strong brand with 54 years of experience in motorsport and high-

end products,” said BBS America (which is owned by the KW Automotive Group) in a statement. “This legacy will help us navigate through the challenges faced by the cast side of the company in Germany.” **RT**



Getty Images/NASCAR

LEFT BBS America supplies the wheels for NASCAR's Cup Series cars



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Avon tyres relaunched as Nova's €20m factory nears completion

NOVA Motorsport is in the advanced stages of a €20m transformation of the Camac tyre factory in Portugal. The fruits of that work are already being reaped with the launch of the first Avon Motorsport tyres.

The new manufacturing facility is expected to produce 500,000 tyres per year: relaunched Avon Motorsport tyres; Camac historic vehicle-focused products; and a new line-up of Nova Motorsport tyres.

More than 200 lorries were mobilised to transfer the entirety of the Melksham, UK facility to Palmeira in Portugal. The first phase of the transition is now completed, along with additional enhancements, including significant improvements to services and site infrastructure, refurbishment of existing equipment, and a complete overhaul of office spaces to ensure full integration of the Camac and Nova Motorsport teams.

The work has resulted in the rapid return to production of the Avon Motorsport ACB9 cross-ply tyre, the multi-championship-winning product of choice for Formula Ford racers globally since the mid-1980s. Nova has also reintroduced the Avon Traction Mileage tyre, an equally iconic product fitted as original equipment to the first Land Rover from mid-1949.

James Weekley, Nova Motorsport Commercial Director, said: "When Nova Motorsport launched in January, the brand set an aggressive timeline to relaunch key products from the Avon Motorsport tyre portfolio of identical quality and performance standards. Acquiring the Camac tyre factory in May further underlined our commitment and ambition. Now, the production of the first Avon ACB9 competition tyre and the first Avon Traction Mileage in Portugal is proof positive for our dealers, customers, and stakeholders that we are firmly on track to bring the products they rely on back into full-scale production in record time.

"With a 20m Euro investment, Nova Motorsport is sparing no detail or expense in our mission to bring back the Avon Motorsport range with products that deliver the quality and performance that our customers demand. This milestone is just the beginning of our global strategy to reintroduce the vast majority of the legendary Avon Motorsport range.

"Our focus remains resolutely on industrialisation, quality assurance, and production of core product lines, ensuring strong supply availability in time for

the 2025 motorsport season."

Full-scale production of the Avon CR6ZZ classic street-legal performance and competition radial tyre – a core Rallycross range – will commence in Q4 2024. This will soon be followed by the production of the Avon ACB10 Sport tyre (suitable fitment for lightweight competition vehicles), several Avon Historic Competition ranges, a core range of 60 Avon Hillclimb products and the first contemporary Nova Motorsport Circuit Racing tyres.

Nova Motorsport has initiated an extensive recruitment campaign – targeting talent in manufacturing, engineering, technical, and commercial roles to bolster Nova Motorsport and Camac's already extensive expertise and capacity. The Nova Motorsport team, comprised of numerous former key Avon Motorsport personnel, brings a combined 942 years of experience in tyre development, testing, manufacturing, marketing, and customer support to the project.

Mike Lynch, Chief Technical Officer at Nova Motorsport, said: "Integrating Nova Motorsport's engineering and design resources into the Camac facility has significantly enhanced the site's manufacturing capabilities. The upgraded labs and NDT (Non-Destructive Testing) facilities will elevate product quality and performance, significantly benefiting both Avon Motorsport and existing Camac products." **RT**

BELOW The Portugal-made Avon ACB9 tyre on a Historic Formula Ford in testing





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Chevron name returns to motorsport

ICONIC brand Chevron Cars has returned to motorsport with a design built for the TOCA Junior Championship, which commences next season.

Founded by Derek Bennett in 1965, the British manufacturer was once a motorsport powerhouse as it went from humble beginnings in Bolton to enjoying worldwide success across the likes of Formula 2, Formula 3, Formula 5000, Formula Atlantic and Sports Cars. The marque's fortunes declined after the death of its founder in 1978.

TOCA Junior director Dave Beecroft, who grew up just down the road from the Chevron factory, acquired the rights to the brand in 2022.

"As a lad growing up in Bolton, the home of Chevron racing cars, and being mad

about racing cars, and living less than half a mile from the Chevron factory, I used to pedal down there to see the cars being built and loaded into trailers while hanging around in the yard," recalled Beecroft.

"I grew up watching Bolton's own racecar factory's cars winning races around the world. And with the untimely passing of Chevron founder Derek Bennett, seeing the decline of Chevron without its understated leader was sad.

"So to put the Chevron name to this new racecar and giving young drivers and teams the opportunity to have hopefully a little bit of that Chevron magic, I hope Derek would approve."

The B1417 – so designated because TOCA Junior is for drivers aged between 14 and 17 – is a front-engined, rear-wheel-drive

LEFT Bolton's finest rides again with the new TOCA Junior car

saloon that has been designed to meet the highest safety standards.

Its spaceframe chassis was created by Custom Cages, which builds the successful Alliance Racing BTCC Ford Focuses, while it is powered by a four-cylinder 1.8-litre engine that has been developed in-house by the championship.

It has been designed from a completely blank canvas and with practicality in mind, offering plenty of space for drivers and their coaches, a large windscreen to aid visibility and constructed in a way that allows for easy assembly.

A total of 26 cars will be available for teams to buy for the inaugural season next year. The cost of one of the new cars is £94,200 once VAT is factored in. **RT**



Isotta bows out of WEC

AS the storied Chevron name returned to motorsport, so another bowed out: Isotta Fraschini's Tipo-6 LMH Hypercar has been withdrawn from the FIA World Endurance Championship.

The Italian marque pulled its car from the races at CoTA, Fuji and Bahrain. The news broke ahead of the two-car mandate for Hypercar manufacturers coming into force for 2025. The ruling would require Isotta to scale up its program to two cars via either a second factory car or a customer car.

In addition to stating a wish to return to the WEC in the future, Miguel Valdecabres, who took over as Isotta CEO last month when Claudio Berro departed the company, said: "We are immensely proud of our achievements in our debut season.

"Competing in the WEC has been

an incredible honour and experience, with the 24 Hours of Le Mans being a particular highlight. This very difficult decision has not been made lightly, but it allows us to build on our successes, fostering the growth of our brand and the development of our products in both the



ABOVE The Isotta Fraschini Tipo-6 Competizione competed just five times

racing and Hypercar markets.

"As a new manufacturer with great ambitions, not continuing in the WEC 2024 season is a strategic obligation to conserve our resources and ensure the continuity of our project.

"Despite this difficult setback, we are excited about the future. Our journey as a performance brand continues, and we are eager to achieve new milestones."

Michelotto, which designed the car, has been working hard to save the program, attempting to sell the design to prospective manufacturers looking to join Hypercar in the future.

The racing career of the Isotta Fraschini Tipo-6 Competizione numbered just five races, with its best finish coming with 14th overall at Le Mans. **RT**

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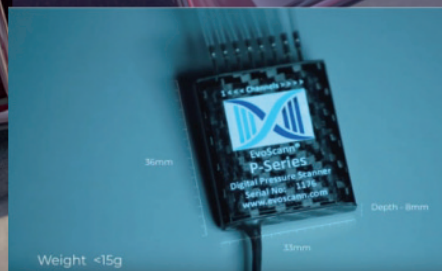
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Performance Factor confirmed for 2025 FIA European Hill Climb Championship

THE 2025 season of the FIA European Hill Climb Championship is set to be a significant one in the history of the longest-running FIA competitions. For the first time all cars will be categorised according to a Performance Factor (Pf).

The system, currently used in Category 1, is being tested in Category 2 of the FIA EHCC during 2024 to ensure that the parameters of the performance calculations are suitable before they come into force from the start of next season.

The introduction of a common Pf system is the result of a combination of developments made by the FIA in recent years to update the hillclimb category across its sporting, technical and safety aspects. Its aim is to ensure the long-term prosperity of one of the core disciplines that bridges grassroots and professional motorsport.

The development and deployment of the Pf system follows concerns over the increasing capabilities of modern competition vehicles.

The Pf system sets common targets across the huge variety of cars entered into hillclimbs around the world, allowing organisers to dynamically manage their events and ensure that the competitors are kept safe according to the performance of their cars and the specific characteristics of the specific hillclimb course. Pf was deployed in Category 1 in 2021 and by a number of national sporting authorities (ASNs)


ahead of its implementation in the FIA EHCC, and it has proved to be highly effective.

Cars will be categorised in groups from P1 to P4 according to their performance level, and the FIA Technical Department will continue to monitor the performance of cars in the EHCC over time and ensure that the parameters are in line with any future changes to the cars competing in hillclimbs.

Online platform

To make this system as accessible and open as possible for competitors and organising ASNs, the FIA has created a dedicated online platform that allows them to directly input a car's specifications and generate the Pf. This tool has been in place for Category 1 cars since 2021, and following the 2024 trial for Category 2 cars will be fully implemented in 2025.

The regulations also set out a clear safety road map that will, over the course of three seasons beginning in 2025, unify and evolve the requirements of all cars to ensure that they have a uniform level of safety that takes into consideration the performance capabilities of modern cars.

The Safety Road Map will be introduced incrementally and during the transitional period, cars that have been certified under the previous safety standards will be allowed to compete using a restricted engine Pf. 

ABOVE The FIA has laid out a safety road map for the hillclimb scene

McMurtry smashes hillclimb record

THE British-built McMurtry Spéirling electric fan car claimed two records and maintained its 100% win rate in competition at the 'Laguna Seca Reverse Corkscrew Hillclimb' last month.

The third annual running of the hillclimb took place during the 2024 Monterey Pre-Reunion. The event marked the North American dynamic debut of the Spéirling, with the return of the 2024 Drako GTE driven by Andy Pilgrim further underlining the impressive performance of electric vehicles.

A new record looked inevitable from the first practice run, with Goodwood record-holder Max Chilton stunning the crowd with the instant torque of the Spéirling's 1,000 bhp electric powertrain.

The first mark to tumble was the longer layout used at previous events. Chilton's 28.6s run shattered the previous record set by Chris Locke in a 1976 Lotus Type 77 Formula One Car at 34.69s. The start line for Locke's run had been slightly further back, rendering a direct comparison impossible. Nevertheless, the six-second margin clearly told the tale.


The fan-assisted Spéirling also set a new record on the revised shorter layout, introduced for 2024. A 21.958s was achieved in the top 3 shootout. The second-place finisher was a 1967 Ford Falcon race car with a 29.004s run, third falling to a 2022 Ferrari SF90 clocking 29.822s.

The Reverse Corkscrew Hillclimb uses the legendary Corkscrew corner plus turns 11, 10 and 9, driven the wrong way to normal racing.

"The Corkscrew is one of the most famous corners in the world," said Chilton. "Normally it's a blind approach on entry, so in the reverse hillclimb it's



unsighted on the exit. You have to shoot up the 18 metres elevation change and then hope you've picked the right line as you launch over the top. Luckily, I had fan downforce to help keep me stuck to the ground. It's been quite a special experience."

Thomas Yates, Managing Director of McMurtry Automotive, said: "The Reverse Corkscrew Hillclimb has been such an enjoyable way to showcase the cars in motion for the first time ever on US soil. The level of excitement from everyone here at Laguna Seca has made it very memorable. You'll be seeing plenty more of McMurtry in the US over the coming years." 

ABOVE The McMurtry fan car set two new records at Laguna

Tur returns to Williams Grand Prix Technologies as tech director

WILLIAMS Grand Prix Technologies has appointed Selin Tur to the newly established role of Technical Director.

Established in April 2024, the F1 spin-off works across a wide spectrum of sectors, from aerospace, marine and premium automotive, through to sport and lifestyle.


Tur is an accomplished engineering leader with over 20 years of experience, including working with Jaguar's Formula E squad.

Matthew Savage, Chairman at Williams Grand Prix Technologies, said: "We are delighted that Selin is returning to



ABOVE Tur: Williams return

Williams as our new Technical Director at Williams Grand Prix Technologies. With her extensive experience, engineering acumen and expertise Selin is perfectly placed to engage with the team at Williams and help solve challenges faced by our customers."

Tur commented: "I have always loved being at the forefront of innovation and high-performance engineering, so it is only natural that I would be keen to return to Williams as the Technical Director of the newly formed Williams Grand Prix Technologies." 

Investigation increases pressure on F1 over Andretti rejection

THE rumbling saga of Andretti's bid to enter Formula 1 took another twist last month with Liberty Media's confirmation that it is under investigation by the US Department of Justice for possible breach of US antitrust laws.

F1's US-owned commercial rights holder snubbed Andretti Global's plan to enter the sport with American car giant Cadillac, claiming that the entry would not be competitive and added no extra value to F1.

It was a decision that delighted greedy F1 teams, eager to protect their share of the sport's revenue, but frustrated many purists, who ridiculed Liberty's long-winded and rather flimsy justification. It also offended an Andretti dynasty – Andretti Global is owned by former F1 driver Michael Andretti, son of

1978 world champion Mario – that in many ways is part of the sport's fabric.

The move also enraged some members of the US Congress, 12 of whom signed a letter questioning whether the decision to maintain F1's closed shop breached antitrust rules.

Greg Maffei, chief executive of Liberty Media, confirmed the process had begun during the announcement of the company's Q2 earnings. "Looking at Andretti [...] there is a DOJ investigation. We intend to fully cooperate with that investigation, including any related requests for information," he said.

"We believe our determination, F1's determination, was in compliance with all applicable US antitrust laws, and we have

detailed the rationale for our decision vis-à-vis Andretti in prior statements.

"We are certainly not against the idea that any expansion is wrong. There is a methodology for expansion that requires approval of the [International Automobile Federation] and [Formula One] and both groups have to find the criteria met and we are certainly open to new entrants making applications and potentially being approved if those requirements are met."

Few believe the investigation will actually force Liberty Media's hand, but it does ramp up the pressure on the American company. It also further underlines the fact that Andretti – which forges ahead with the long-lead items of its first F1 car at a new base in the UK at Silverstone – will not go quietly. **RT**



ABOVE F1's battle to deny an Andretti-Cadillac entry still rages

Toyota launches new GR Supra GT4 EVO2

TOYOTA GAZOO Racing (TGR) has begun accepting orders for the new GR Supra GT4 EVO2.

Since the launch of the GR Supra

GT4 in 2020, sales of the model have surpassed 120 units. The car has won GT4 races in 11 countries, earning more than 500 podium finishes and becoming

class champion in three regions: Asia, the United States, and Europe.

An updated GR Supra GT4 EVO for the 2023 season featured improved braking, handling and engine performance, making the car easier to drive for drivers of various skill levels. Now TGR has set the race debut of the GR Supra GT4 EVO2, with improved performance, reliability, and operability, for the start of the 2025 season.

With ABS playing an increasing role in GT racing, the ABS maps have been meticulously re-tuned on the new car. Additionally, downshifting time has been reduced, cooling improved to the engine, brakes, and drivetrain, and cockpit temperatures optimized to aid driver concentration. **RT**



ABOVE The new GR Supra GT4 EVO2 is ready for action

Gevo inks deal to supply renewable low-carbon race fuel to Shell

AMERICAN renewable chemicals and biofuels company Gevo has entered a purchase agreement with Shell Global Solutions (Deutschland) to supply low-carbon intensity fuel blendstock for use in motorsport.

Gevo's renewable blendstock has been targeted at premium motorsport fuel, with the aim of demonstrating that sustainability and peak performance belong together.

Gevo is committed to carbon abatement. By producing high-performance racing fuel blendstock from sustainable feedstocks like agricultural waste, which comply with the EU Renewable Energy Directive Annex IX requirements, it is developing a crucial component for low-carbon fuel solutions.

"This is an important step towards a sustainable future," said Damien Perriman, Gevo's Chief Business Development Officer. "The racing industry exhilarates and inspires, and its enormous audience has an appreciation of what technology can do to enhance the human experience. Leading companies across the globe are looking to Gevo to deliver net-zero fuels and chemicals. With products

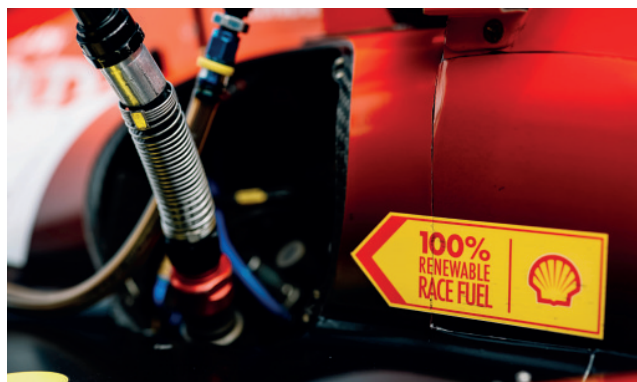
like renewable fuels for all modes of transportation, specialty additives for lubricants, and sustainable chemicals that replace outdated technologies, Gevo is thrilled to drive this transformation."

Matthias Mundt, General Manager Fuels Technology Future Mobility Portfolio at Shell, said: "As a supplier of specialty fuels to racing series around the world, Shell is focused on improving sustainability while maximizing efficiency and performance, such as with the 100% renewable race fuel we developed for the NTT IndyCar series. We are pleased to collaborate with Gevo to

explore the possibilities provided by their low-carbon intensity products."

Gevo's innovative technology is used to make a variety of products, including sustainable aviation fuel (SAF), motor fuels, chemicals, and other materials. Gevo's business model includes developing, financing, and operating production facilities for these renewable fuels and other products. It currently runs one of the largest dairy-based renewable natural gas (RNG) facilities in the United States. It also owns the world's first production facility for specialty alcohol-to-jet (ATJ) fuels and chemicals. **RT**

RIGHT Shell produced a 100% renewable race fuel for IndyCar



JOTA earns works Cadillac WEC deal

CADILLAC Racing's two-car factory Hypercar program in the 2025 FIA World Endurance Championship (WEC) will be run by Hertz Team JOTA.

The UK-based team currently runs a brace of customer Porsche 963s in the series. It made history this season by becoming the first privateer squad to record an outright victory in Hypercar, winning the TotalEnergies 6 Hours of Spa-Francorchamps in May. It was also runner-up in the season-opening Qatar Airways Qatar 1812 Km.

Sam Hignett, director and founder, Hertz Team JOTA, said: "JOTA has always strived to become a manufacturer team, so now joining forces with Cadillac is the realization of this goal. Having competed against the Cadillac V-Series.R for the last two seasons, we have experienced how competitive it is and we are genuinely

honoured to be entrusted with fielding its cars from 2025 onward.

"We are in the privileged position to have enjoyed record-breaking success in the FIA World Endurance Championship, especially at Le Mans, and we are very much looking forward to continuing this success with Cadillac and Hertz."



ABOVE JOTA became the first privateer to record an outright victory in Hypercar

The cars will be powered by the purpose-built Cadillac 5.5-litre DOHC V8 engine, which was voted race powertrain of the year at last November's Race Tech World Motorsport Symposium.

"Cadillac is proud to be racing against the best in the world as part of the FIA World Endurance Championship, and that includes Hertz Team JOTA," said John Roth, vice president, Global Cadillac. "We are thrilled to welcome Hertz Team JOTA next year, bringing decades of racing and technical expertise together, to achieve continued success on the track and create new advocates for our brand around the globe."

Cadillac Racing also runs a two-car Grand Touring Prototype (GTP) factory program in the IMSA WeatherTech SportsCar Championship, where it swept the titles in 2023. **RT**

Revolution Race Cars lands US investment

REVOLUTION Race Cars has secured significant new funding and presence in America from two longtime Revolution customers and the team that founded and operates Classic Car Club International.


A new American company, Cabotage Corporation – an investment vehicle formed by Classic Car Club Inc. directors Zac Moseley, Revolution Race Cars leadership Phil Abbott and Nigel Redwood, together with longtime Revolution customers Marc Russell and Channel Islands-based entrepreneur Terry Thompson – has acquired 100% of the issued share capital of Abbott Automotive Limited, trading as Revolution Race Cars.

This new phase of Revolution's development will fast-track the development of new models to its line-up.

Zac Moseley will assume the role of Chairman, with Nigel Redwood joining Revolution full-time as Managing Director, bringing a wealth of experience from his previous roles as MD and CEO of various international businesses. James Abbott will continue as Head of Product Development, working alongside his father, Phil Abbott, who will serve as Operations Director.

Phil Abbott, Co-founder of Revolution Race Cars, commented: "With this new investment and leadership, we're poised to introduce exciting new models and push the boundaries of performance."

Nigel Redwood, Managing Director, added: "With Revolution Race Cars, I see a unique opportunity to merge my decades of commercial expertise with a lifelong passion for motorsport. Joining full-time as Managing Director is not just a professional decision; it's a testament to my belief in the Abbott family's ability to deliver exceptional race cars. As an ex-race driver myself, I continue the theme of 'built by racers for racers.'"

Zac Moseley, Chairman, said: "The motorsport industry has experienced colossal growth in the US market over the past 10 years. More than a dozen new racing circuits are currently under construction across America, access to motorsport academies is at an all-time high and the explosion of interest in Formula 1 and other racing series is driving Americans from the golf course and to the racetrack. Our ambition is to give these drivers and racers a true prototype race car experience that is affordable, reliable, safe and capable of being on the top step of the podium on Sunday." 

BELOW Revolution Race Cars seeks to expand its range of Le Mans-style prototype racecars



Idemitsu Kosan launches first plant-based race engine oil


JAPANESE lubricant specialist Idemitsu Kosan has developed a new engine oil, Idemitsu IFG Plantech Racing, which uses more than 80% plant-based raw materials.

This OW-20 viscosity grade product has achieved API SP certification, making it the first engine oil in the world to combine racing performance with API certification while using plant-based materials, according to Idemitsu.

API (American Petroleum Institute) requirements include fuel efficiency, heat resistance, and wear resistance. In addition to API SP certification, Idemitsu

IFG Plantech Racing has received Biomass Mark certification from the Japan Organics Recycling Association, confirming its substantial use of biological resources.

The oil is part of Idemitsu's IFG/IRG Series, a line-up available in 13 countries where the company's lubricant affiliates operate. The product is slated for release in November 2024.

Shunichi Kito, president and CEO of Idemitsu, said: "We are committed to developing products that delight driving enthusiasts through our technological capabilities, blending performance with sustainability." 




ABOVE Idemitsu's revolutionary new oil

BMW M Motorsport developing new entry-level car

BMW M Motorsport is currently developing a new entry-level car to expand its portfolio of customer racing vehicles.

This new model, to be used from the 2026 season, will join the ranks of the BMW M235i Racing, BMW M240i Racing, and BMW M2 CS Racing, which have been engineered to provide a technically advanced entry point into motorsport.

Björn Lellmann, head of customer racing at BMW M Motorsport, said, "Proximity to our customers is one of the maxims we pursue at BMW M Motorsport. From our point of view, this also includes offering a car for grassroots racing that teams and newcomers to racing can afford and that at the same time offers them BMW M Motorsport technology at the highest level.

"Accordingly, we are delighted to be able to announce a successor model to the BMW M235i Racing, BMW M240i Racing, and BMW M2 CS Racing at this point. Our engineers are already working intensively at this early stage of development to optimally prepare the car for customer use." 



ABOVE BMW has teased the new racecar design

AP Racing launches PRO SPORT brake caliper range

AP RACING has unveiled a new range of profiled brake calipers. The PRO SPORT collection is designed to excel in a wide range of race and rally applications, including R2, R4 and other cost-conscious motorsport series.


The off-the-shelf range demonstrates the continued evolution of AP Racing's pioneering forged technology. Offered initially as a four-piston system with two-piece aluminium radial mount, the design is internally ported with a stainless steel piston and finished with a hard wearing anodised surface treatment.

The optional addition of a bleed screw shield fitment offers superior protection, while the collection is fully compatible

with CP3215 brake pads.

David Hamblin, managing director of AP Racing, commented: "Designed at AP Racing's state-of-the-art R&D facility

in the UK, the all-new PRO SPORT collection aims to set the standards in cost-effective braking performance, providing a truly competitive edge."

AP Racing is a key supplier at all levels of international motorsport formulae, including Formula 1 and other single-seat racing, rallying, endurance racing, stock car racing and touring cars. 



ABOVE PRO SPORT is an entry-level range of forged brake calipers



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“Another great learning experience for the two of us that attended from NASCAR. The topics were very relevant to the future of motorsport, and challenged us to look deeper into some areas of development that we had not previously considered or perhaps considered seriously enough. As always, the collegial atmosphere and lively debates and conversations make for a great event. I am looking forward to seeing everyone again next year and hearing about the advancements another year brings.”

Eric Jacuzzi, Vice President, Vehicle Performance, NASCAR

NASCAR TASTES THE FORBIDDEN FRUIT!

Of all the taboos for NASCAR to break, an EV racecar ranks as one of the biggest. So what's going on? **Chris Pickering** talks to the lead engineer behind the project

NASCAR has been thinking outside the box lately. First, there was the Next Gen Cup car, which ushered in the series' biggest technical shakeup in half a century. Then came the Garage 56 entry that proved to be one of the biggest hits at Le Mans last year. And now... Well, now the series has unveiled its own concept vehicle in the form of an all-electric all-wheel drive stock car crossover.

Before anyone chokes on their moonshine, it's worth emphasising that this car is a technology demonstrator pure and simple. Part marketing tool and part engineering exercise. There's no intention to ever race it, or indeed run it on a superspeedway.

It has, however, already clocked up over 60 laps at the half-mile Martinsville Speedway. NASCAR's longest-serving track, with a history stretching back to the 1940s. What's more, the



RIGHT The car's 78-kWh lithium-ion battery is larger than the batteries in either Formula E or Extreme E

BELOW The EV prototype is part marketing tool, part engineering exercise



Getty Images/NASCAR

“We want to show our capabilities, whether that’s electrified powertrains, hydrogen or sustainable fuels”

EV’s lap time was within two tenths of a second of the V8-powered Cup car, with more left to come, according to test driver David Ragan.

“We want to continue to push the sport, and we want to push the technology behind different powertrains,” explains NASCAR’s senior engineer for vehicle systems, CJ Tobin. “We want to be in the driver’s seat. We don’t want to be trying to catch up with everyone else 10 miles down the road. So, we want to show our capabilities, whether that’s electrified powertrains, hydrogen or sustainable fuels.”

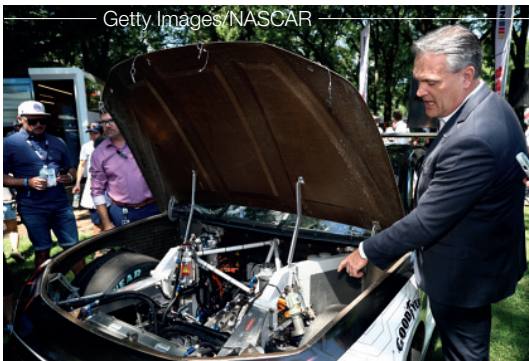
Tobin and his team at NASCAR’s R&D centre in Concord, North Carolina, developed the car in partnership with the series’ OEMs, Ford, Toyota and Chevrolet, with electrification specialist ABB later joining as a sponsor. It’s loosely based on the Next Gen chassis, with three STARD UHP 6-Phase motors (one at the front, two at the rear) providing a combined power output of 1,000 kW (1,340 bhp).

Energy storage comes from a 78-kWh lithium-ion battery. That’s comfortably larger than the batteries in Formula E or Extreme E, and it’s enough to give the EV prototype a meaningful range on a street course or a short oval, as the Martinsville test demonstrates.

“Where battery technology is right now, there was never any intention to run it at anywhere like Daytona or Talladega,” explains Tobin. “We never looked into fast charging or battery swaps or anything like that. Quick charge ►



Getty Images/NASCAR



Getty Images/NASCAR

wasn't an option based on the logistics, and the structure of our cars wouldn't suit a quick swap. So, our focus was always on high brake energy tracks like Martinsville and the road courses because of the regen potential."

It's no secret that the idea of experimenting with electrification was driven by the trends that are impacting NASCAR's OEMs in the road car market. But this is more than just a marketing stunt, Tobin insists.

"This has been a great learning experience for us, and I think the biggest takeaway has been the battery packaging," he comments. "We've taken the Next Gen platform that we already had and packaged a completely different powertrain into the

same base platform. That's shown that if we wanted to package hydrogen tanks or something like that in the future we are already well-equipped to do that."

Powertrain exploration

This is all part of a wider engineering exercise that stretches back beyond the EV, he explains: "Next Gen is a modular platform, and even in the very early days we knew there would be other powertrain options that we'd be looking to explore. We took that platform and we applied some modifications to run it in endurance racing under the FIA regulations at Le Mans. Then, we took the lessons learned in both Garage 56

“The target was to achieve 50 high-speed laps at a half-mile oval. In the end, they managed 63”



Getty Images/NASCAR



Getty Images/NASCAR

ABOVE Removing the engine and fuel tank gave sufficient packaging volume for the front and rear bumper struts to be lengthened for additional impact protection

TOP LEFT Look, no V8! The car on display in Chicago

LEFT The engineering team incorporated many of the lessons learned from the Garage 56 project into the EV



and the original Next Gen programme and put those into the EV.”

The centre section of the EV chassis, including the roll structure, closely follows that of the Next Gen car. Conscious of the fact that a battery-electric powertrain would add weight, the engineering team took the lessons learned from Garage 56, including the carbon fibre floor and firewalls, and carried those over into the EV. The end result is a car that tips the scales at around 4,000 lb (1,814 kg) which is some 515 lb (234 kg) more than a Cup car, but comparatively svelte by electric standards.

Wherever possible, parts have been

sourced from the Next Gen car, Tobin explains. The steering rack, for instance, is carried straight over. Similarly, NASCAR has eschewed a brake-by-wire setup and uses the same ‘heavy duty’ brake package that the Cup cars run on road courses and short ovals, complete with the standard hydraulics. The rear uprights are identical (the fronts having been revised to accommodate a CV joint). Likewise, the dampers are carried straight over on the rear, whereas the fronts use the same body but with a forked shaft that allows the driveshafts to pass through; the springs are unchanged on both ends. The BBS wheels also come

from the Cup car, although the tyres are an EV-specific design from NASCAR’s longstanding tyre partner Goodyear.

Packaging challenges

As with the Next Gen car, the front and rear sections of the chassis are subframes known as clips, which can be removed to repair damage on the racecar. The EV follows the design of the Garage 56 car, which had its rear clip integrated into the chassis to allow the fuel tank to move forward (here, it’s used to free up packaging space for the battery).

The NASCAR engineers were comfortable about packaging the ►

motors, inverters and gearboxes, based on the flexibility of the platform that they had already explored with Garage 56, says Tobin.

"We have the advantage that a pushrod V8 takes up a lot of space," he jokes. "The first thing to think about from our perspective was the battery packaging. STARD's simulations gave us a good idea of the volume that we needed for a given number of laps, so we knew we were going to be okay for the total volume. We explored multiple options in terms of stack cells [and] in terms of a skateboard design."

Battery location

As a general rule, stock car racers try to avoid putting too much weight on the right-hand side of the car; the Cup cars just have the 12-volt battery and some of the electronics located on the passenger side. For this technology demonstrator, however, it was decided that this would be the simplest place to locate the battery.

Alongside the vehicle dynamics aspect, safety was a key consideration. Contact is relatively common in NASCAR,

“Within the first day we were all staring at each other, because the shakedown was done”

and on the faster tracks the wall can be whizzing past the right-hand side of the car at up to 200 mph.

"Intrusion is a huge safety topic, especially with a battery in the car," comments Tobin. "That's one thing that we focused on with the door bars. If you're looking at a T-bone style impact, you want to ensure that there's no intrusion, because the battery pack is on the right-hand side of the car. So, we've got the door bars, which are a proven system from our Next Gen car, and then also the battery casing itself. A lot of time and work went into the battery casing to ensure that if there were to be any intrusion [into the side of the car], the battery casing could withstand whatever comes to it." ▶

BELOW The yaw characteristics of the crossover SUV bodywork were investigated in the wind tunnel



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In other areas, removing the engine and the fuel tank actually gave the engineers more packaging volume to utilise. For instance, the front and rear bumper struts were lengthened to provide additional impact protection.

Performance targets

With the options of swapping or quick charging the battery discounted from the outset, the main priority was to accommodate a battery large enough to provide a reasonable demonstration of the technology on a single charge. The target was to achieve 50 high-speed laps at a half-mile oval like Martinsville. In the end, they managed 63.

Tobin and his colleagues were pleased with this result. In fact, he says, the whole project has gone remarkably smoothly: "We were pleasantly surprised how well the whole process worked. When you go into testing a prototype like this it's normal to have a few hiccups, so we were expecting the initial shakedown to last at least a day and a half into our three-day test. But within the first day we were all staring at each other, because all of that was done and we were ready to move onto the tyre testing."

Prior to the track testing, NASCAR and its technical partners had used driver-in-the-loop simulation

ABOVE NASCAR leveraged the experience of sister organisation IMSA, which operates a spec hybrid system, to prepare its track services for running an electric vehicle on the racetrack

to explore the concept's potential. This was based around a composite model, which used an adapted version of an existing vehicle model, combined with bespoke models for the tyres and suspension.

"Ford had a lot of carryover knowledge from the Supervan project and we did lot of driver-in-the-loop simulation as a collective group once this project kicked off," says Tobin. "It was good to be able to verify what we'd seen in simulation in real life. The car performed as we expected from the very first swing, which is testament to everyone involved in the project."

The idea was not to set an EV benchmark as such, but to ensure that the performance would be comparable to the combustion-engined cars, he explains: "Our main aim was to show that this could be done without the style of racing having to change. Obviously, there are intricacies within the races that will change in terms of battery strategy, regen strategy and driver ability in an electric vehicle, but we didn't want anything to change in terms of the fundamental style of racing."

Learning curve

Not surprisingly, he says it's the electric powertrain that has proved the steepest learning curve, but one aspect stands out in particular: "The biggest

thing as we've gone through testing has been understanding regen strategies. A huge part of our testing plan was to find a happy medium where we had a regen strategy that worked without changing how the drivers would race."

This car has helped to shed some light into how things might work if NASCAR ever was to race electric vehicles, but the chances of that seem slim. A hybrid powertrain – perhaps retaining the traditional pushrod V8 – seems like a more plausible option. NASCAR did initially consider just such a system for its Le Mans foray. Tobin won't be drawn on how far this research might extend, but he does reiterate that work on the battery electric prototype should lessen the learning curve for any future

“The biggest takeaway has been the battery packaging”

studies on alternative powertrains.

"It's a great foundation for whatever the future of powertrains might look like," he comments. "Most of us have a background in combustion-engine stock car racing. We have one engineer who did a summer internship [on electrified vehicles] but for most of us it was completely new. So, that was a huge learning curve. Now we have the foundation and the data that we could use if we moved onto another project that involved regen."

While electrified powertrains may be a new topic for NASCAR itself, the same organisation now owns IMSA, which has raced with hybrid powertrains in the LMDh category since the start of last year. There was no direct input on the design of the NASCAR EV prototype from the IMSA engineers, but they did provide a degree of assistance.

"The biggest collaboration that we've had with ▶

NASCAR's sustainable composites

NOT all of the innovations seen on the EV are focused on the powertrain. NASCAR has also taken the opportunity to experiment with sustainable flax composites, which were developed by lightweighting specialists Bcomp, using the Swiss firm's ampliTex and powerRibs reinforcement fabrics.

As a raw fibre, flax is lighter than carbon, but it doesn't possess quite the same tensile strength, so Bcomp has developed a structural concept known as powerRibs to provide reinforcement. The finished product is said to offer similar performance to carbon fibre while slashing its carbon footprint by some 85 per cent. There are also said to be safety benefits from using the plant-based fibres, which break without sharp edges, reducing the risk of punctures compared to carbon fibre.

"Working with our sustainability lead Riley Nelson, our aerodynamics director Chris Popiela and our vice president for vehicle performance, Eric Jacuzzi, we wanted to try something a bit different to see how the future might work with these more sustainable materials," recalls Tobin. "We were pleased with the technology. It's a little heavier than carbon, but it's easier to work with, in terms of carbon splinters, as well as the sustainability benefits." **RT**



ABOVE Bcomp's extensive work with flax underpins the natural fibre bodywork



LEFT Ford's carryover knowledge from its Supervan project informed the initial driver-in-the-loop simulation



Getty Images/NASCAR

IMSA was on the safety side. What we realised going into this project was that it might seem like electric vehicles have been around for a while now on the road, but a lot of the race series that deal with them are still building their own rules and regulations around things like battery handling. We've taken all the safety courses, but those regulations and how they apply to your specific race series are going to change.

Emergency services

"How they handle incidents in IMSA is different to how we handle it in NASCAR, due to the style of the racing and the style of the tracks. But we've been able to work with those folks on things like how to

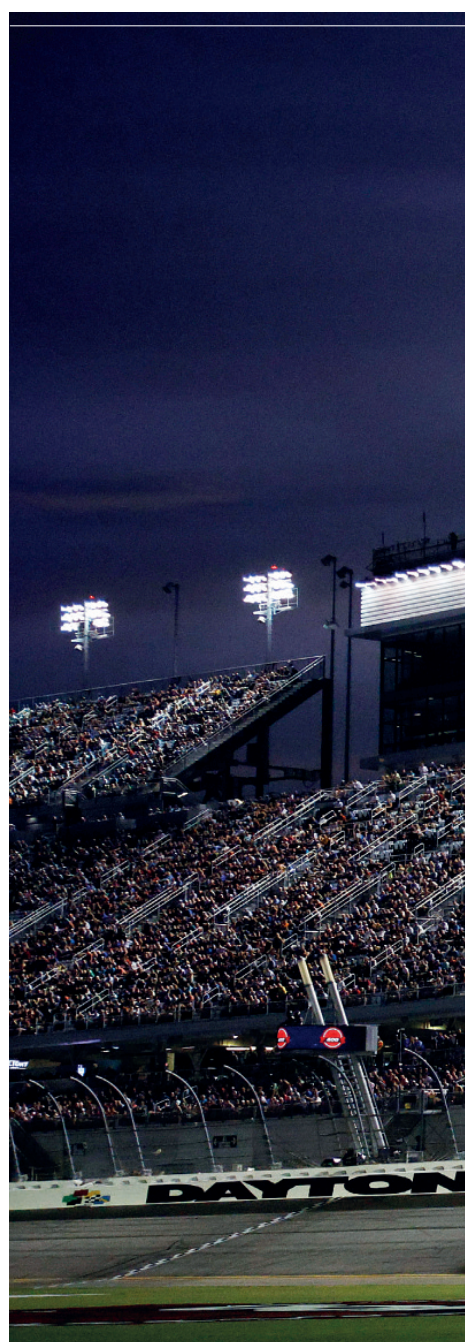
LEFT & ABOVE

Heresy? The EV, complete with a rear wing, tests the boundaries not just of technology but fans' acceptance



Getty Images/NASCAR

RIGHT The modular nature of the Next Gen car design paved the way for NASCAR's future experiments, but there's no suggestion a field of EVs will be charging around the World Center of Racing anytime soon



isolate the battery, how to isolate the vehicle and how to tow it if there were to be an incident. As a designer, you just want to get your hands on the car and start designing it, but there are other changes we needed to make outside of the car. That's where we've leaned very heavily on the IMSA folks – preparing our track services and emergency services for having an electric vehicle on the track.”

It's also a learning curve for the drivers – not all of whom are convinced by the idea of an electric NASCAR. But it certainly seems to have left an impression on test driver David Ragan.

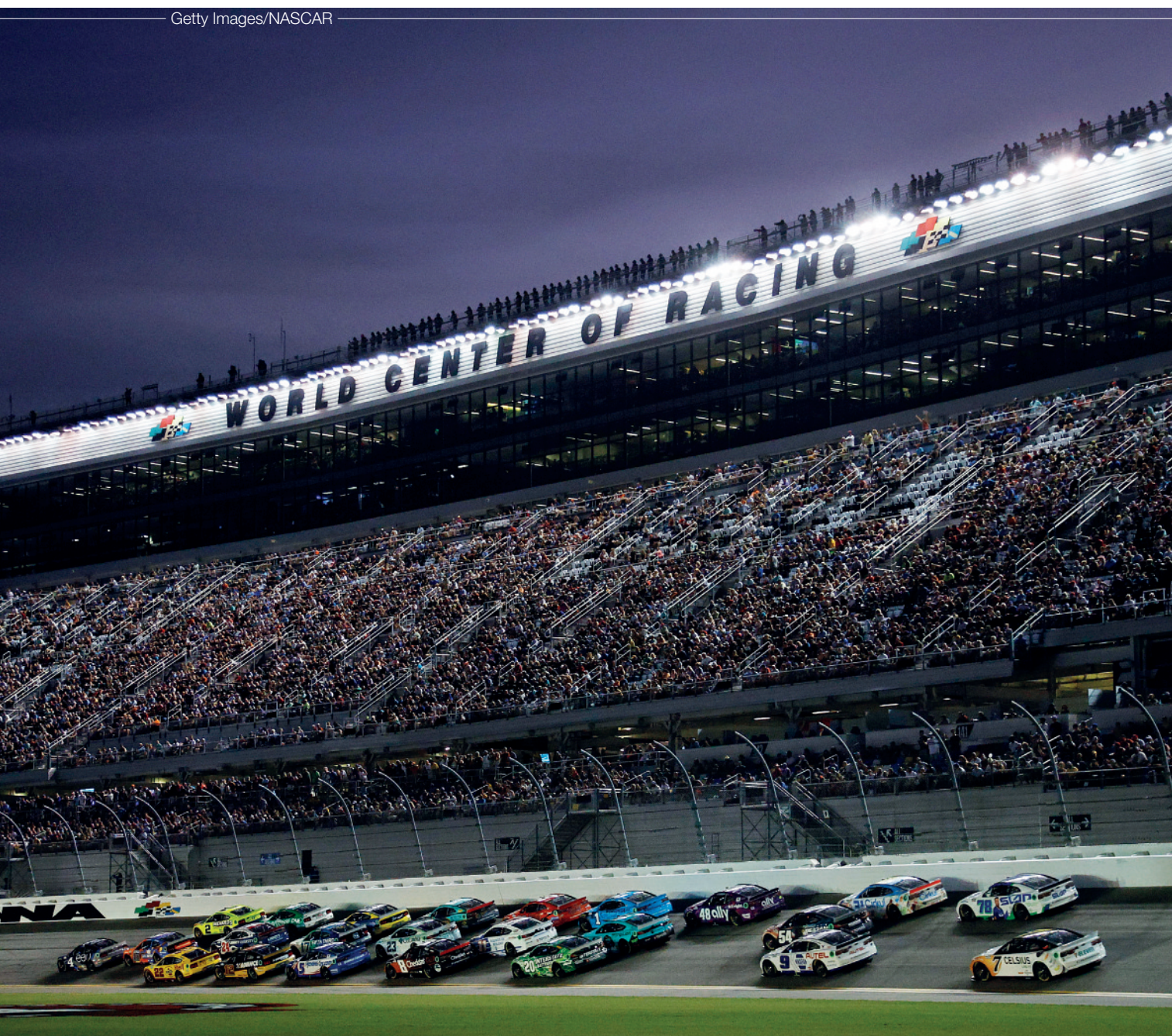
“More than just a marketing stunt”

“David's comment when he stepped out of the car was that everyone should be able to feel that feeling when you have an all-wheel drive electric vehicle that's supplying instantaneous power to the wheels. It's a different sensation,” comments Tobin.

And that comes back to the whole point of this exercise. There's never been a serious suggestion from NASCAR

or anyone else that we might see 40 battery electric cars shrieking into turn one at Daytona any time soon. But with each new technical exercise – whether that's Garage 56 or the EV – the series gathers experience, some of which *could* be repurposed for race use in the future. Just as importantly, it tests the boundaries of acceptance among the fans. An all-electric powertrain is surely the biggest taboo that NASCAR could ever break. In comparison, perhaps an alternative fuel or some degree of hybridisation wouldn't seem so bad after all? **RT**

— Getty Images/NASCAR —



MAKING MOTORSPORT'S 'MOONSHOT' A REALITY

Chris Pickering talks to the motorsport director of Symbio, the hydrogen mobility pioneer whose technology underpins the ambitious Extreme H and MissionH24 hydrogen projects



MissionH24

TEN years ago this month, motorsport crossed a new frontier. As the lights went out on the gantry in Beijing in September 2014, the first ever Formula E ePrix brought electric racing to the mainstream.

Since then, the continued success of Formula E – and latterly Extreme E – has played a huge part in normalising the concept of electric motorsport. It remains niche, but it no longer seems outlandish in the way it did when those first cars lined up in the shadow of the Bird's Nest stadium.

Racing with hydrogen fuel cells is a very different matter. Sure, there's been a handful of prototypes and technology demonstrators, but the idea of fuel cell vehicles racing at a major international level still seems like a moonshot. Except,

it's about to become a reality.

When Race Tech spoke to Formula E founder Alejandro Agag recently, he made no secret of the fact that his new hydrogen venture, Extreme H, was motivated largely by the desire to do something that no one has done before. Something that would have a comparable impact to the arrival of electric motorsport a decade ago.

The Extreme H car is known as the Pioneer 25. Almost every part of it is new, but the concept behind its electrical and mechanical design is similar to that of the outgoing Extreme E car. The motors (manufactured by Helix and originally designed to the Gen2 Formula E regulations) are carried over, as are the inverters. Even the battery, although repackaged and reduced in capacity, is based around the same internal

architecture as the current Fortescue Zero unit used in Extreme E.

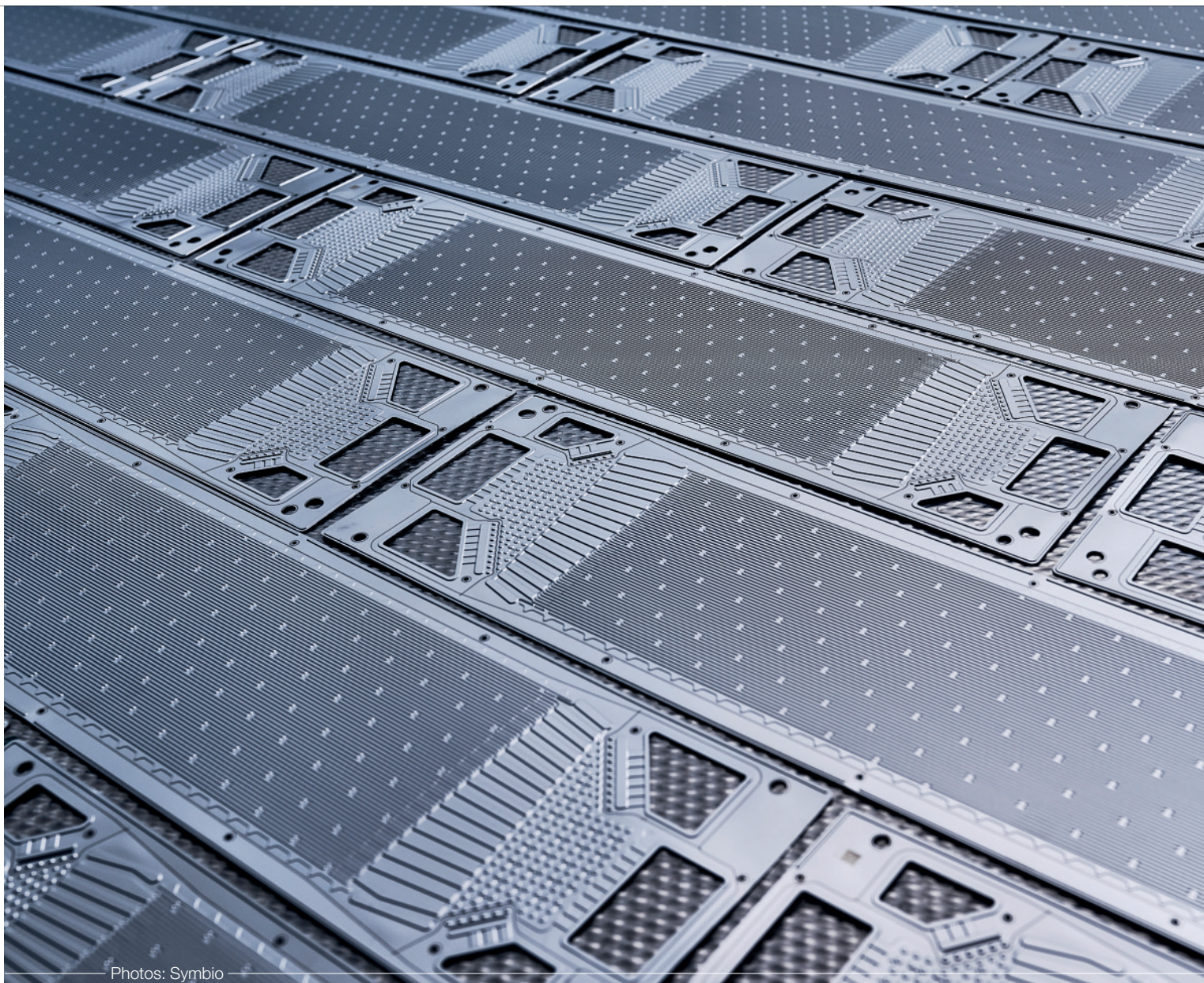
What really sets the Pioneer 25 apart is its fuel cell, which comes from hydrogen specialist Symbio. It's a name that may well ring a bell even if you've not been following Extreme H. The firm has been a long-term partner of Green GT and the ACO's Mission H24 initiative.

"We're very interested in how motorsport can accelerate the transition towards zero emissions mobility," explains Symbio's motorsport director Serge Grisin. "It's an opportunity to race with no emissions besides water vapour."

Fuel cells are essentially generators. They use an electrochemical reaction – typically between hydrogen and oxygen – to produce electricity. As a general rule, they operate at or close to ►



ABOVE Symbio's fuel cell expertise is taking MissionH24's hydrogen fuel cell-powered prototype into new territory. The H24EVO will chase performance, where its predecessors targeted range and reliability



Photos: Symbio

fixed load, charging a battery or other storage system. This battery provides an instantaneous response when the driver puts their foot down, while the fuel cell can continue to operate at its most efficient point. In effect, it's a hybrid.

As with any hybrid, one of the first decisions when designing the system is how heavily you're going to rely on the battery. At one end of the spectrum, you can have a fuel cell that produces enough energy to fulfil almost the entire power demand at any given time. In that instance, it's only necessary to use a very small battery (or potentially another storage method such as supercapacitors) to provide a buffer that can respond to sudden spikes in demand. At the other end of the spectrum, the car functions more like a battery electric vehicle, with substantial reserves of energy in the

“A wisp of water vapour is the only real clue to the fact that this car carries its own power station around on its back”

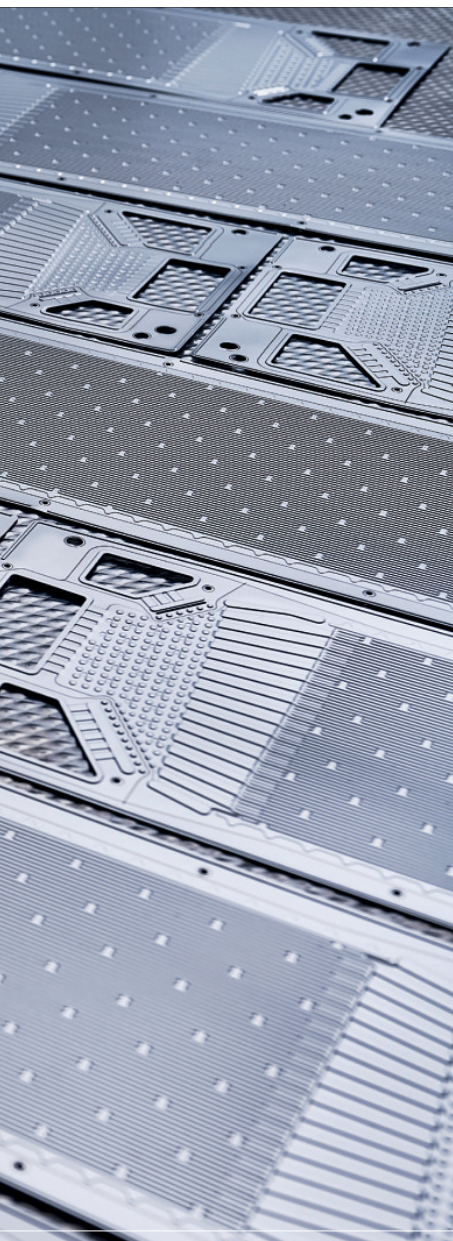
battery, which is topped up gradually by a low-output fuel cell.

Extreme H sits towards the more battery-dependent end of the spectrum with a 75 kW fuel cell charging a 36 kWh battery that has a maximum output of 400 kW – more than five times the nominal output of the fuel cell. In order to maximise range, the batteries will be charged in the paddock before the start of each heat. It's important to note, however, that this will be done entirely with the fuel cell – the Pioneer 25 remains 100 per cent hydrogen powered, even when it's pre-charged in the pits.

Tricky balance

The more power you choose to extract from the fuel cell, the bigger and heavier it becomes. This also has an impact on the size of the hydrogen tanks and the capacity of the cooling system that's required. It's a tricky balance to strike.

“When it comes to Extreme H we're acting as a supplier, so the decisions on things like what output would be required for the fuel cell came from the championship's technical department,” comments Grisin. “But what was very interesting from our perspective was that the performance they required was very



similar to that on some of the small buses and light duty utility vehicles that we already work with. There's also a similar level of hybridisation. It's the same technology inside, which makes anything we learn from motorsport directly relevant to those other segments."

The design of the fuel cell has been adapted for motorsport use, but the core technology is taken directly from Symbio's existing range.

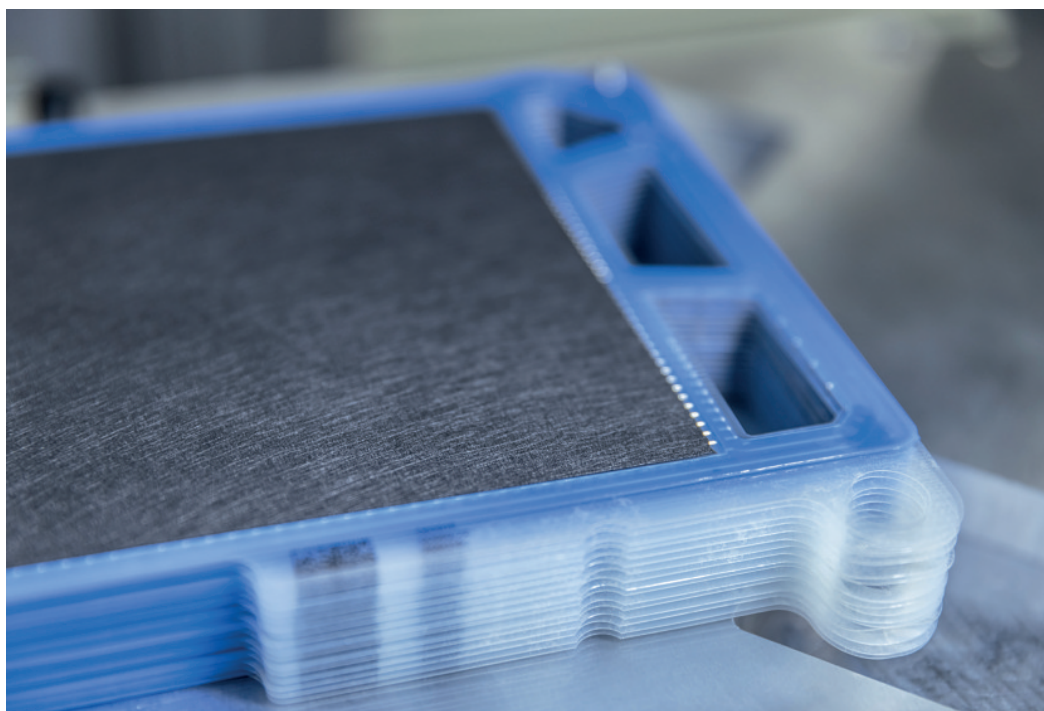
"If we want motorsport to function as a laboratory for other industries, we must use technology that's applicable to those applications," comments Grisin. "The stack and the cells in the Extreme H fuel cell are standard. Around the fuel cell itself you have

the rest of the system, which includes the compressor, humidifier and DC-DC converter. That's where the work has gone into adapting this unit for motorsport use."

Various different configurations were trialed during the development process, but the finished design uses a single stack comprised of 400 individual cells.

"There have been several evolutions along the way," comments Grisin. "The underlying system works very well and has proved very robust, so we've not changed that, but we've had to adapt the fuel cell to meet the requirements for the FIA crash tests, which are very severe. They're a step forward compared ►

ABOVE & RIGHT Symbio's unit (top right) for assembling the bipolar plate (above) and the MEA (membrane electrode assemblies, seen right), the two key parts in the construction of a fuel cell





LEFT You're familiar with the term 'flatpack', well this is 'StackPack': Symbio's complete range of fuel cells designed to address companies' decarbonization objectives, whatever the needs in terms of power or durability

to what we need to comply with for normal road use. There have also been some changes to the packaging and the overall specifications of the car, which have caused us to make small changes to the design of the fuel cell."

Testing of the Pioneer 25 is reported to have gone well. Race Tech was present at the car's first public test in Scotland earlier this summer, where it was visibly quicker than the Extreme E machines that it's due to replace.

Overall, it looks and sounds much the same as the

'E' car. There's a combination of electric motor whine and a whoosh that comes from industrial quantities of gravel being clawed from the surface and blasted out behind the car. Even from a distance, however, you can hear a sound a bit like an idling jet engine from the fans and the compressor attached to the fuel cell. Up close, you can even pick out a wisp of water vapour coming from the back of the car as hydrogen and oxygen bond together. It's the only real clue to the fact that this car carries its own power station around on its back.

Different applications

Extreme H is a very different proposition to Symbio's other main motorsport project, MissionH24. Far from being a hindrance, however, Grisin says the contrast is useful: "Extreme H follows an off-road sprint format with the fuel cell functioning mostly as a range extender. That's very different to H24, where ▶

“The idea of fuel cell vehicles racing at a major international level still seems like a moonshot”

BELOW Symbio's first gigafactory, SymphonHy, Europe's largest integrated site producing hydrogen fuel cells, targets an annual output of 50,000 fuel cell systems



Photos: Symbio

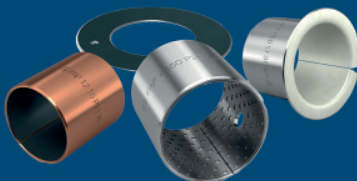


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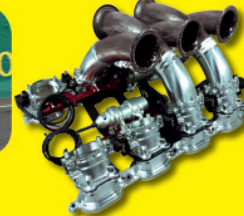
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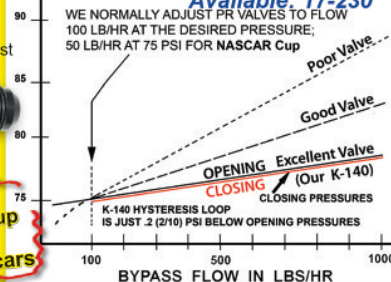
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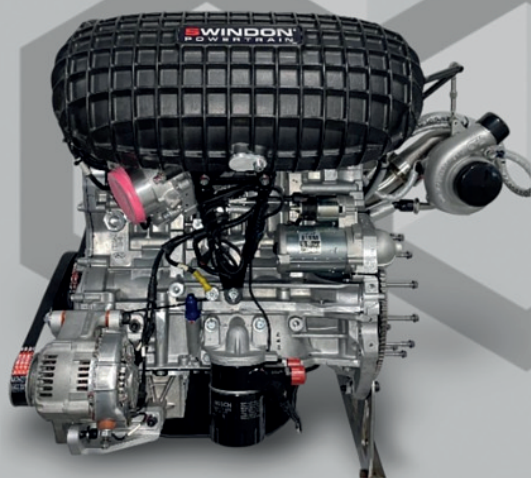


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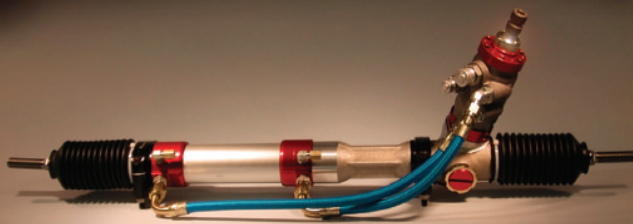
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it's an endurance race on a circuit, with a 400 kW fuel cell as the primary power source and a small battery that's used mostly for the energy recovery. Both complement our road-going projects very well. The output of the H24 fuel cell is roughly what we need for a truck application.

"It's two different technologies – partly due to the timescales as we're already running with Extreme H and we won't start running H24 until next year – but both are feeding into each other to a certain extent. I think you need a specific mindset for motorsport, which is common to both, and it's also helped to accelerate the innovation for our road-going programmes."

Another area where the plans for hydrogen vehicles in endurance racing are now set to differ considerably from Extreme H is the use of liquid hydrogen storage. So far, the H24 development cars

“We’re very interested in how motorsport can accelerate the transition towards zero emissions mobility”

have used gaseous storage, similar to the Pioneer 25, but the FIA has made it clear that it sees liquid hydrogen as the best option for the future.

Switching to liquid storage poses huge challenges for the hydrogen tanks, the fuel system and the infrastructure, but it's less of a concern for the fuel cell itself, Grisin points out: "We can adapt to either of those storage types with only very minor changes. The H24EVO that's being developed at the moment still uses gaseous storage, but one of the advantages of a fuel cell is that it doesn't mind where the hydrogen comes from. You can change ►

BELOW Plans for the world's first hydrogen World Championship have been made possible by Symbio's development of the hydrogen fuel cell for Extreme H's Pioneer 25



Extreme H



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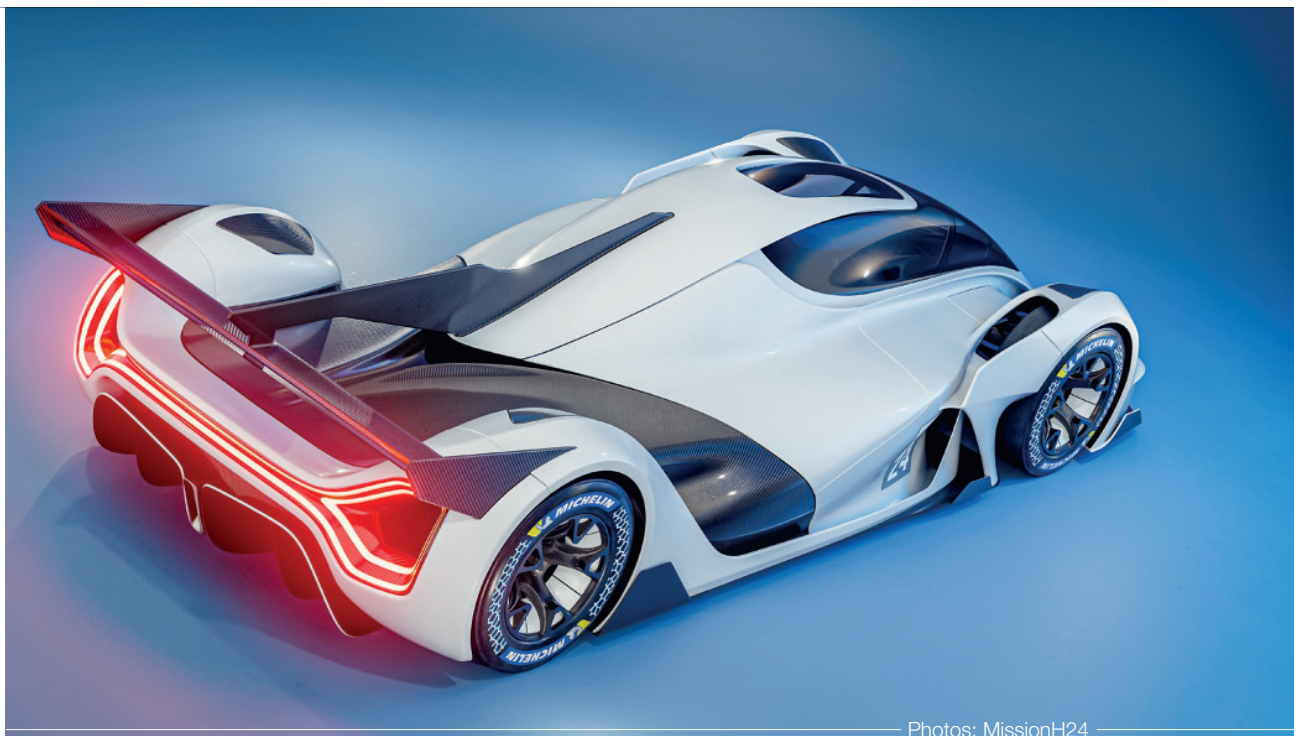
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Photos: MissionH24

ABOVE & BELOW Symbio is official fuel cell supplier for the H24EVO hydrogen-electric prototype (above), which will feature a 50 per cent improvement in power density compared to the current H24 car (below)



the shape of the tanks or move them to another part of the car and it still works. By the time it reaches the fuel cell, the hydrogen will be a gas, even if it starts off in liquid storage.”

Wider view

The concept of fuel cells goes back more than 180 years, with the first hydrogen-oxygen fuel cells developed in the 1930s. NASA has used a similar concept on space programmes since the 1960s. But the current push towards low-carbon mobility has stimulated renewed interest in the technology down here on earth. In road-going applications as in motorsport, the main focus of development is

increasing the power density.

“For the H24EVO, we plan to have a 50 per cent improvement in power density compared to the current H24 car,” comments Grisin. “This improvement means you can either have more power or a smaller, lighter fuel cell for the same output. At the same time, we’re also looking at the efficiency, because this is directly linked to the range that you can get out of a certain quantity of hydrogen. This is another major concern. Hydrogen is very light, but you need very strong tanks to store it, which translates to weight. So, if you can improve your efficiency and reduce the amount of hydrogen you need to carry that will have a significant impact

RIGHT The clean room of the Symbio production unit

“The FIA crash tests are very severe, a step forward compared to what we need to comply with for normal road use”

on the size and weight.

The other big focus is on cost, he says: “We think professional fleets are a key market for hydrogen, and there it’s all about the total cost of ownership. We’ve set up a gigafactory with the capacity to produce 50,000 units a year, because this will help us to dramatically reduce the cost. All of these are considerations that are relevant to motorsport as well as

road vehicles, so there is a common link between the two.”

Extreme H and H24 are Symbio’s two main motorsport activities. Alongside that, the company is also involved in the Formula Student Hydrogen initiative, which aims to nurture a new generation of motorsport engineers.

“At the moment, there are no real hydrogen training programmes at universities. So, we’ve started a project called Hydrogen Academy to establish a training programme at universities in France and beyond. And we are also working on the Formula Student concept to help this happen,” Grisin explains.

Long-distance rally raid events such as the Dakar are another discipline that could lend themselves to hydrogen in the future, but Grisin adds a note of caution: “There’s a strong willingness to

have hydrogen on the Dakar, but I think it will be complicated with regards to the infrastructure.

“Refuelling with hydrogen is quite easy if you have a conventional racetrack, or even a fixed location for an off-road event like we have with Extreme H. But if you’re moving hundreds of kilometres each day it becomes a lot more complicated. That’s another area where motorsport can help. If you strengthen the infrastructure, whether it’s a fixed refuelling station at a circuit or a mobile truck, it won’t just be used for racing.”

Of course, it’s still early days at the moment. Hydrogen mobility is a common topic among engineers and environmentalists, but in most regions it has yet to reach a mainstream audience. Motorsport could have a key role to play here too. And that starts with Extreme H. **LT**



Symbio

FOR all the advances in computing power and CFD, one fact remains.

Aerodynamicists love a wind tunnel. That's particularly true in Formula 1 where all the top teams once again have in-house facilities or imminent plans to introduce them.

It's perhaps no coincidence that

McLaren's recent return to form has coincided with the opening of the team's own heavily-upgraded wind tunnel, allowing the Woking engineers to test on-site rather than shipping parts out to Toyota's facility in Cologne. Likewise, Aston Martin Racing is gearing up to bring its testing in-house with the opening of a

new multi-million pound wind tunnel at its Silverstone headquarters.

For now, at least, wind tunnel testing remains an indispensable tool in top-level motorsport. But the tunnel itself is only part of the equation. The 60 per cent scale models used for testing will set you back more than a Bugatti Chiron and each one is crammed with something like 1,000 channels of data logging. It's not just a question of logistics, either. Better data means greater insight, which can ultimately translate to a race-winning advantage.

The sensors are a work of art in their own right as Iain Gordon, Evolution Measurement General Sales Manager, explains. He's holding up an MPS4216 16-channel miniature pressure scanner. Roughly the plan area of a credit card, it contains all the hardware required to capture 16 individual pressure readings, synchronise and time-stamp them, then export the data via an inbuilt web server. It's a very clever little box.

SMALL IS BEAUTIFUL

The latest in the MPS4200 family of miniature pressure scanners from Scanivalve could offer aero teams unprecedented insights. **Chris Pickering** discovers more



Courtesy of Formula 1



ABOVE No, it's not a giant pen – the MPS4216 really is miniature!

The MPS4216 is the latest in the MPS4200 family of miniature pressure scanners from US firm Scanivalve. Evolution Measurement is Scanivalve's distributor for much of Europe, but the Hampshire-based company also brings a wealth of specialist expertise in motorsport, working directly with some of the biggest names in the industry, and is a scanner manufacturer and systems integrator in its own right.

As Gordon explains, the principal thinking behind the MPS4216 is miniaturisation: "The key thing about the '16 is that it's absolutely tiny. It's

so what you apply one end doesn't necessarily make it to the other end," notes Gordon. "In extreme cases, you're limited by the speed of sound, so sudden pressure spikes can be attenuated or missed completely. Really you want to have the tubes as short and ideally the same length, as you can."

In the past, pressure scanners have often come with a significant amount of external hardware to process the data. By integrating all of this onboard the MPS4216, Scanivalve has been able to eliminate that additional volume. Aside from the pressure ports, there are only

“Better data means greater insight, which can ultimately translate to a race-winning advantage”

got all the same features you get in the larger versions, but it's small enough to fit inside something like a wing element or a brake duct. Some of the aero details on the cars now are getting so intricate that the smaller you can go with the measurement system, the better."

Reducing the size of the scanners also means that they can potentially be placed closer to the pressure tapping, reducing the tube length that's required to sample the air pressure at that point. This helps to improve the tube's frequency response.

"It's a bit like applying a pressure down a hosepipe. The air itself is compressible, plus the hose will expand and contract,

two connectors: one that brings the power in and another that takes the data out via an ethernet connection.

Power can be anywhere from 5 volts to 30 volts, either from an external source or a battery pack installed on the model.

"We've done a project with an automotive OEM that couldn't have any power to the wind tunnel model for various reasons, so this allowed them to run a 9-volt battery on the model itself," comments Gordon. "Another battery-powered application we had was on a drone with a pack of four 9-volt batteries, which ran for about eight hours without any additional power." ▶

LEFT Major rule changes always stimulate aerodynamic innovation. F1 aero development will be a ferocious battleground as teams look to get the jump with the 2026 car





Clever thinking

One area where the MPS4216 differs from some of the previous designs is that each channel has its own 24-bit analogue to digital converter running in parallel. "Running individual ADCs gives us more resolution and performance and improves overall measurement integrity," he says.

A dual core processor is used to crunch through the data, ensuring that everything remains synchronised, using the IEEE 1588 protocol that allows multiple devices on a network to be time-stamped to a central clock to sub-microsecond accuracy.

"Even if you're using the larger 32- or 64-channel devices you've probably got at least 10 of those inside a Formula 1 wind tunnel model, so there's a lot of channels," comments Gordon. "You want to be sure that when an event occurs, like a change in the turbulence or the wake characteristics, you can capture

that and track its impact right across the car. So, you need to make sure that the scanner at the front wing, for instance, is synchronised with that on the rear wing."

All 16 (or indeed 64) channels can now be logged at up to 1 KHz. Gordon admits that even in Formula 1 – with its famed appetite for data – this sampling rate can be excessive on some parts of the car.

“Time-stamped to a central clock to sub-microsecond accuracy”

There, the device can be set to log at a slower rate to reduce the volume of data that needs to be analysed. In critical areas, however, it can open up new insights.

"We've seen a few teams who've started to do measurements in certain areas where they run the scan and just see if they can find something. They're just

experimenting with it in areas that they couldn't measure before. They're now being able to go much, much faster and potentially pick up turbulent effects that they've not seen before," he says. "Potentially phenomena that they'd previously only seen on CFD or which the CFD had missed completely, and they didn't realise were happening."

The internal processor also corrects the channels for temperature. Not only does the air pressure that's being measured fluctuate in accordance with ambient temperature, but the material properties of the sensor need to be taken into account. The scanner contains 16 pressure sensors that are mounted on individual silicon mounts by a unique patented method. This isolates them mechanically from any potential



Courtesy of Formula 1

LEFT The scale models currently feature in excess of 1,000 channels of data logging

stresses that may occur from external influences.

"The pressure sensors work in a similar way to a resistance transducer, but where that is tightly constrained so it only changes resistance by strain effects or by temperature effects and hence produce a measurement," explains Gordon. "Any residual remaining stresses, however small, are characterised and negated by Scanivalve in a series of calibration processes. Without this detailed correction there could be accuracy and hysteresis offsets created by temperature or mechanical influences, as with any instrument under extreme conditions. Accurate, local temperature measurement within the scanner is used to negate any further temperature effects on the sensors."

Open doors

The sensors boast a 100 psi pressure range and they provide a true differential output. Each sensor has a diaphragm, with the static barometric pressure applied to one side and the pressure measured from the port on the other. Typically, this static pressure comes from an external probe, mounted inside the wind tunnel and/or from some form of static reference.

"People go to all sorts of lengths to isolate the static pressure from any dynamic fluctuations. Static references can sometimes be a container full of ping pong balls or empty cans to remove any dynamic effects; we supply such devices from Scanivalve, or customers sometimes make their own," comments Gordon.

That might sound excessive, but it's entirely sensible when you're dealing with such sensitive instruments, he points out: "If someone opened a ▶



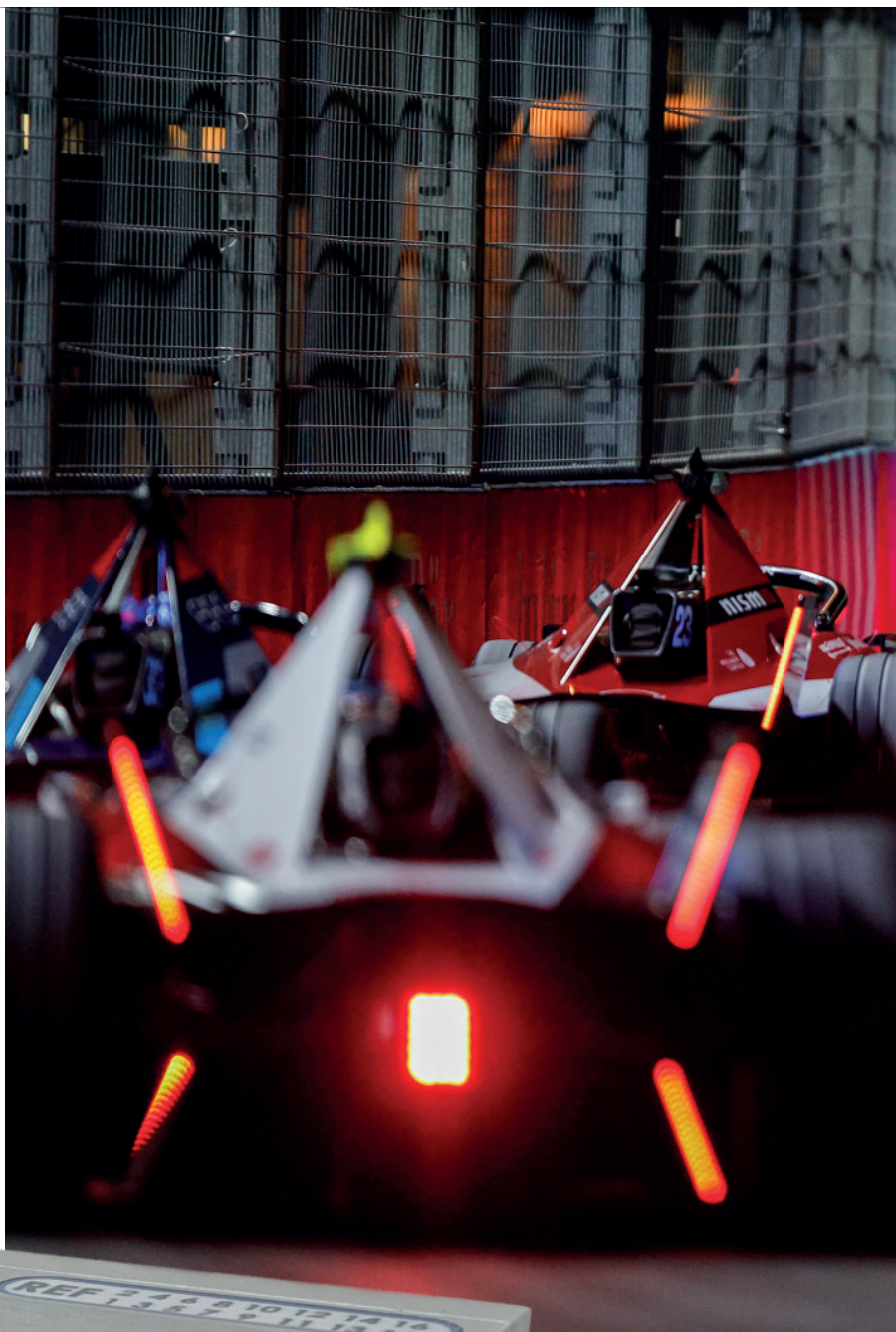
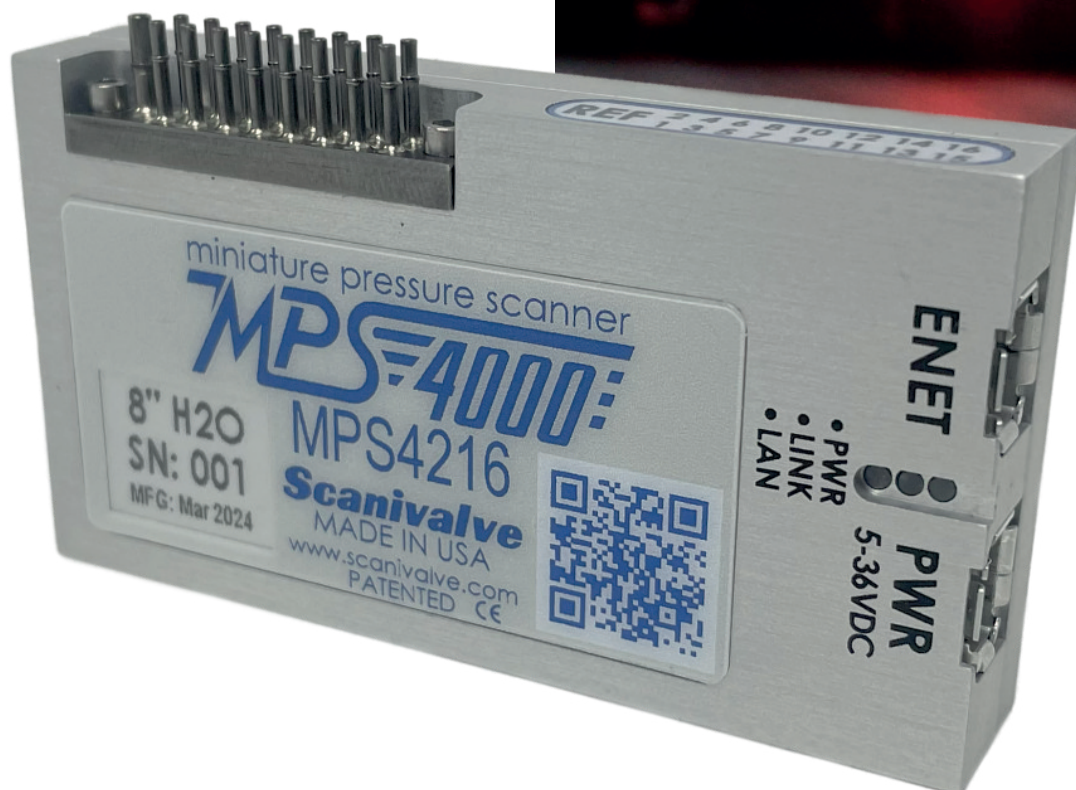
LEFT The Scanivalve 16-channel intelligent miniature pressure scanner targets aerodynamic testing and industrial applications with its compact size, high accuracy and high speed

door or a window in the next office down the hall, we'd see that change on the scanner right now. In a wind tunnel you generally have static ports in the walls. What we've seen before is a 16-channel scanner in the floor of the wind tunnel, another in the ceiling and two in the walls. The weather can change significantly overnight. There's a danger that the wing you test today might look like a big improvement over the one you tested yesterday, when it's actually due to the weather."

“Picking up phenomena that they'd previously only seen on CFD or which the CFD had missed completely”

Other features of the MPS4216 are somewhat less high-tech but no less useful. Gordon points to the removable header – a detachable manifold that allows the pressure pipes for all 16 channels to be attached before the header is fixed onto the sensor.

"One of the biggest headaches when you're working in a wind tunnel is getting all the tubing on, and ensuring that nothing is split or plugged into the wrong channel," he says. "If you're tubing up a wing or something, the removable header means that you can get all the tubes in place. If you're using the 64-channel device that process alone can take you a significant time. The



ABOVE Even Formula E, where aerodynamics are not meant to be a performance differentiator, is not immune to the quest for more aero data. Some teams used on-car measurements to understand what was happening when the Gen3 rules were introduced

LEFT No bigger than the plan area of a credit card, the MPS4216 contains all the hardware required to capture 16 individual pressure readings, synchronise and time-stamp them, then export the data



investment goes into the scanner – the headers are comparatively affordable, so if you’re testing multiple wing sections you could leave the headers in there and just transfer the scanner over. It’s more of an issue on the larger scanners, but if you’ve got four or five 16-channel units built into a wing it soon adds up.”

Changes

Major rule changes always stimulate aerodynamic development, and the 2026 Formula 1 regulations look set to be a case in point. The cars promise to be smaller and lighter, with less floor area to generate downforce and movable front and rear wings to encourage closer racing. It’s a significant shift, and one that


the teams have already been working on for some time.

“The teams aren’t allowed to begin wind tunnel or CFD testing on the 2026 cars until next year, but it’s certainly something that’s being talked about. The big question next year will be the point at which they start to concentrate less on the 2025 car and focus more on 2026,” Gordon notes.

Aerodynamic testing continues to play an important role elsewhere – even in spec series and those subject to a balance of performance system.

“Even if you’re running to a homologated aero package in something like LMH there’s a huge benefit to understanding your setup from a race

engineering perspective,” comments Gordon. “It’s the same in Formula E. They’re not necessarily spending much time in the wind tunnel, but they’re using on-car measurements to understand what’s going on. We know of at least one team that did quite a lot of work around benchmarking the Gen2 car to Gen3 in Formula E.”

It’s clear that rumours of the demise of physical testing for aerodynamics have been greatly exaggerated. In fact, there are probably more wind tunnel building projects taking place at the moment than at any time in the past 20 years. But the real value comes from the data that these facilities generate. And that means that there’s a lot resting on these little sensors. 

LADDER FRAME

Two major announcements have added to the ladder of progression for newcomers to motorsport – and the same man is behind both of them. By **Andrew Charman**

ESTABLISHING a 'ladder' – a path of progression for those wanting to start in racing and progress up towards the highest disciplines – has long been a desirable aim among the sport's rule-makers. Various initiatives have been tried out over the years, some more successfully than others.

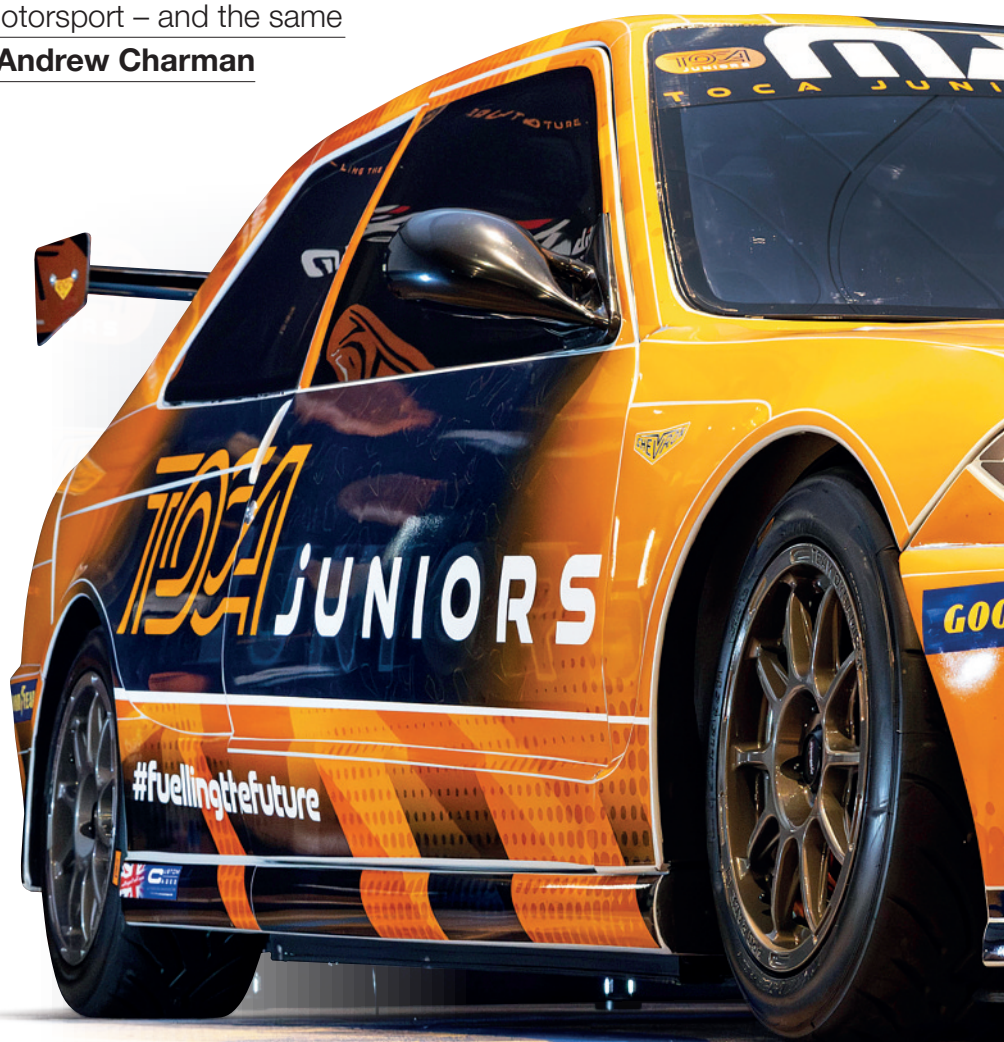
The latest moves in this direction see the announcement within weeks of each other of a new entry-level rule set forming the base of the international touring car racing pyramid, and a new junior series for young drivers who want to start motor racing or progress from karting. Australian Alan Gow has been central to the creation of both, in his dual roles as president of the FIA Touring Car Commission and chief executive of TOCA, organiser of the British Touring Car Championship (BTCC).

A popular part of BTCC race days has long been the support package, not least because the categories that race alongside the Touring Cars benefit from a wall-to-wall television package with most of their races shown live and in full on UK commercial channel ITV4. Combined with numerous replays across the ITV network, this forms a strong proposition for drivers to present to potential sponsors.

For some 14 years the support package included the Ginetta Junior Championship. Not only was this series for 14- to 17-year olds highly popular with race day and TV viewers, its importance could not be understated – drivers including F1 race winner Lando

Norris, 2022 BTCC champion Tom Ingram and BTCC title contender Jake Hill took their first steps in racing at the wheel of a Ginetta.

At the end of 2022, however, Ginetta decided to remove its series from the BTCC package, leaving Gow with the task of not only filling vacant slots on his support package but finding something to keep the youngest competitors in the race day entertainment. That has now come to fruition with the launch last month of the car for the new TOCA Juniors Championship.



BELOW The new Chevron B1417 takes its first bow

“A junior series is much more than developing a future touring car driver. That’s why the car had to be rear-wheel drive”

“When Ginettas left (the TOCA package) it left a hole,” Gow says. “Having a junior series at a high-profile race meeting is really important, not only for us, developing our next generation of race drivers, but for the juniors, as they get to race in front of big crowds and TV, and to improve their skills in an environment they wouldn’t get anywhere else.

Vital stepping stone

“It’s important for the drivers, their parents, their team and sponsors, to display their talents in the biggest arena they can – you’ll only get that on the TOCA package because of the crowds we have and the TV we have, and that’s an important stepping stone.”

Gow says he had the idea to set up a new Junior series the day after he waved goodbye to the Ginettas. Expressions of interest were issued producing

many emails and phone calls and leading eventually to David Beecroft.

Over the past 10 years Beecroft has with Vickie MacClinton organised the Junior Saloon Car Championship, a series specifically aimed at 14- to 17-year olds. At one point he sketched out an idea for a bespoke series among fears, ultimately not realised, that Motorsport UK would not allow the JSCC to continue using Citroën Saxo cars as its race machines. That concept has now formed the basis of TOCA Juniors, with Beecroft heading the engineering side and MacClinton the administration – Gow is very keen to make it clear that this is not his championship: “TOCA has put our name to it because we believe in having a good strong junior series, but it is very much Dave’s baby.”

Gow did, however, have very specific requirements of the new series: “I didn’t want a production front-wheel drive saloon car because a junior series is much more than developing a future touring car driver. And that’s also why I didn’t want it named as a junior touring car series. ▶



"It was important that the specifications of the car were correct in terms of safety, serviceability and running costs. It also had to be rear-wheel drive – all the things that enables a driver to go from this series to anything else, to open-wheelers, sports cars, touring cars, whatever."

These parameters removed several prospective projects, including, according to Gow, some OEMs which had put forward production hatchbacks. "That just wouldn't have ticked the box for me."

Ensuring these parameters were met resulted in Beecroft and MacClinton working with BTCC technical director Sam Riches. "Alan had some very specific requirements related around things we've observed from Juniors and other support categories which we think don't look very good," Riches tells Race Tech. "There's a traditional aspect of these sort of series around lots of bodywork falling off and cracked windscreens – and neither of us like that from a real aesthetic point of view."

The pivotal aspect, however, has been safety and Riches was able to make use of research in this area carried out by his father Peter, his predecessor as BTCC technical director. "He was involved in writing the criteria for junior motorsport and agreeing it with Motorsport UK 15 to 20 years ago. Alan and I have a strong line that a Junior has to be the safest car out there and my role was to make sure that happened."

Beecroft fully endorses this view, which he says is paramount for any driver but especially youngsters. "Team managers, mechanics, everyone has a duty of care when dealing with youngsters. As an adult you can get in a race car and get on with it, it's up to you, but with children it's different. They do mature very quickly within motorsport."

Ahead of the game

The criteria included working closely with Custom Cages. The respected rollage specialist – with a customer base that includes World Rally Championship teams and much of the BTCC grid – was responsible for producing the TOCA Junior car's frame and safety cage. Riches adds that the FIA's latest 2025 rollage homologation rules, which include a 60 mm diameter roll-over protection system main hoop, had been applied: "These regulations have actually not been adopted yet, pushed back for various reasons, but we've taken the principles of them and applied them to this car."

"In principle we've copied the touring car specification that we have learned and evolved over time. The car follows the same logic, based around a safety cell and a detachable front and rear subframe. The only difference is that this has a floor made out of the same tubes, whereas a Touring Car has a road car shell."

Other safety aspects include the latest advanced racing seat, a window net and the latest-generation

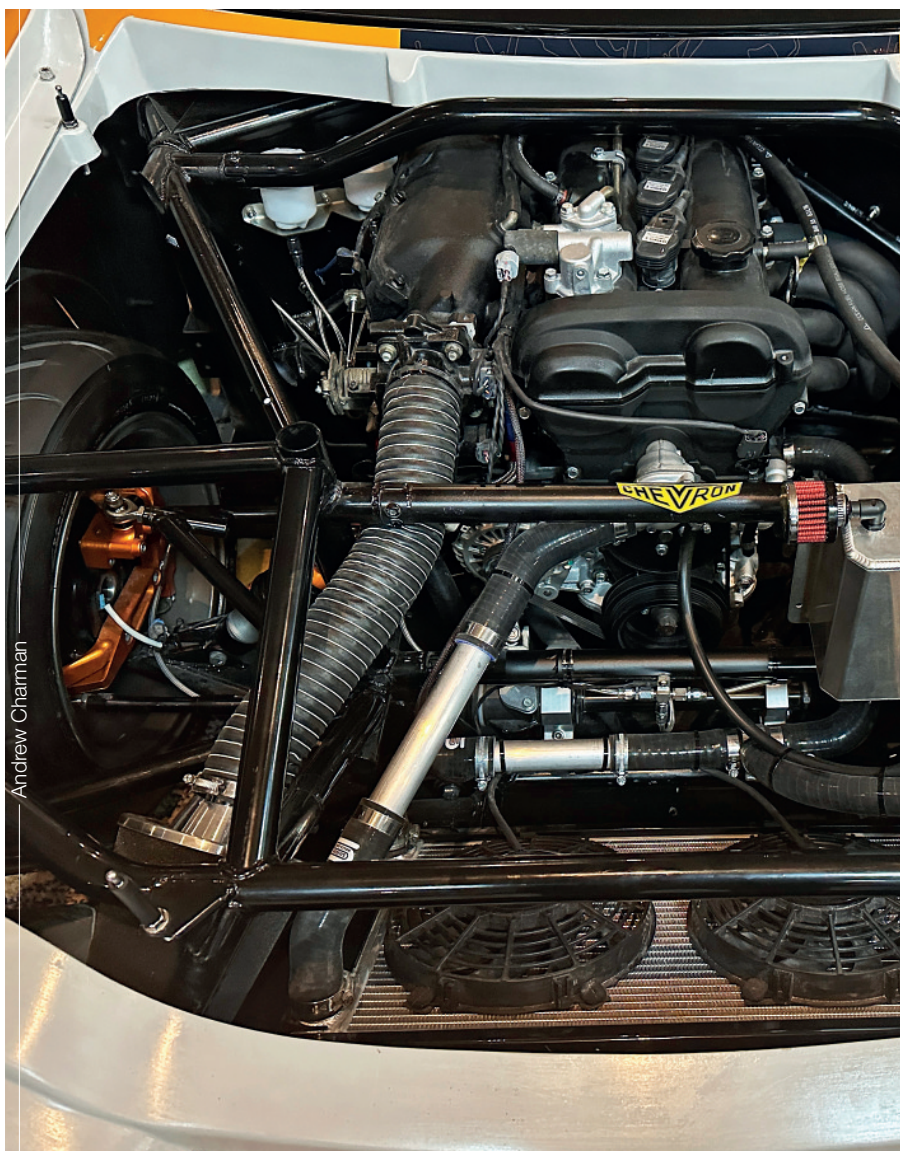
RIGHT The car is built for a new championship catering specifically for young novice drivers

fire extinguisher. "The seat is a fixed object and we move everything to it. The car has full side-impact panels and door foam – take the body off and it is the safest rolling spaceframe car I believe we can make. Our partners, such as Vic Lee at Corbeau Seats, the team at Custom Cages, have all stepped up and accepted that challenge."

The resultant car, dubbed the Chevron B1417 (see panel) has been designed specifically for young drivers, according to Beecroft right down to its basic shape. The profile is very much a traditional three-box saloon, which has divided some opinions, but Beecroft is unrepentant in not following a typical hatchback route – again part of the emphasis that this is a racing car not a touring car. "We wanted a big glasshouse so the drivers could see adequately – with some junior cars we have found that you can't (see out too well). We wanted the car to be accessible too, so marshals could get in if the drivers had an incident – some marshals are big people."

He adds that having worked with many cars and

BELOW The 1.8-litre engine is built in-house by David Beecroft's company, which also produces the engines for the Junior Saloon Car Championship



Andrew Charman



Jakob Ebrey Photography

teams in the past, serviceability of the car was a vital consideration, not only in terms of repair after on-track incidents but in general terms, with components built for a long service life and easy to maintain. This view is firmly backed by Patrick Scharfegger, newly appointed production director of the Junior project. "I got involved in December last year," Scharfegger tells Race Tech. "I knew Dave was up to something because my children race in his other series and we live in the same village. One day he put a drawing in front of me and said 'what do you think?'"

Scharfegger's role until now has been to offer a second view of the designs and suggest improvements, both from technical experience, having run his own race cars for several years, and with practical knowledge of the young clientele through his children's racing: "I was told ►

Why Chevron?

THE new TOCA Juniors race car carrying the name and to many so recognisable badge of former major racing constructor Chevron surprised many, but the company, and the name, are now owned by David Beecroft. "I'm from Bolton where Chevrons were made between the 1960s and 1980s," he says. "As a lad I used to go on my pushbike and watch the cars being built and loaded on trailers."

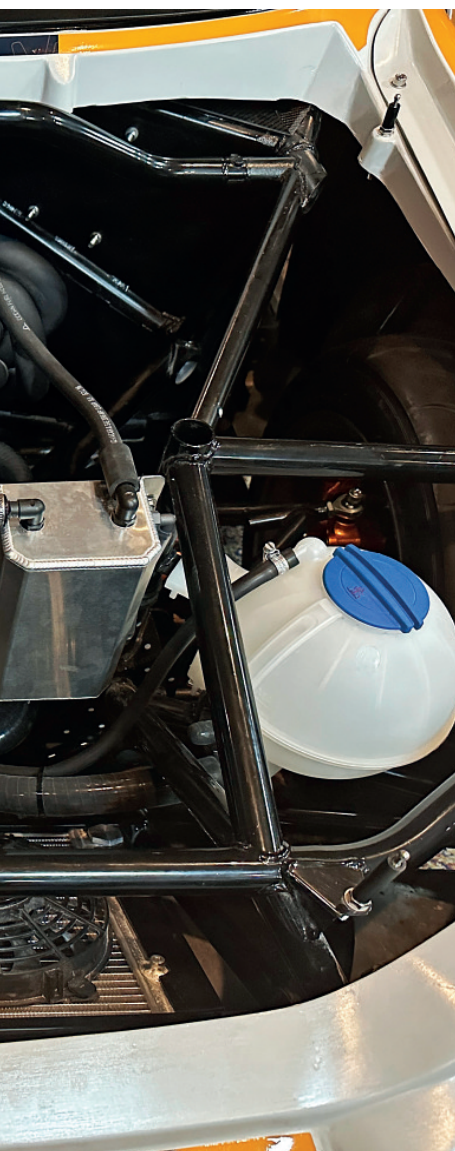
Chevron founder Derek Bennett died in a hang-gliding accident in 1978 and the company passed through several owners until Beecroft was able to buy it, together with the rights to the logo, in 2022.

"At the time the TOCA Juniors car was only being mooted but as it became real it became a Chevron," Beecroft says, adding that the model number had virtually decided itself. "Derek Bennett never did any cars with dual numbers such as 11 or 44. Our car is going to be driven by 14- to 17-year olds so it's a Chevron B1417." **RT**

RIGHT Cockpit layout reflects its clientele: push buttons, not switches



Andrew Charman



the look of the car was fixed in stone but everything underneath we could change.”

He too considered serviceability a priority: “How do you change a gearbox, how do you get a socket in? Young drivers are going to have accidents, so how much damage will be done and how will we repair it?”

The completed design with its detachable subframe met his criteria and he particularly enjoyed certain aspects of the process: “Everything comes apart which is great – you can take a subframe off to put a new differential in for example. I was working with Custom Cages to get an extra 100 mm clearance here and there so I can get a socket in and such – the kind of things you can’t do with a production car.”

All this work has resulted in a front-engined, rear-wheel drive car with a flat floor, its front splitter and adjustable rear wing providing a degree of aerodynamic assistance as the young drivers will need to grow accustomed to such aspects of race car setup.

RWD drivetrain

Power comes from a 1,798 cc four-cylinder unit with the chassis again accommodating the requirements of weight distribution, propshaft and the RWD drivetrain – something which would have been far more difficult starting from a production typically FWD shell.

Beecroft’s company is building the engines in-house, already being responsible for those used in

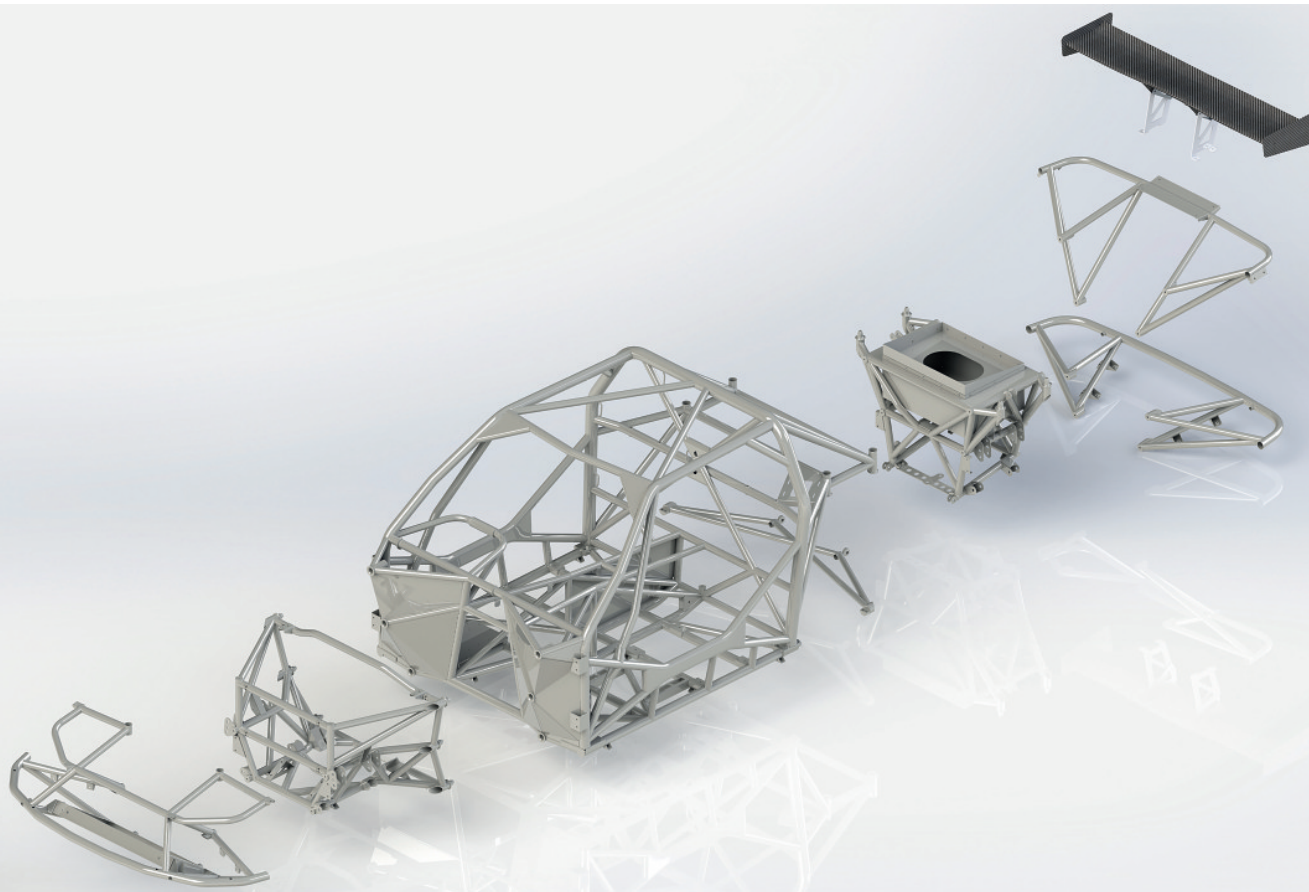


the Junior Saloon Car Series. Riches describes it as effectively a customised road car engine: “A safety requirement laid down for all four junior categories that are currently licensed by Motorsport UK targets (a terminal speed of) approximately 100 mph. There is a quite small power-to-weight figure you have to achieve of 0.12. With a car of around 950 kg, that only gives us 102 horsepower to play with.”

The engine is fuel-injected with a sealed ECU from Haltech, fed by a 30-litre fuel tank with the routing protected by the chassis pipes. Scharfegger is particularly pleased with a safety innovation that was his concept. “If a driver stalls on the startline the ECU will automatically start flashing a light at the rear of the car, as an immediate warning to other drivers that there’s a car stationary on the grid. The amount of accidents I’ve seen that I’ve thought were ▶

ABOVE Chevron fame stretched out from Bolton across the motorsport world. Here a B16 powered by a 200 bhp twin-rotor Mazda engine competes at Le Mans in 1970

BELOW The Custom Cages design follows touring car practice with a central safety cell having front and rear subframes attached to it



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Andrew Charman

preventable – it's something that should be standard. I'd previously tried to do it but didn't have the electronics knowledge but thankfully Haltech does."

Both the in-house produced gearbox and the differential, supplied by Elite, are sealed and to the surprise of some observers, the former is a traditional H-pattern unit. According to Scharfegger, whether to go sequential was a subject of much debate: "H-pattern is cheaper with less things to go wrong with it and people should learn to drive with H-pattern gearboxes as they don't know what will follow. They may go on to single-seaters with paddle shifts instead of straight sequentials. And they might get invited to the Goodwood Revival one day where they will actually be able to drive one of the period cars."

The suspension employs two-way dampers bespoke to the car and again built and sealed in-house, acting on wheels provided by former BTCC champion Matt Neal's Team Dynamics and Goodyear all-weather tyres. There is plenty of adjustability, Scharfegger adds, to the dampers, ride heights, toe and camber. "Adjusting suspension is all part of the learning process for drivers."

"Flashy dash!"

There are also less obvious aspects specifically targeted towards those who will drive the cars and again coming from personal experience. "We've gone away from having switches on the dash and replaced them with buttons, because young people like flashy dashes with push-buttons."

Beecroft is pleased with the way in which his concept has come together. "We've had 10 years with our other junior series and touch wood that's all been good. But this is a different level, a modern car built specifically for juniors," he says. "It's not an adaptation of anything else, we started with a fresh, clean piece of paper."

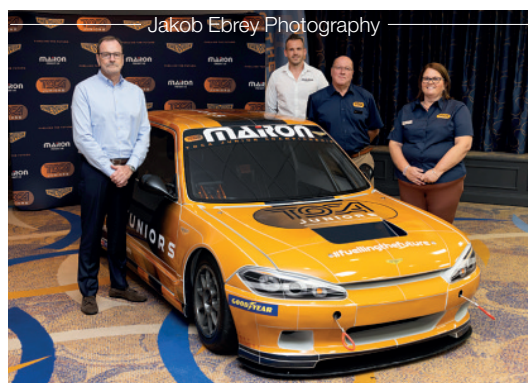
Currently Beecroft and Scharfegger are overseeing the construction of 30 cars, with grid sizes for the first season fixed at 26 entries. The complete car is costed

ABOVE Ginetta Juniors were a core and popular part of the BTCC support package for many years, nurturing such talents as F1 star Lando Norris

at £78,500 plus VAT, which is a significant gain over the previous Ginetta Junior machines and again has caused some comments among observers. But the team behind it argue this reflects the fact that it is a bespoke-designed state-of-the-art racing car.

Certainly interest is high. At the launch event, which saw the unveiling of the pre-production car, several established national racing teams were present, including leading BTCC squads West Surrey Racing and Laser Tools Racing, and Beecroft reports strong interest in the series. Round one, at Donington Park on April 26 2025, will see the preparation come to fruition. **RT**

RIGHT Prime movers behind the TOCA Juniors Championship. Alan Gow, who had the requirement, championship directors Dave Beecroft and Vickie MacClinton, and Tommy Watson of Mairon Freight, the championship's title sponsor



RIGHT Body structure is designed to a classic three-box shape, eschewing latest curved shells



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PYRAMID SELLING

A universal technical platform, based on existing rally regulations, is to form the base of the FIA's touring car pyramid. By **Andrew Charman**

SOME comments following the launch of the TOCA Junior car, particularly on social media, have wrongly assumed that it is meant to be a novice touring car, rather than an introductory car to motorsport as a whole as Gow, Beecroft and their teams intended. And its launch has come within weeks of the FIA taking a major step to strengthen the Touring Car ladder around the world – a new rule set that seeks to create affordable Touring Car categories underneath the established TCR formula.

TCR was launched by Italian Marcello Lotti in 2014, a formula based around production four- and five-door vehicles powered by 1.75 to 2.0-litre turbocharged engines. It was designed to be more affordable than the then Super 2000 Touring Car rule set that was at that time approved by the FIA. TCR grew quickly with a number of national and regional series emerging, and from 2018 the FIA replaced its World Touring Car Championship with the World Touring Car Cup, running to TCR regulations – this was superseded at the end of 2022 by the TCR World Tour, run by Lotti's WSC Group rather than the FIA.

TCR has continued to be the de facto Touring Car series in several countries and regions around the world, and has now even established itself in the UK, though it sits beneath the high-profile British Touring Car Championship which has run to its own NGTC rules for some years. Now the FIA has sought to create a distinct feeder rule set to TCR by adopting established regulations from its rallying categories.

Named TC Lite, the new rule set employs the regulations of the Rally4 and Rally5 categories, with the intention of cars to these regulations being able to be raced on circuits with only minimal modifications and no requirement for any further homologation by their manufacturers over that for rallying.

Announcing the move, the FIA stated that TC Lite will “therefore form the basis of the touring car pyramid, with the well-established TCR class, developed by the WSC Group, above it. The adaptations will be kept to a minimum so that the class remains cost-effective and the competitors are provided with a level playing field – the objective is to have the cars suitable for different motorsport competitions without the need for costly and time-

consuming conversions between the cars' rally and circuit specifications.”

The principal changes are expected to encompass only an adjustment in minimum weight to compensate for the removal of spare wheels, tools and hand-held fire extinguishers that are not required for circuit racing, the addition of window nets required in all FIA saloon series, and the use of slick racing tyres. The co-driver's seat of the rally car will either remain fitted or be replaced by ballast.

The two classes within TC Lite will follow the existing Rally4 and Rally5 categories. TCL5 will be designed to be most accessible and affordable with cars offering a power to weight ratio of around 6.0 kg/bhp, while the higher performance TCL4 will have around 5.1 kg/bhp.

Current Rally4 regulations have two sub classes, the first using 1390-1600 cc normally aspirated engines or 927-1067 cc turbo units, while the second employs 1600-2000 cc normally aspirated and 1067-1333 cc turbo engines.

Homologated Rally4 cars include the Ford Fiesta, Opel/Vauxhall Corsa, Peugeot 208, Skoda Fabia, Renault Clio/Twingo and Kia Rio and all these cars are also eligible for Rally5, others including the Citroën DS3, Mazda2 and Suzuki Swift.

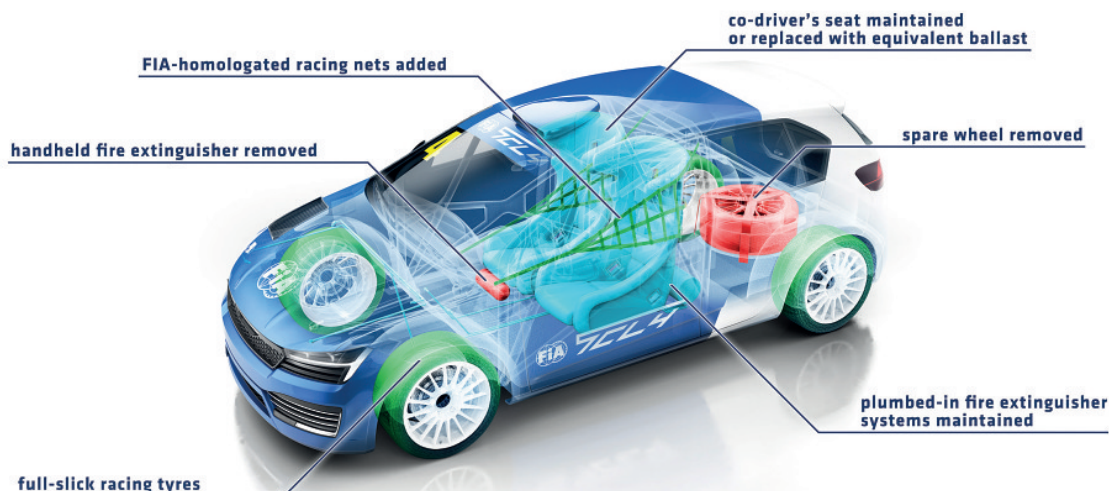
Grassroots racing

Rally5 regulations are the most cost-efficient and accessible within the FIA with only the bodyshell with cage, seat mountings and harness needing to be homologated. Under the TCL5 sub-class National Sporting Authorities will be able to approve cars prepared and homologated by local preparation specialists for national competitions without involving a manufacturer, allowing for example cars sold in only one domestic market to be promoted in competition.

Being able to do this without having to go through a manufacturer has been welcomed by those trying to promote grassroots touring car racing within their



LEFT The FIA initiative opens up the use of the already homologated Rally4 and Rally5 cars in circuit racing



RIGHT Modifications to Rally4 and Rally5 cars for circuit use are intentionally minimal

“A bit like the Group N days when you would sometimes see the same front-wheel drive cars taking part in different disciplines”

national arenas, particularly the Rally5-kit regulations. “It’s a good way to get an FIA homologation without having the manufacturer [directly involved], you can do it through your own technical team within the ASN and this is the way to have more options in the grassroots categories,” says FIA Vice President for Sport in Europe, Manuel Aviñó.

Describing the plans as innovative, Rodrigo Rocha, Africa’s FIA Vice President for Sport, adds: “The easy transition

between circuit racing and rallying is something that reduces the cost.”

According to Alan Gow, in his role as FIA Touring Car Commission president, introducing a pyramid structure to touring car racing has been the aim for some time. “TCR is a proven customer racing platform that works well both in national-level series and in world-level touring car racing, however, we have been missing an accessible entry-level platform,” he says.

“The introduction of the TC Lite ruleset

fills that gap. Having the very same cars in rallying and touring car racing has plenty of benefits – it is cost-effective, sustainable, provides the competitors with a level playing field and creates opportunities for more available seat time. At the same time, the manufacturers and their customer racing programmes will be able to grow their business as the market of these cars will naturally broaden.”

Gow’s view has been backed by Andrew Wheatley, the FIA’s Road Sport Director, who hopes that broadening the use of entry-level cars and making them compatible with circuit racing will replicate the success already seen with them in rallying.

“This is a bit like in the Group N days when you would sometimes see the same front-wheel drive cars taking part in different disciplines,” Wheatley says, adding: “This is also good news for drivers at the early stages of their careers who, to develop their skills, look for as much time behind the wheel as possible. Having one car eligible for different types of events offers exactly that. A universal technical platform like this one also has the potential to draw new people to motorsport and – long term – should contribute to increased motorsport participation globally.”

How quickly such cars will be seen on the world’s circuits remains to be seen. The process is still at an early stage but the FIA is expected to approve the new appendix to its regulations bringing in TC Lite before the end of 2024, with the hope that TCL4 and TCL5 cars can begin racing in 2025.



LEFT The Opel Corsa Rally4 car has already proven itself on gravel, here in the Junior European Rally Championship. Now it may find a second career on tarmac

SPARKING A REVIVAL

Significant technical changes in the all-electric Formula E World Championship could provide a route back to the front of the grid for one of its longest-serving manufacturers. By **Andrew Charman**

TEN years in, the electric motorsport pioneer Formula E has come a long way.

Regarded as an oddity over its first season in 2014-15 – emphasised by a lack of battery longevity requiring mid-race pit stops in which drivers changed their car – it is now a fully-fledged FIA World Championship. The series races at a combination of prime city centre venues and classic motorsport circuits and is contested by major brands currently including Jaguar, Porsche, Nissan, Maserati and Cupra – OEMs seeing great advantages in being associated with ‘zero-emission’ motorsport.

The cars are now fast to Formula One levels and make great use of the innovation that electric power allows them, such as energy regeneration and the mandatory use of ‘attack modes’ that produce extra potency over a short period, resulting in races that are typically intriguing from start to finish.

And more changes are coming: even as Porsche driver Pascal Wehrlein celebrated his Season 10 championship on 21st July at the 2023-24 finale at London’s Excel (Formula E again doing things differently to traditional motorsport with seasons that run from early winter to early summer), teams were already deep into planning for Season 11. The cars that line up at Sao Paulo in Brazil on 7 December will be very different to what has gone before, with the arrival of the Generation3 Evo era.

Generation games

First some history – the cars that took their final bow in London in July were the championship’s ‘Generation 3’. The Formula E car’s first incarnation, used over the opening four seasons, had a 0-62 mph time of three seconds and a terminal speed of 225 km/h (140 mph) thanks to a rear-mounted motor putting out 150 kW (raised in season 2 to 170 kW), and a range of around 50 km, necessitating pit stops midway through the 45-minute races with drivers jumping out of one car and into another.

“The other teams are more in evolution, us in revolution”

The base cars were and still are built by Spark Racing Technology, founded in 2012 by now Ferrari F1 Team Principal Frederic Vasseur, to a design by renowned single-seater manufacturer Dallara. Fortescue Zero (formerly WAE Technologies/Williams Advanced Engineering) currently supplies the battery packs, while in season one McLaren developed the electric motor which was coupled to a Hewland five-speed gearbox.

From season two teams were permitted to produce their own motor, inverter, gearbox and cooling system and at the time nine teams, including the UK-based squad representing Indian automotive giant Mahindra, chose to go the manufacturer route.

Season five saw the launch of the Gen2 car – a new lightweight battery pack doubled the range to 100 km while battery recuperation jumped from the 150 kW of Gen1 to 250 kW, producing enough energy to last an entire race without the car-swap pit stop. This ►





LEFT Mahindra's first test of next season's Gen3 Evo. The complexities of the new car offer the team the opportunity to leapfrog back to the front of the field

was despite power also being ramped up to 250 kW which raised the cars' terminal speed to 174 mph (280 km/h).

By now the technical format of the cars was more to what has become typical among owners of electric road vehicles – no more traditional gearboxes but transmissions using the capability of the motor and varying among the manufacturers, some opting for two or even single speeds.

Also introduced was 'Attack Mode' – at each circuit a section was designated around the outer edge of one corner and cars were obliged to take this route once in a race, boosting their power by 25 kW for a number of pre-determined minutes.

The series gained FIA World Championship status in Season 7, 2020-21, and two years later the Gen3 car debuted. This was very different to its predecessors, its aggressive dart shape reputedly visually inspired by the look of a fighter jet. Its recyclability, from body panels to battery packs, was heavily promoted but the most significant changes were in the powertrain.

The rear motor jumped by 100 kW to 350 kW, giving the car a potential terminal speed of 322 km/h (200 mph), while a second motor was added on the front axle, its purpose purely to provide regenerative energy. The Gen3 car is actually 60 kg lighter than the Gen2, partly due to having a smaller battery pack and no rear brakes – the cars are expected to produce 40% of their required energy by means of regenerative braking, compared to 25-30% on the Gen2 and this has changed the entire format of Formula E races.

The battery pack was also updated to accept 600 kW ultra-fast charging with the intention of recharging cars during pit stops, though at the time of writing this innovation is yet to be introduced to races.

Already development is underway on Formula E Generation 4, scheduled to be introduced for the 2026-27 season. But before that comes an interim step – unveiled at the Monaco e-Prix in April was the Generation 3 Evo car, to be used for the next two seasons and a significant development of the Gen3.

The primary updates focus on new tyre compounds produced by championship supplier Hankook, a stronger body with less aero drag and notably, all-wheel drive:

the front motor will now fulfil both regeneration and propulsion requirements, putting 50 of the car's 350 kW through the front wheels but only at certain times – during the qualifying duels, at the race start and while cars are in Attack Mode. The Gen3 Evo can now accelerate through 60 mph in 1.82 seconds, 30% faster than a Formula One car.

Drive and grip

According to Josef Holden, Technical Director at Mahindra Racing, the new tyres and all-wheel-drive are the fundamental updates on the Gen3 Evo. "The tyre being a softer compound all over has quite a big

BELOW The driveshaft on the front wheel is evidence of a major change on the Gen3 Evo, which will use the front powertrain for propulsion for the first time



All pictures: FIA/Formula E

effect on the dynamics of the car – from a kinematics point of view, how we optimise performance from a vehicle/tyre duo,” Holden tells Race Tech.

“The four-wheel drive is a strong element, even just during practice sessions. Previously you’d take the power hike from 300 to 350 kW as the delta where you were going to be in attack mode and full quali mode. Now it comes with a balance shift – for example you will be doing 300 kW two-wheel drive in free practice but go out for your qualifying run and you will be in four-wheel-drive. You need to ensure from a chassis setup and balance perspective that you are detailing what’s controlled

BELOW New, softer-compound Hankook tyres are a fundamental change that could shake up the established order



ABOVE The Gen3 Evo car retains its futuristic visual appearance

versus what is underlying car and driver interaction – it throws a big curve ball into the whole weekend.”

Even before the required additional development, in simulation and at the track, the new elements greatly affect the powertrain build process: “It fundamentally changes what we need in terms of torque requirement from the rear axle. The front powertrain is spec across all of the manufacturers and teams, but how you optimise that in the control system development is where everybody will be spending the majority of their time, us included.

“The change we need to get a grip on is how much time does the rear powertrain actually spend at 350 kW versus the amount of time with power on the front axle. Therefore it alters the duty cycles, the prove-out requirement. It doesn’t necessarily change what you’d want in peak torque on the rear axle, so as a result we will still target what we believe in this stage of the Gen3 evolution to be optimum.”

“The four-wheel drive throws a big curve ball into the whole weekend”

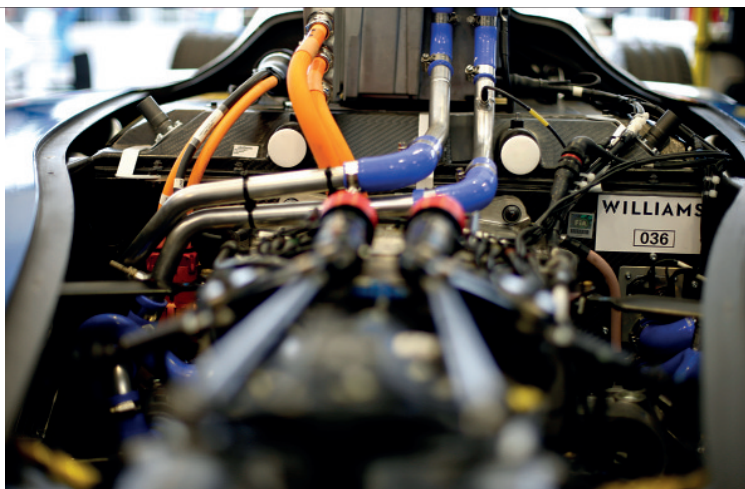
Holden adds that the tyres and all-wheel drive are a re-baselining exercise for the series as a whole. “(For Mahindra) the two main challenges are how do we ensure we adapt to those changes better than the competition, and secondly how do we know where the competition are? How do we benchmark them?”

Even the bodywork update is significant – the changes a consequence of the more significant regeneration in Gen3 that in turn resulted in wholesale changes to the format of races and therefore a complete revision of race strategy. Teams are now concerned with generating and effectively using energy, while coping with the most recent rule set that requires the taking of Attack Mode twice in a race – either for two lots of two minutes or for one minute and three minutes – and with more power, now increasing to the 350 kW qualifying trim. ►

This has produced 'Peloton Racing', more familiar in a top cycle race – typically the Formula E field now circulates as one close pack with much place-changing as drivers decide when to try and make a break. This results in many instances of front wings being damaged, wrecking a driver's race, and the Gen3 Evo addresses this with not only stronger bodywork but a shape with less aerodynamic drag.

"From season seven to 10 you've gone from time-based to lap-based and then peloton races – these can have many overtakes in a single race which completely changes the strategic element, for the whole team. Previously the driver might have said 'go now' but if you do that at the start of the race in somewhere like Shanghai or Tokyo you are in trouble," Holden says.

Nyck de Vries, who with Edoardo Mortara comprises the Mahindra driving strength, concurs with this view. The Dutchman, 2021-22 champion in a Gen2 car, says that the peloton racing of Formula E is very uncommon in conventional series. While preferring to see a little more conventionality he admits to Race Tech that he likes the fact the Formula E is a bit different: "it doesn't need to be conventional and it's not. It being electric racing cars automatically makes it innovative and different but on some occasions we are a little too extreme on the unpredictable side of it."



ABOVE The Gen1 powertrain, relying on the expertise of the Williams and McLaren F1 spin-offs, was like nothing seen before in motorsport

De Vries is not yet too familiar with Gen3 Evo. "In terms of technicality the biggest difference is the front motor accelerating the attack mode, qualifying and race start. Tyres will be a big thing and with the bodywork (they are) trying to reduce the drag effect a little bit – when losing front wings you won't be losing any performance. It allows people to go around without (a front wing) which is fine, in fact it's better when it's gone because you can't break it and risk it getting tangled up."

Evolution and revolution

For Mahindra the introduction of Gen3 Evo is more significant than for rivals – the manufacturer is undertaking a root-and branch rebuild of its

BELOW Start of a revolution: the very first Formula E race, at Beijing, China on 13th September 2014





LEFT Today the series is established and racing at prime venues, including Monaco

BELOW Mahindra was part of Formula E from the start, here with Bruno Senna in Malaysia in November 2014...

Formula E presence as it seeks a route from its current backmarker status back to the wins of its early years in the series. The car's integration has been planned ever since the announcement in April but for Mahindra this includes installing a completely new powertrain produced by an as-yet unnamed new supplier. "As a team it will be a bigger change and we obviously hope to make a bigger step forward," de Vries adds.

"We've been doing offline development work for quite some time, but only in the past few weeks have we reached the point of getting on top of the physical hardware, delivery, integration, running in anger," Holden says.

"Through to the Valencia test (in November), race number 1 in December and the Gen3 Evo race cycle is a continuous development piece. At present we are focused on ensuring that when our full architecture turns up for race one we know from a reliability perspective it will be able to last the season, but also that we are already at the baseline performance levels that we targeted, so that we can separate what is fundamental hardware performance versus what is optimisation of the system, car and driver interaction."

He admits that the team has long known it needed to increase the capability it has as a manufacturer. "We've been sort of between manufacturer and competitor size but doing both those activities forces you to be very sequential – with Gen3 particularly we were one of the last cars to turn up in Valencia in race trim.

"Now we've bifurcated – the race team are exclusively responsible for ensuring our on-track performance, continuous development that feeds into what we expect next year. But the manufacturer element has switched, now fully ►



BELOW ... and remains so today, Edoardo Mortara here on his way to pole position in Berlin in May 2024





focused on the delivery of Season 11 and the best that it can be for race one.

"We've increased around 30% in size – some personnel have been with us for some time, some are still coming in over the next weeks and months. We are fundamentally increasing our capabilities across the whole area of vehicle performance, tyre science, design, control systems, software, the lot."

The future is now

All this effort is focused on a car that will be raced for just two seasons before Formula E introduces its Generation 4 machine – in May 2024 the FIA published a technical road map for this car, indicating that it will remain an all-wheel drive machine with 600 kW of power in qualifying, up to 450 kW in the race and 700 kW of recuperation, split 50 per cent between the front and rear axle. The FIA expects Gen4 cars to be seven per cent faster than the Gen3 Evo while the road map also indicates that the Gen4 era could be extended by a further two years over the standard four seasons.

Four manufacturers have already committed to Gen4, including the revived Lola, and while Mahindra is not yet among them, Holden clearly has some grasp of the car. "Yes, we are looking at Gen4 already," he says, adding that Gen3 Evo development will provide some future proofing for Gen4. "The underlying performance targets for Gen4 are quite different from Gen3 and Gen3 Evo, but from a power level and torque level it will be for us an evolution and not a complete starting from scratch.

"From battery, aero, control, total power, tyres again, it will be all-change for Gen4. Normally over the four-year period your activity on the homologation side would take a bit of a dip but for us it's staying high. (Our) Gen3 Evo has a completely new rear end, new architecture, new supplier and partner on the powertrain side – as a result we are experiencing a very similar cycle to what we expect to do with Gen4."

And finally, how much prospect of seeing the much-vaunted but so far never used in-race fast charging?

ABOVE Remember these? Changing the entire car, rather than just the tyres or the driver, at the mid-race pit stop was a feature of the Gen1 racing that went against the entire DNA of the sport

According to Holden, Mahindra as a manufacturer is committed to validating technology that has a direct relevance to the switch to electric in road cars – but the racing cannot suffer as a result.

"The difficulties we face in the introduction are how you bring something to track that is so ambitious – car and boost-charging tech that ensures you add to the racing, rather than cause disruption to it. I think at this stage we are still going through that validation process."

Back to the front?

The official representative in Formula E of Indian automotive giant Mahindra has a long and at times glorious history in the championship, having competed in every season and built its own powertrains since Season 2, collecting five race wins and a best championship finish of third in 2016-17.

The last of those victories, however, came in 2020-21 and over the past three championships of 11 contending teams Mahindra has ended the season 8th, 10th and 10th. It is a squad badly in need of a reset and a visit to its headquarters, adjacent to the M40 motorway in Banbury on the former site of English motorsport dynasty Prodrive (which has moved to new premises a quarter of a mile up the ▶

“The front powertrain is spec, but how you optimise that in the control system development is where everybody will be spending the majority of their time”



LEFT Mahindra's Nyck De Vries, in the centre of the picture, battles in the Portland e-Prix, a race where the Peloton racing first became evident

LEFT The Gen3 Formula E car stood out for its dramatic body shape, inspired by fighter aircraft

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*The Basic Analysis of Race Car Data Acquisition by **Christopher Brown***

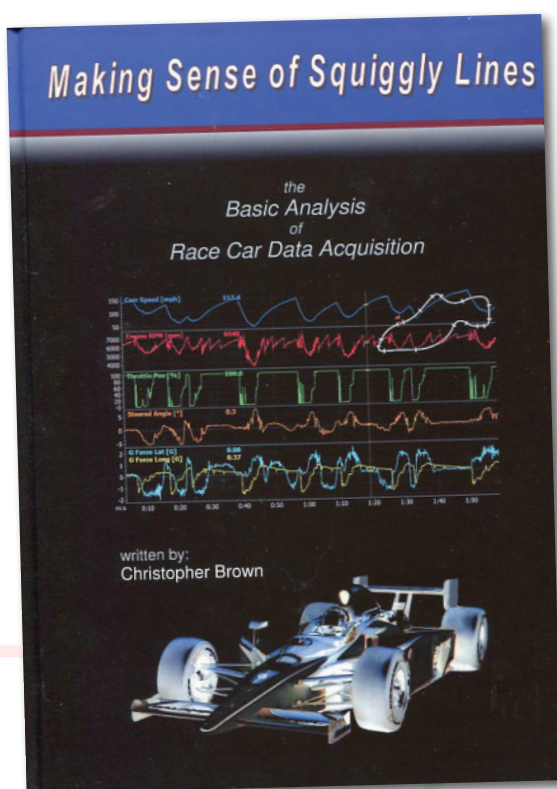


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road), suggests that Mahindra regards the arrival of the Gen3 Evo as the catalyst for that reset.

A tour of the premises reveals not only the standing of Formula E today as a top-level international championship but also the ambitions of Mahindra. The facilities feel almost 'F1 light', extending to a pair of simulators (which both drivers each spend two full days on before every race) and a 'remote garage' – a sealed room in which during races six engineers are directly connected to and liaising with the team at the venue. Six is a maximum mandated by the FIA, and monitored accordingly – on the wall are mounted two cameras, one connected to the race team, the other to the FIA rule-makers...

Fightback from COVID hit

The current Mahindra team comprises around 80 staff with a core group of 70 based at Banbury, including around 40 who travel to races. But that 70 look virtually lost in very open-plan offices that could easily accommodate double their number.

Recruitment is the current prime concern of senior consultant Tony Ross, recently brought into Mahindra to provide team principal Frédéric Bertrand with engineering guidance – Ross's CV includes 20 years in F1 with Williams and Mercedes, before clocking up two double Formula E World Championships as chief engineer at the Mercedes team between seasons five and eight.

The biggest challenge within Mahindra, Ross tells Race Tech, is to achieve the transition from the Season 9 hiatus (caused by the COVID pandemic) to attempting to win the World Championship in the



future. "You need stability, you need to build a team up, to grow, adjust and adapt," he says.

"One of the reasons (Mahindra) hasn't been so successful is that it doesn't have the biggest of budgets – now obviously you can't have everything and you have to cut your cloth but Fred (team principal Frédéric Bertrand) basically has the vision.

"It's a great team in terms of the individuals here and their abilities. (Success is about) working on the procedures and process as well to produce a cohesive engineering structure, that actually moves in one direction. I'm not here to say you need to fit this widget and suddenly it will all happen."

Ross is working closely with Holden and another recent recruit Jeremy Colancon – twice Formula E

ABOVE Just as in F1, a 'Remote Garage' of a mandated maximum of six personnel monitors and contributes to all aspects of a race weekend performance



LEFT Mahindra team principal Frédéric Bertrand celebrates pole position in Berlin. He is focused on making such celebrations a more regular occurrence

race engineer of the year, he has been brought in as performance director to take over the day-to-day running of the race team, allowing Holden to move into a more overt technical director role. The early focus will be on powertrains, particularly as for Mahindra this will be all-new in Season 11. "In qualifying there is no reason why we can't be at the front," Ross says. "Obviously it's not going to happen overnight, but it's about putting in the building blocks to build on this from Season 10, with a new powertrain from Season 11.

"It's an interesting one because in terms of powertrain efficiency some of the more established teams are already there so their potential for gains is less. It's more of a challenge for them, plus with the new regulations, four-wheel-drive, traction control and such, from a technical side it does provide quite an interesting cycle, an opportunity."

And Ross is optimistic: "The progress we've made in Season 10 is not stunning but going in the right direction. We had pole for Edou in Berlin, now we need to have that a few more times – it's a good starting point."

To Mahindra team principal Frédéric Bertrand – recruited in late 2022 after a decade at the FIA including overseeing Formula E – the arrival of Gen3 Evo is highly important, perhaps for Formula E but definitely for Mahindra: "The change is huge, because we can change. What was done previously (in the team) was not that bad, but it was not evolving quick enough. When other teams are in front and further improving you don't recover the gap, even if you improve at the same level. So you lose pace rather than gaining or at least compensating.

"The new car for us is definitely a challenge because we are changing everything in a short time. We have worked in a philosophy that is definitely more ambitious, and probably more ambitious in the way we do it.

"If you do not from the beginning do all you can with all the small details in Formula E, you end up with a cumulative amount of small details not tackled, which creates a significant gap. That gap you have to live with and even if you correct a few of those areas, you don't correct all of them.

"Definitely the gap between where we



ABOVE Understanding the changes in the Gen3 Evo is the job of Mahindra Technical Director Josef Holden

were and where we will be is important – mostly on efficiency, probably on driveability and hopefully also the potential for improvement through the season because we will be better in control in many areas where we were a bit weak in the past two years, not only because of the hardware but also the staff. We had not enough and not necessarily the right people in place – not because the ones before were not good but because in some areas we were missing, (for example) control software – that area was poor."

“We are increasing our capabilities across the whole area of vehicle performance, tyre science, design, control systems, software, the lot”

Bertrand admits that a complete redesign is a bit of a gamble. "We don't have so many references from the past powertrain which we could just have an evolution of – all the other teams are more in evolution, us in revolution, the only hope we have is that by doing a revolution we have compensated more than (what is) the gap."

"We know this will not necessarily put us in a position to fight with the top-level teams, but will definitely put us back consistently and genuinely into the midfield. Today we are at the back, and because our drivers and team do a good job we are able to fight P8 to P12. I would

like us to be more consistently in the top 10, so that we more regularly score points, and not because others don't score but because we deserve them. We want to be there because we perform."


The mindset of the Mahindra squad and the depth of the facilities in Banbury suggests a team that will still be part of Formula E into the Gen4 era, though this is still to be confirmed and Bertrand does not give away many clues. "It's difficult because even if the manufacturer is as successful as Mahindra is right now it means spending money until you get the result – it's much easier if you get the result," he says.

Three-step recovery plan

"Even the top manufacturers right now, the time they needed to perform properly was a minimum three seasons, a bit more for some and spending more than probably we have spent up to now. Our goal is to make sure that the people in the top management at Mahindra understand; say you have £20 million – on one side you can put it in a race team and some nice French guy says let's keep the consistency and in three years' time we will get the result you deserve, while on the other side you have dealerships, customers and with that money you could do this and that."

Bertrand remains optimistic because he says the Mahindra recovery plan has

always comprised three steps. "Step one was Season 10, not too much in results but how we structure the team. The second step is Gen3 Evo, making sure the car helps us in the competition, to say P5 or 6 – I would not complain if it's 2 or 3 but let's be realistic. Then Gen4 should be bringing us podiums. We hope to do the third step, we don't want to remain in the middle of the river."

And Gen 4? "It's coming slowly into place. The timing is a bit difficult – we need to start developing Gen4 if we want to be ready but we still don't have the result from Gen3 Evo. You need to have trust on the other side..." 

HAPPY BIRTHDAY FORMULA E!

What do Captain Sensible, **Sergio Rinland** and former FIA president Jean Todt all have in common? Find out...



FORMULA E has reached a very important milestone in its short history: it is 10 years since its first race, held in Beijing on September 13, 2014.

Back in 2009, while working in Spain as Epsilon Euskadi's Engineering Director, we were hired to develop an interesting project. It was a small city electric vehicle conceptualized by PhD students at the MIT (Massachusetts Institute of Technology) Media Lab, in those days under the direction of renowned architect William J. Mitchell. Called Hiriko, it was meant to be used initially as a city runaround in Vitoria-Gasteiz..

It was a very ambitious project which, although it did not come to full fruition, served to trigger my interest in alternative transportation technologies and EVs in particular. These days, it has become an activity which occupies most of my time.

By the time I returned to the UK after the Epsilon Euskadi adventure, at the end of 2010, I had totally caught the EV bug. When my old friend Steve

RIGHT The seeds of the 'Hiriko' project, conceived by the Massachusetts Institute of Technology Media Lab, first sparked Sergio's EV fascination

BELOW Initially lampooned by the purists, Formula E's cars now boast formidable performance, with more to come

Hollman (of Carlin Motorsport in those days) asked the question, "Do you think that one day we will see electric Formula 1 cars?", my answer was: "Maybe. Let me look at some numbers."

That innocent question triggered my next step, which was to investigate the state-of-the-art EV technologies, design and start simulations on a concept racing car to see what performance could be achieved.

My research showed that it was possible, but certainly not to the F1 performance level and also not to the customary 200 miles/2-hour race. What I found, using technologies not allowed in F1 at the time, was that we could achieve close to GP2 (F2 today) levels for about 20 minutes in places like Monaco or on other street circuits.

The reason to limit them to street circuits was, and still is, because high-speed drag on tracks like Barcelona or Silverstone would consume the battery energy in half of that time.

That concept had one inboard motor per wheel. It featured piezoelectric materials for adaptive body panels, low rolling resistance tyres, only ground effect aerodynamics (no wings), covered wheels and a safety canopy. With that concept now on paper, the eternal dreamer in me started to think of the possibility of ►



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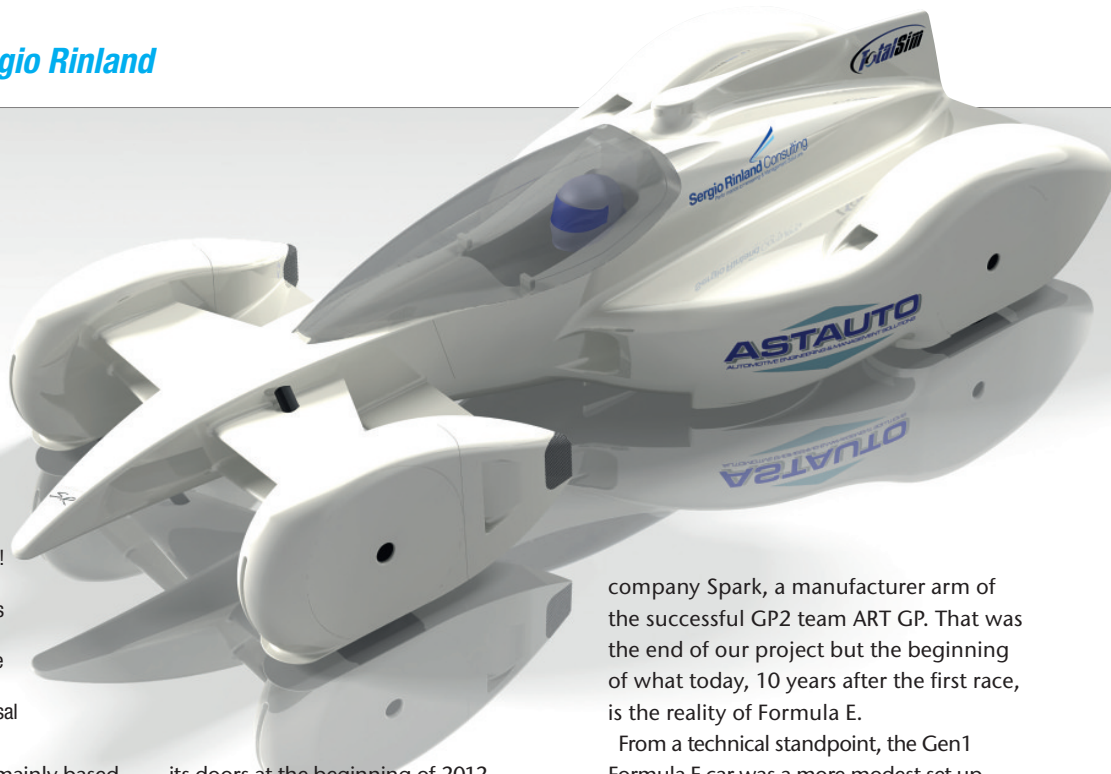
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RIGHT Sergio's original proposal for a 'Formula Electric' racecar. Nope, surely that would never catch on...

BELOW ... Only it DID catch on! The series lurched into life with that first race in China, 10 years ago. We would have to wait a decade for the cars to reach the sort of performance Sergio was expecting from his initial proposal



making it a reality. This was mainly based on the inevitable rapid technology advance in batteries (nearly following Moore's Law!), which has proven right these days.

With that concept in hand, I started to explore the world outside of my bubble. My first port of call was the then FIA President, Jean Todt. I visited him in the summer of 2011 to show him the concept and see if the FIA would entertain such a crazy idea.

To my utter astonishment, he was not surprised! His answer was: "Well, what a coincidence. We are planning an electric car series and will announce a tender for interested parties to be part of it in the next few months." He asked if I had been in contact with the company Spark, because they were performing some research on the FIA's behalf. Clearly, I was not the only one thinking of that idea.

The personal disappointment did not last long. By the autumn I was working with Lola Cars and Lord Drayson's company on a presentation and tender to the FIA for the forthcoming Formula Electric.

Unfortunately, Lola was going through some challenging times and sadly closed

its doors at the beginning of 2012.

Nevertheless, the ever-enthusiastic Paul Drayson decided to continue with the tender of our concept to the FIA.

At a meeting in the FIA offices in Geneva, with other interested manufacturers, we were informed that due to the withdrawal

“I wondered how Todt would react to such a crazy idea. But I was the one left feeling astonished”

of the potential sponsor and investor, the Formula Electric Championship was going to be put on the back-burner until a new commercial partner would be found.

Six months later, we read in the news that Spanish entrepreneur Alejandro Agag had reached an agreement with the FIA to promote and run the Formula E series with cars built by the French

company Spark, a manufacturer arm of the successful GP2 team ART GP. That was the end of our project but the beginning of what today, 10 years after the first race, is the reality of Formula E.

From a technical standpoint, the Gen1 Formula E car was a more modest set up than our proposal. Their target was F3 performance. But, as we witnessed at the first test at Donington on July 3rd 2014, performance was only marginally faster than what Formula Ford was doing at the time.

Cost control has been and still is a major concern for the FIA. Hence, the first-generation FE not only had a control chassis with limited adjustability, but also a control battery developed by WAE and a spec motor derived from a McLaren hybrid car at the time. Because the motor was of low torque and high revs, the car needed a four-speed gearbox.

Those choices restricted the performance of Gen1. The battery limitations prompted the FE organisers to come up with the novel idea of drivers jumping into a second car fully charged for the second half of the race. Some found this amusing...

By the fifth season, the Gen2 car regulations allowed teams to develop their own motors. That again contributed to a steep learning curve for all concerned, with a new McLaren battery (developed by Atieva) that had enough energy to do the whole 45 minutes without the need to have two cars.

By Season 9, in 2023, the Gen3 car had arrived, allowing a front motor for the first time, albeit only to recover energy. We will have to wait until the Gen4 car in 2026 to have a truly four-wheel drive electric racecar not too different to the one we proposed back in 2012.

Perhaps we were dreamers then, but as Captain Sensible's song 'Happy Talk' pointed out: "You've got to have a dream, if you don't have a dream, how you gonna have a dream come true?" **LT**



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