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WHY AL CAN BE THE START, NOT THE END

HEN America first switched its focus from flight to space travel, engineers had to adapt to a paradigm shift: instead of planes flying at five miles per minute, its projectiles were now travelling at five miles per second!

That extraordinary shift required the development not only of new technology, but a fresh mindset.

Now, today's motorsport engineers are fortunate to participate in a new 'space race', for the Artificial Intelligence genie has been unleashed. And it's not going back in the bottle!

The presentations at last month's World Motorsport Symposium were hugely impressive and thought-provoking at the same time. But perhaps the biggest takeaway was the astonishing emergence of Al. This isn't a technology that's coming; it's here.

Some simulations that once took days can now be completed in just minutes, or even seconds. During the presentations we witnessed one procedure that, with the benefit of Generative AI, can now be completed 8,300 times quicker than before. And no, that figure isn't a typo!

Such a transformation clearly has huge societal implications far beyond the ofteninsular world of motorsport. From medicine to music, fashion to finance, AI is going to change the world.

Emerging technologies can often appear scary. We've all heard talk from world leaders about Al's threat to humanity; all felt the fear that it will take people's jobs. And yes, of course war-mongers will already be exploiting it. It would be naïve to pretend otherwise. But the message that emerged from WMS 2023 was that Al can also be a huge force for good, and that it will still need humans to guide it. Motorsport is a hugely data-rich sport and, as such, the perfect playground for Al. That means motorsport rules will have to be rethought – and quickly: resource restriction agreements were conceived before Al had fully been unleashed.

All the F1 teams, like the top sportscar squads, already have AI partners. Pandora's Box is open.

The temptation, of course, is to legislate even more restrictively. But we must beware.

We have the opportunity here not only to hasten the development of AI – for AI will learn from F1, as well as vice versa – but to influence people's perception of this new kid on the block. Seeing it operate so efficiently in motorsport can pave the way for the acceptance of a tech that we will benefit from hugely if we learn to work with it.

But we've bene here before, haven't we? The finest brains in motorsport once arguably took another disruptive discipline, Computational Fluid Dynamics, to new heights, only to restrict its use so harshly that we ushered it down a technological cul-de-sac. We mustn't make the same mistake with AI.



Mark Skewis EDITOR

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Why Formula 1 is joining the FIA and Extreme H to explore a hydrogen future. By **Mark Skewis**

HE development of a hydrogen ecosystem for motorsport is the tantalising objective to be explored by a ground-breaking collaboration between the FIA Formula One World Championship, the Fédération Internationale de l'Automobile (FIA), and Extreme H, the world's first off-road hydrogen motor racing championship.

The triumvirate is to establish a joint Hydrogen Working Group. Its aim is to monitor the progression and development of hydrogen technology: both for the fuel cells and battery systems which will be used in Extreme H's first-generation racing chassis, as well as hydrogen technology within race site infrastructure, transportation, charging, storage and management, and its safety implications.

Pat Symonds, Chief Technical Officer, Formula 1, explained: "Our sport has a tradition of bringing new technologies to the forefront of public perception in incredibly short timescales. We do this by being open-minded to all solutions and embracing cross-functional engineering. With climate change mitigation at the forefront of everyone's mind we are committed to promoting sustainability and therefore need to explore all areas of decarbonisation of the mobility sector. This must include sustainable liquid hydrocarbon fuels, electrification and hydrogen.

"This Working Group enables a collaboration which will allow us to gain

first-hand experience and contribute to the understanding and development of the many aspects of hydrogen propulsion that Extreme H will embrace."

Hydrogen is currently a hot topic throughout the automotive, transport and aviation industries. Given hydrogen's potential for energy storage, as well as for propulsion, it is also increasingly on the radar of governments seeking energy security against the backdrop of Russia's invasion of Ukraine.

At COP28, held in Dubai, a suite of flagship initiatives were launched to accelerate commercialisation of hydrogen to keep the 1.5 Degrees target within reach and to unlock the socio-economic benefits of cross-border value chains for hydrogen and its derivatives.

What's in it for F1?

It is the involvement of Formula 1 in the new collaboration that will attract most intrigue. The establishment of the Hydrogen Working Group is a no-brainer for Extreme H, due to compete with hydrogen fuel cell SUVs in 2025, and for the FIA. The latter has to develop a regulatory framework for motorsport, in which hydrogen is scheduled to become the top category at the Le Mans 24 Hours by 2030.

But Formula 1 has already pinned its colours to the Internal Combustion Engine mast for the foreseeable future, replacing fossil fuel with sustainable hydrocarbons. Its technical pathway, introducing drop-in sustainable synthetic liquid fuels for 2026, has already lured in the likes of heavyhitters Audi, Ford, Honda and Cadillac.

F1 does have crossovers with Extreme E – former World Champions Lewis Hamilton, Nico Rosberg and Jenson Button all own Extreme E teams, as does McLaren Racing – but the hydrogen fuel cells used in the Extreme H derivative of the off-road series have no direct translation to F1. Their slow response time and heat rejection requirements can be overcome when used in conjunction with a battery over short race formats in Extreme H, but they make no sense for an F1 car.

Where F1 could potentially learn valuable lessons is in terms of hydrogen infrastructure. For instance, at last month's Race Tech World Motorsport Symposium, Toyota Racing Development's Steve Wickham revealed how his team had developed the company's Hydrogen Fuel Cell-based Power Generators. These units have been successfully trialled at events and festivals, where they have proved to be zero-emission replacements







ABOVE F1 is

committed to sustainable liquid hydrocarbons for its racecars. But, needing to systematically reduce CO2 emissions generated by its operations, events, logistics and cars to Net Zero by 2030, it is closely monitoring the progress with hydrogen for traditional diesel generators.

At present, these units are expensive – you have to pay to play in the sustainability game – but increasing familiarity with such technology will inevitably bring down costs. As yet, F1 has no equivalent to TRD's latest innovation.

Asked where the most immediate gains could be with hydrogen, Symonds said, "If our society is going to a hydrogen-based mobility system, there is no low-hanging fruit. There is an awful lot of work to do. Low-hanging fruit in the mobility energy sector is more likely based around sustainable liquid hydrocarbons because so much of the technology and infrastructure exists and has done for years. Hydrogen is complex. That's why we are keen to learn."

Strategic alliance

The Hydrogen Working Group will comprise of representatives from all three organisations, including Mark Grain, Extreme E Technical Director – who is leading the series' transition to Extreme H – Pat Symonds, F1 Chief Technical Officer, and Nikolas Tombazis, FIA Single Seater Director. They will bring together their collective expertise in a strategic alliance





to evaluate developments and potential applications for hydrogen within motorsport and wider mobility.

Mark Grain, Technical Director, Extreme E, said: "It's a privilege to be working alongside Formula 1 and the FIA as we continue to develop our world-first hydrogen racing proposition. Our transition to Extreme H makes us the pioneers and first-ever testbed of hydrogen technology in motorsport – not only in our racing cars, but also transportation, infrastructure, refuelling processes and safety regulations. It's a ground-breaking initiative and we look forward to collaborating with Formula 1 and Pat [Symonds] both technically and operationally, as we continue to champion new technologies and break boundaries on behalf of motorsport, with hydrogen at the forefront." Nikolas Tombazis, FIA Single Seater Director, said: "As the governing body for both the FIA Formula 1

We champion new technologies and break boundaries on behalf of motorsport, with hydrogen at the forefront"

World Championship and the upcoming FIA Extreme H Championship in 2025, we welcome this latest collaboration. The FIA Technical Department has experience and knowhow in the area of hydrogen technology which we will be bring to the Working Group along with sporting, safety and regulatory expertise. As is currently the case across the entire FIA motorsport portfolio, we will take learnings from this collaboration for the benefit of our sport and mobility."

Extreme E, which debuted in 2021, has already established itself as a leader in sustainable technologies, with a unique racing format that combines off-road racing in electric SUVs, a mandatory gender-equal driver line-up in each team, and a mission to highlight climate change issues and environmental impact. In March 2022, it announced plans to transition to the first-ever hydrogen-powered racing series – Extreme H – from the 2025 season.

Development of the first Extreme H series is underway, with the prototype hydrogen-powered chassis, built by its partner Spark, having already completed its first full-speed shakedown. A comprehensive testing programme is scheduled for the next few months.

"There is still plenty of work to be done ahead of the launch of Extreme H in 2025, but we are pleased with the progress of our concept, which believe will deliver strong performance levels and break the mould in terms of innovation not just in motorsport, but with potential for the future of mobility more widely," commented Grain after the first test.

NASCAR, Cadillac and Alcon win WMS23 tech awards

ASCAR, Cadillac and Alcon scooped Race Tech's 2023 technical awards. They were presented at last month's World Motorsport Symposium awards evening, by former Renault, Ferrari and McLaren aerodynamicist John Iley.

NASCAR's Eric Jacuzzi, Vice President, Vehicle Performance, and Brandon Thomas, Vice President – Vehicle Design, collected the Dino Toso Racecar Aerodynamicist of the Year accolade. Their team was recognised for its work on the Garage 56 Hendrick Motorsports Next Gen Chevrolet Camaro that starred at the Le Mans 24 Hours.

The project was in many respects one man's dream. NASCAR Chairman and CEO Jim France was intent on completing the mission his father, NASCAR founder Bill France Sr, had begun when he brought two stock cars to Le Mans for the 1976 race. Yet for all the human passion involved in this Garage 56 entry – and there was much – it was the project's technical underpinnings that made it such a huge success.

Everyone involved in the all-star team dreaded the prospect of falling flat on their face in front of a sell-out European crowd, so a remarkable amount of effort was expended on the design and development of a car that was based on the regular Next Gen Cup machine. The best Computational Fluid Dynamics aero program in NASCAR's history helped fashion a car that could achieve its objective of running at GT pace, yet without resorting to bolting on a rear wing.

The car ran near the top of the GT field for more than 20 hours until a drive line issue sidelined it for more than an hour. The car was running at the finish, completing 285 laps on the 8.4-mile circuit, and finished 39th in the 62-car field. It was a case of mission accomplished, in spectacular fashion, and Race Tech's panel of tech experts wanted to recognize that feat.

NASCAR faced stiff opposition for the award from both the race's eventual winner, Ferrari's 449P, and Red Bull's history-making RB19.

The Race Powertrain of the Year award also had a strong Le Mans flavour, with Cadillac's LMC55R GTP powertrain beating opposition from Toyota's H2 Corolla, that competed on liquid hydrogen in the Super Taikyu Series, and from Jaguar's Gen3 Formula E powertrain.

Cadillac scored its first podium finish at the 24 Hours of Le Mans, returning to the iconic race after more than two decades away. It also performed a clean sweep of GTP titles in the IMSA WeatherTech SportsCar Championship.



The dawn of the LMDh hybrid era prompted Cadillac's engineers to opt for a bespoke 5.5-litre naturally aspirated V8 ICE. It was much larger than anything used by the GTP opposition in the IMSA series, whose engines ranged from 2.4 to 4.6 litres, and it was the only LMDh powertrain to buck the trend of turbocharging.

The introduction of a hybrid system was a landmark moment for North American motorsport. While the hardware for the LMDh hybrid system is shared across all competitors, the software is defined by each entrant and became a major battleground.

The Don Burgoon Most Innovative New Motorsport Product of the Year accolade was won by Alcon for its SMART (Spherically Mounted ARTiculating) inserts, which were successfully trialled in last year's World Rally Championship.

The SMART product is a piston insert intended for motorsport applications. It compensates for pad taper wear and will mitigate its propagation by resolving any angular gap between the piston and brake pad.

The SMART piston assembly comprises an insert that is retained by and articulates between two spherical surfaces. This then restores the co-planar/ parallel relationship between the piston and the brake pad backplate.

Other nominations were: Dynisma (for its DMG-1 simulator technology); Bosch (for its LMDh hybrid); and McLaren Applied, for its VCU-500 Vehicle Control Unit.

David Clegg, principal motorsport brake engineer at Alcon, commented, "Introducing an innovative yet simple solution to a long-standing challenge, within a well-established technological field, is hugely rewarding. To then be recognised by industry experts for this achievement is truly phenomenal!" **ABOVE** The award winners with KMG publishing director Soheila Kimberley





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Bridgestone and Podium AT spring Formula E coup

RIDGESTONE is to return to world championship single-seater competition for the first time since 2010 after winning an FIA tender to supply Formula E's Gen4 chassis.

The Japanese manufacturer recently lost out to Pirelli after making a strong pitch for the Formula 1 contact. Now it will replace Hankook as the sole tyre supplier to Formula E and produce two different types of tyre for the Gen4 machines, which will be used from the 2026-2027 season over a period of at least four years.

The switch to two different types of tyre is a departure for the all-electric series, which for nine seasons has placed a lot of emphasis on its ability to run one allweather compound. From the Gen4 era the championship's 'baseline' rubber will be a grooved all-weather tyre that "must guarantee sufficient grip to ensure safe racing in light rain". A second 'typhoon' rubber will be mandatory in heavy rain.

The Gen4's tender process saw sustainability take centre stage as a key pillar for Formula E. Suppliers were required to identify all of the measures they are taking to optimise their products' sustainability credentials, reduce their overall emissions and resource consumption through a life cycle assessment process – right from the beginning. In addition, all unavoidable emissions are offset as part of Formula E's net zero commitment.

Bridgestone's sustainability credentials are said to have impressed F1 during its recent tender process, and the tyre giant says that he Formula E deal will be a cornerstone of the company's sustainable global motorsports strategy.

"Motorsports is Bridgestone's passion. Always has been, and always will be," commented Shu Ishibashi, Global CEO and Representative Executive Officer, Bridgestone Corporation. "Bridgestone aims to evolve sustainable global premium motorsports products with our enduring passion to embrace the ultimate challenge and to pursue excellence in every moment. The core of our supply arrangement with the FIA will be the expansion and enhancement of "ENLITEN" tyre product technology, enabling 'ultimate customization' that we define our 'new premium in the EV era'."

Battery surprise

Bridgestone wasn't the only surprise amongst the Gen4 suppliers: battery provider WAE – which has been conducting an investigation into the battery fire that interrupted Formula E's pre-season test – will be replaced by Podium Advanced Technologies.

The Italian company has previously been involved with Glickenhaus in the World Endurance Championship and secured the supply of battery systems for the MotoE World Championship to Ducati.

Francesco Monti, Podium Advanced Technologies CEO, commented: "We take exceptional pride in winning this tender, as it signifies an extraordinary accomplishment and a substantial recognition of the hard work, dedication, and expertise demonstrated by our entire team.

"This achievement is the result of a long journey and is now coming to fruition as a new milestone. The path ahead will be demanding and challenging, yet I am confident that with the same passion and commitment demonstrated thus far, we can confront these challenges and continue to achieve new outstanding milestones."

Spark Racing Technology will continue to supply the chassis for the new car, as it has since Formula E's inception, and Marelli will provide the front powertrain.

Informed by the pioneering Gen3 and record-breaking GENBETA, Formula E's next evolution, the Gen3.5, will hit the track in Seasons 11 and 12. Beyond that, the Gen4 era will mark the next major leap for the series. A big power increase is scheduled, and a greater focus placed on the aerodynamics of the car, with a high and low downforce configuration being created.



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WRC greats tasked with revitalising rallying

Championship-winning co-drivers have been tasked by the FIA with navigating a new route: the future direction of the sport.

A working group to fix rallying was established by the World Motor Sport Council Strategy session at the Annual General Assemblies Week in Baku last month. It will be headed by FIA Deputy President Robert Reid, the 2001 World Rally Championship title-winning codriver, and the 1981 WRC co-driver champion David Richards, who is the chairman of Motorsport UK and a World Motor Sport Council member.

The FIA statement said: "Under consideration will be the technical, sporting and promotional aspects of the FIA World Rally Championship. The group will also address the pathway for grassroots development of rallying." Richards is well-placed to understand the WRC and rallying from both sides of the fence, having won the 1981 world title with Ari Vatanen, established Subaru as a dominant force in global rallying and owned the commercial rights to the WRC. The move to create the working group comes after a season where the WRC has come under fire from drivers, teams and fans for a perceived lack of appeal and direction.

WRC drivers have been particularly vocal regarding the need for change, which has resulted in Elfyn Evans' co-driver Scott Martin joining the WRC Commission to provide drivers a voice in any future changes for the discipline.



Hankook wins WRC tyre tender

ANKOOK has triumphed in securing the exclusive tyre supply contract for the FIA World Rally Championship, with a deal set to commence in 2025 for a duration of three years. It will be responsible for providing tyres to the premier Rally1 vehicles as well as those in the WRC2, WRC3 and FIA Junior WRC support championships.

Hankook's appointment was approved following a vote by the FIA World Motor Sport Council and will close a three-year tenure by Pirelli.

In 2023, Hankook played an integral role in more than 50 motorsport series. It is no stranger to rallying, having been the exclusive tyre partner for the Junior ERC category within the FIA European Rally Championship. Its highest profile involvement in motorsport is with the ABB FIA Formula E World Championship, though it will be replaced by Bridgestone for the 2026-27 season.

"We are thrilled to embrace an exciting new chapter for the FIA World Rally Championship and extend a warm welcome to Hankook as our exclusive tyre provider for the next three years, commencing in 2025," said Peter Thul, Senior Director of Sport for **BELOW** Hankook will be the single WRC tyre supplier from 2025

WRC Promoter.

"We also express our sincere gratitude to Pirelli for their valuable contributions throughout the recent seasons. Their partnership has been greatly appreciated," he added.

Sooil Lee, President & CEO of Hankook Tire & Technology, said: "The FIA World Rally Championship is one of the most spectacular motorsports globally with a rich history and a huge, dedicated fanbase. Hankook Tire is very pleased and proud to become the new and exclusive supplier and partner of the WRC from 2025."





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"Mythbusting" Formula E praised at COP28

HE UK's Secretary of State for Transport, the Rt Hon Mark Harper MP, commended Formula E at COP28 in Dubai for its pioneering role in revolutionizing electric mobility.

Describing the series as a "myth-busting" force, Harper highlighted the all-electric series' exceptional blend of "world-class performance" and commitment to the carbon agenda.

In a major move to boost electric vehicle infrastructure, Harper also announced the UK Government's £70 million pilot scheme to expand ultra-rapid EV charging points across motorway services, marking a significant stride towards the UK's net-zero targets.

Formula E's role as a catalyst for technological advancement and decarbonization in the road vehicle sector was praised by the MP, who outlined the championship's potential to help the UK achieve its ambitious environmental goals.

The announcement followed insightful panel discussions at the summit, featuring experts from Formula E's ecosystem, including ABB, DHL, NEOM McLaren Formula E Team, Envision Racing, and UNICEF. These sessions delved into the future of mobility and the championship's influential role in driving sustainable change and technical innovation. The panel sessions and broader efforts at COP28 by Formula E and its partners underlined the synergy of sustainability, entertainment, and innovation in electric racing, demonstrating the sport's significant role in fostering sustainable human progress.

Jeff Dodds, CEO, Formula E, commented after the session: "Formula E's presence at COP28 sends a powerful message that sustainability and high performance can coexist without compromise. Our championship has consistently pushed the envelope in e-mobility, thrilling fans worldwide while serving as a cutting-edge test bed for EV technology. "We're gratified to see the UK's recognition of our efforts and excited about the potential for our track innovations to transform everyday electric vehicles and consumer technology.

"The UK's investment in EV infrastructure is a testament to the tangible impact of our vision, reinforcing Formula E's position at the forefront of sustainable motorsport and technological progress."

In a related session at COP28, Julia Pallé, Vice President of Sustainability at Formula E, delivered two masterclass workshops at DHL's Dubai Innovation Centre. Pallé – who also recently gave a presentation at Race Tech's World Motorsport Symposium – emphasized the critical need for action and collaboration in combating climate change, highlighting how sustainability can – and must – accelerate growth rather than hinder it.

Speaking about the urgent need for action to tackle climate change, Pallé said: "The time for debate is over; it's time to embrace change. Our partnership with DHL showcases how collaboration and innovation are central to advancing sustainable human progress. Formula E and DHL are demonstrating that sustainability is not a limit to growth but a driver for innovation and progress." Season 10 of the ABB FIA Formula E World

Championship begins on 13 January 2024, in Mexico City. The series will then race in Diriyah, Hyderabad, São Paulo, Tokyo, a venue in Italy to be announced, Monaco, Berlin, Shanghai, Portland and London. **BELOW** Julia Pallé was among a sizeable Formula E delegation to attend COP28, held in Dubai in the United Arab Emirates



ATL aligns to become unified global powerhouse

AERO Tec Laboratories (ATL), the leader in safety fuel systems and flexible fluid containment technology, is to align and unify its USA (Ramsey, NJ) and UK (Milton Keynes, England) manufacturing and engineering facilities.

For decades, ATL Inc (USA) and ATL Ltd (UK) have shared common ownership but operated as separate entities, respecting each other's geographical territories. Although extremely successful acting individually, the merging of ATL's technological resources, workforce, and manufacturing capabilities will not only result in an enhanced customer experience but will also allow new product innovation and development to take centre stage.

Beyond Safety

With the alignment comes a fresh look in the form of a company rebrand. A sleek new logo has been debuted, as well as a strapline, 'Beyond Safety', that will be proudly donned on all marketing materials and slowly integrated into the product line itself.

"The strapline of 'Beyond Safety' pays homage to ATL's founding principle of safety, but also challenges partners, old and new, to dive deeper into the multitude of advantages that ATL products offer as well as the wide array of sectors that ATL products serve," explained CEO Giles Dawson, the driving force behind this vision. "This rebrand signifies a new era, one where teamwork and cooperation pave the way for new opportunities and, I hope, exponential growth, while enhancing the overall customer experience."



IndyCar delays hybrid

THE NTT IndyCar Series has delayed the introduction of its much-anticipated hybrid units until after this year's Indianapolis 500 in the month of May.

The unit, which has become a joint collaboration between IndyCar and its manufacturers, Honda and Chevrolet, completed a total of 15,256 miles of testing in the build-up to Christmas.

IndyCar President Jay Frye has also revealed an important decision regarding how its upcoming energy recovery systems and their enclosures will be serviced and distributed. Michigan-based Ilmor Engineering – the company founded in the 1980s by Mario Illien, Paul Morgan, and Roger Penske, which also makes Chevrolet's 2.2-litre twin-turbo V6 IndyCar motors – will act as the service provider for the ERS units.

Under a new technical regulation, the new magnesium bellhousings made by Dallara, which contain the ERS units, will be treated as a spec component that is assembled and distributed by Ilmor.

"The partnership between Chevrolet and Honda has been phenomenal," Frye said. "The IndyCar-specific hybrid power unit is dynamic and an engineering marvel, and we're completely committed to its successful introduction next season."

The start of the 2024 season is expected to see some track records tumble, with lighter chassis components (aeroscreen, bellhousing and gearbox) prepared for the hybrid addition.

The supercapacitor hybrid system will fit inside the bellhousing, located between the combustion engine and the gearbox. Multiple strategies for regeneration and deployment have been tested. Unlike the traditional IndyCar "push-to-pass" system, the hybrid power unit will not have a restriction on total time used over the course of a race.



QEV Technologies revealed as Formula G technical partner

QEV Technologies, a front-runner in electric mobility, has been formally announced as the technical partner behind the all-new Formula G series.

The company builds and runs the FIA RX2e Championship – the stepping stone category in the all-electric World Rallycross series – as well as running Carlos Sainz Snr's ACCIONA | SAINZ XE Team Extreme E squad, along with working with several Formula E teams and manufacturers. It also took part in the development of the Nitro RX FC1 with a battery-powered SUV platform.

QEV Tech will lead the Formula G project, undertaking the development of the powertrain and battery.

"Motorsport is our passion," said CEO Joan Orus. "It provides the 'halo effect' for everything we are creating in the factory and gives the company an exciting, vibrant environment for all our technicians.

"I was involved in Formula E from the outset and I have been saying to Alejandro Agag and others within Formula E and Extreme E that we need a junior category for drivers entering the electric journey. I am delighted that we are involved in Formula G and that it creates two categories for drivers to specialise in this field.

"Formula One has Formula Two and Formula Three which is the proving ground for drivers graduating into the top echelon. To be successful in Formula One you need to be quick and have the fastest car. In electric motorsport you need to have a number of more complex skills as well; you need to be able to understand how to conserve energy and use the power intelligently. These are skills which can be learned in the Formula G series.

"Similarly, the collaboration will give us an opportunity to provide opportunities for young engineers and mechanics in the early stages of their career to learn the skills around electric motorsport."

"QEV Tech is the perfect partner," said Dilbagh Gill, Founder and Chief Executive Officer – Formula G. "We share the same aims and goals and we have worked together in Formula E and other projects."

Longman Button Panel launched

LONGMAN Racing, specialists in motorsport electronics, engine management systems, wiring looms, data-logging and engine mapping/ vehicle calibration services, has launched its new Longman Button Panel.

The Dorset-based company – which was formed by former saloon car driver and engineer Richard Longman and his then-partners back in 1971 – has produced a unit that offers cost-effective, intelligent, lightweight, and striking CAN switch control.

The Longman Button Panel (LBP) was designed as an evolution of the original OBR Control Systems MSP. The LBP continues to simplify both wiring complexity and maintain intelligent microprocessor control over a traditional switch panel. The LBP CAN controller can directly replace the previous generation OBR CAN controller. These programmable CAN panels offer

These programmable CAN panels offer

improved driver visibility, simplified cockpit layout, increased flexibility, and quick error diagnosis.

Panels can handle up to 20 switches with software configurable momentary or latching conditions, user selectable CAN bus settings, as well as up to three optional analogue inputs. All data is exported via one of the two CAN ports, both with user selectable CAN termination jumpers. Vehicle connection is via a five-pin Deutsch ASL Autosport connection as standard.

The LBP Universal Panels feature UVfluorescent inks for button surrounds and labels as standard; developed especially for endurance racing (requires addition of LED strip in cabin for nighttime applications).

LED switch status lights are controlled in closed loop feedback from the vehicle's VCU, PDM, PCM, ECU. This control provides excellent fault diagnostics and a clear indication of switch/output status. As a standard off-the-shelf option, there are two layouts (15 switch and a 12+3) offered, each including 100 icon/label sticker packs.

The LBP switch panels can also be supplied in totally custom configurations, shapes, size, logos, labels, and general design. Custom panels are subject to individual quotation.

Multiple panels can be used in single installations (driver + co-driver). The LBP controller can also be incorporated into CAN-based steering wheels/panels.

The LBP CAN controller PCB is also sold as a separate part for integration into customers' own switch/steering wheel hardware.

PC Communication is provided by a micro USB cable with rear side USB port. This also allows easy power supply to the panel whilst off vehicle to enable configuration on the bench with a dedicated user configuration software for Windows PCs.





World RX "Battle of Technologies"

USTAINABLY-fuelled internal combustionengined cars will return to the World Rallycross Championship for the 2024 season alongside the current electric cars, marking the first time both technologies have competed side-by-side in an FIA world championship.

The move, which the FIA is billing as a "Battle of Technologies", was approved at the final World Motor Sport Council meeting of 2023 in Baku with the guarantee that both would be competing on "equal terms".

The plan is not without precedent, for both the British and Nordic championships have adopted mixed combustion and EV rulesets. But it is the first time both combustion and fully electric vehicles will be accepted in the same class in a top-level championship.

"As World RX races into its second decade, we are excited to introduce the new 'Battle of Technologies' concept," said Arne Dirks, Managing Director, Rallycross Promoter GmbH. "We have all seen and enjoyed the electrifying power and potential of RX1e over the past two years, and we have also witnessed a lot of passion for combustion-engined cars in Euro RX.

"There has been tremendous interest from drivers and teams across the board, and we believe this

ABOVE World RX ended the 2023 campaign with spec cars. 2024 will see a head-to-head duel between the RX1e machines and their ICE rivals on a level playing field

sustainable new format offers competitors and fans alike the best of both worlds."

World RX adopted an all-electric formula in 2022, but entry numbers have been low, and social media reaction to the new cars mixed. The series was also brought to a halt last summer after a fire destroyed both Special ONE Racing Lancias ahead of the British round to the championship at Lydden Hill. An investigation into that fire continues, while the final four rounds of the season – double-header events in South Africa and Hong Kong – were contested using the Zeroid X1 from the single-make RX2e support series.

As well as the adoption of both electric and combustion technologies, a decision to revert to position-scored qualifying rather than time-based was approved, in a bid to "reduce the jeopardy of track conditions/evolution and to be more easily understood by fans new to the sport."

Hoosier Tire will also replace Cooper as the series' sole tyre supplier following a successful test before Christmas. Hoosier has yet to supply rubber to a premier-level FIA championship, but is no stranger to off-road racing or rallycross, and was a supplier to the short-lived TitansRX Europe rallycross series that ran throughout 2019.

"We call them safety fuel cells, they're explosion proof, and so they're in great demand in racing cars and marine craft, and some specialized land vehicles."

VENT

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Peter Regna | ATL Founder, 1970



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BEYOND SAFETY

WHY REBRAND?

The ATL rebrand represents the alignment and unification of ATL Inc. (*New Jersey, USA*) and ATL Ltd. (*Milton Keynes, England*) into one global powerhouse, driven by a common vision that is reinforced by a shared set of company values.

THE LOGO

Simple, yet iconic. ATL, the acronym for Aero Tec Laboratories, has stood the test of time for decades and has become one of the more recognizable logos in motor sports. For the rebrand, the goal was to introduce a sleek, modern version that still holds true to our roots.

BEYOND SAFETY

Over 6 decades ago, ATL was founded on one simple, yet critical, principle - **Safety**. All these years later, safety is still at the very core of ATL, in the values we uphold and in the products we manufacture - many of which are hand-crafted with pride by a legion of highly skilled technicians. However, to fully understand the entire scope of ATL, you must look **Beyond Safety**.





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SUSTAINABLE NOTORSPORT LEADING THE WAY

Mark Skewis offers a glimpse behind the scenes at what many considered the finest World Motorsport Symposium to date

HEN the captains of industry begin talking about the possible extermination of mankind, by one of its own creations, it's hard not to sit up and take notice.

Given the headlines, good and bad, that propelled Artificial Intelligence into the limelight last year, it was fitting that AI – and its ramifications for motorsport – was one of the big takeaway topics at Race Tech's 2023 World Motorsport Symposium. Never mind humanity: could it one day destroy Formula 1? *Now* people were interested!

Yet WMS 2023 was about far more than the one topic, albeit a fascinating one. The automotive industry is currently in a state of flux, so the event covered all the trends that are preoccupying companies as they address the fight against climate change and the ever-increasing role of sustainability in motorsport: from batteries to hybrids; and from hydrogen to sustainable fuel. All will have a role to play as we move forward, and all were covered. The discussions were navigated adeptly by both Chairmen: Ulrich Baretzky, former Director of Audi Motorsport Engine Development, and Pat Symonds, Formula 1 Chief Technical Officer.

Held once more in the heart of London, at The Embassy of Switzerland, WMS 2023 was opened by Markus Leitner, Ambassador of Switzerland, FDFA. Amid his welcome, he didn't pass up the opportunity to remind us that, for the 13th consecutive year, Switzerland had again been ranked the most innovative country in the world, according to the 2023 Global Innovation Index (GII) published by the World Intellectual Property Organization (WIPO).

He is understandably proud of the Swiss motorsport hub and its companies played an important role in many of the discussions across the two days.

The opening morning kicked off with a mix of battery technology and sustainability – not always the most comfortable of bedfellows. It makes for a healthy debate!

In the first presentation, **lain Wight**, Chief Commercial Officer, InoBat, offered an insight into what is required to make battery cells. He noted of batteries that, with scale meaning everything, this is "not an industry for the faint-hearted".

China's lithium battery exports



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ABOVE A stellar assembly of speakers and panellists not only informed, but challenged the audience

RIGHT Co-chairman Pat Symonds, F1's Chief Technical Officer, was again a sometimes provocative, always informative presence

LEFT Co-chairman Ulrich Baretzky brought a cow bell, as threatened, to summon the audience back from coffee breaks. He also brought an immense knowledge of many of the topics being discussed



experienced explosive growth last year, driven by the pull of overseas demand, and Wight highlighted the fact that the US and EU have both lagged behind China.

Douglas Campling, Head of Motorsport, WAE, has extensive experience with batteries, his company currently supplying Formula E, Extreme E and IMSA's flagship GTP category. He detailed the latter's adoption of hybridization, a factor that has been instrumental in the dawn of a new golden era for sportscar racing.

The IMSA LMDh category is the first major US series to go hybrid, reflecting the fact that sustainability is playing an increasingly important role in competition on both sides of the Atlantic. The rules need to provide a pathway towards these sustainability goals and WMS featured a number of influential speakers who are working hard in this sphere.

Julia Pallé, Vice President, Sustainability, Formula E, >

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

gave her time before dashing off to COP28, hosted in Dubai, UAE. She emphasized Formula E's improvements in sustainability without undermining performance.

It has been an incredible journey for the series, with its next leap being the introduction of fast-charge pit stops in which 10 per cent of the battery will be replenished in just a couple of seconds. Fast-charging is a big issue in EV circles but, increasingly, so too is the final destination of the batteries. Pallé reported that 95 per cent of materials in the championship's batteries are currently recycled.

Dr Cristiana Pace, Founder and Chief Executive Officer, Enovation Consulting, later presented on the subject of 'Systemic Change in achieving Net Zero in Motorsport'. She called on the sport's technical chiefs to focus not just on road relevance, but indutrsy relevance, pointing out that many sectors were experiencing the same challenges. She observed that there were some surprising synergies between motorsport's issues and those faced by soccer clubs.

Tyres are one problematic area where no silver bullet has yet been found. In a first for the Symposium, **Matteo Battaini**, Sustainability and Future Mobility Officer, Pirelli, gave an insight into the hard work going on behind the scenes – including end of life solutions, logistics overhaul, reduction of microplastics and the use of Al to reduce prototypes – as F1's tyre supplier strives for carbon neutrality by 2030.

As motorsport embraces sustainability, rather than evading it, there have been some surprising developments. One such nugget was revealed by Ash Warne, CEO, Dynisma, who explored the unlocking of sustainable development with the next generation of driving simulators for the motorsport industry. Dynisma's low latency, high bandwidth technology has taken realism to unprecedented levels in simulation, enabling teams to develop racecars without the traditional exhaustive ontrack testing. One unexpected benefit of the approach has been a huge reduction in emissions. One team revealed some startling figures: having saved 250,000 track miles in a year, it estimated that equated to saving 450 tons of CO2. An equally unexpected dividend

arising from the can-do attitude that



drives motorsport engineers was reported by **Steve Wickham**, Director of Business Development, Toyota Racing Development (TRD). Tasked with developing TRD's first hydrogen-powered fuel cell generators at the end of the COVID pandemic, his team's focus on emission-free power generation is now attracting interest from other industries that **ABOVE** KMG Publishing Director Soheila Kimberley is the driving force behind the event

BELOW Dr Cristiana Pace called for the sport to stay relevant not only to the automotive sector, but to other industries faced with similar problems



The WMS is such a rare event, where teams, industry and governance are helping shape the future of motorsport thinking. This year's event rightfully focused on motorsports in the Age of Al, which is transforming the way engineering is practised. We have challenging work ahead of us to map out how motorsports balances technology leadership whilst providing a level playing field across the competitors."

Robin Tuluie, CEO, PhysicsX



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are grappling with the replacement of traditional diesel-powered generators.

The tech, which can use second life batteries, can be scaled down as well as up, and can be deployed just with batteries or with hydrogen. To date it has been harnessed both at music festivals and at a golf tournament.

The President's State of the Union

Perhaps more than ever before, WMS23 was truly a World Motorsport Symposium, with delegates coming from throughout the motorsport spectrum. John Doonan, President of the International Motor Sports Association (IMSA) delivered a keynote speech. ►

ABOVE & RIGHT Simon Dodman, Principal Aerodynamicist, FIA, discussed Al-driven simulation in Formula 1 (above). FIA Aerodynamicist Sean Cartmale (right) brought the audience up to speed with F1's wet weather investigations

BELOW LEFT Alcon MD Alistair Fergusson in discussion with Multimatic founder Larry Holt

BELOW RIGHT Audi's Lea Schwarz contributes to the hydrogen panel session. The fast-evolving technology is increasingly on companies' radar







With the American sportscar series playing host to no fewer than 18 OEMs, IMSA is the envy of many rivals. Doonan debated the future of motorsport in the context of the IMSA GTP division's adoption of hybrid technology in 2023.

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The halo effect from that success includes an infectious enthusiasm, with Doonan noting the "rising tide that floats all boats" impact.

"Governing bodies have the ability to make sustainability cool," he suggested, explaining how the increasing role of software in GTP was engaging young engineers.

Another notable discussion was prompted by **Larry Holt**, Executive Vice President, Multimatic Special Vehicle Operations. Always a highlight, his refreshing approach to the discussion of Balance of Performance – "an issue that has made grown men cry in press conferences" – evoked the thrill of the battle between motorsport's gamekeepers and poachers.

If you weren't present, you missed a treat. The WMS relies on Chatham House Rules, whereby participants are free to use the information received, but neither the identity nor the affiliation of the speaker(s), nor that of any other participant, may be revealed, so my hands are tied!

The Ford GT, which famously won its





The best I have participated in. Very interesting topics; I especially welcome the AI subjects, which were highly innovative. I like the spirit and the ambience of this symposium: friendly in the form, serious in the way the subjects are treated; where questions, answers and discussions are really open and where the debates are real. It is also a good opportunity to network and really useful to see a mix of young and more experienced engineers sharing their ideas."

Bernard Niclot, ACO Consultant



ABOVE Eric Jacuzzi, Vice President, Vehicle Performance, NASCAR, gave an insight into the aerodynamic research that made the Garage 56 project a huge success

LEFT AI and aero had lots to discuss: PhysicsX CEO Robin Tuluie with F1 aerodynamicist (and WMS Speaker) John Iley

LEFT Michael Brueckner, Bosch, talks to WAE's Douglas Campling and Lucy Rimmer

RIGHT Leading figures from both sides of the legislative fence find the WMS useful. Here Jason Somerville, Head of Aerodynamics at the FIA, takes a keen interest in the latest instrumentation technology



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LEFT The role of Artificial Intelligence, and whether it can be policed, opened a flood of questions for the experts

FAR LEFT Sustainability is increasingly a big-ticket item for tyre companies. In a WMS first, Matteo Battaini, Sustainability and Future Mobility Officer, Pirelli, explained the steps being taken by F1's tyre supplier

LEFT An exchange of views after the Electrical and Battery 25



class at Le Mans in the hands of Multimatic, featured prominently in the discussion. The car was the result of extensive work in CFD and in the windtunnel, and aerodynamic trends played a key role in WMS23.

Eric Jacuzzi, Vice President, Vehicle Performance and **Brandon Thomas**, Vice President – Vehicle Design, NASCAR Garage 56, revealed how the Hendrick Motorsports Next Gen Chevrolet Camaro had been transformed for Le Mans, in order to run at GT lap times around the iconic circuit. It was, they observed, the best CFD program in NASCAR history. It had to be: the easiest thing to do would have been to bolt on a huge GT-style rear wing – something they did experiment with out of sheer curiosity – but instead, tasked with preserving NASCAR's DNA (no wing!), they achieved their mission largely through generating more underbody downforce.

The success of that Le Mans Centenary race mission won NASCAR's tech team the Dino Toso Aerodynamicist of the Year award. Not so long ago, the same accolade was scooped by the FIA for the ground-breaking development of the latest F1 car. The design has been a huge step forward in terms of improving the racing, but changing ►





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LEFT PFC Brakes CEO Mary-Ann Burgoon presented Alcon MD Alistair Fergusson with the Don Burgoon Most Innovative New Product of the Year award

BELOW LEFT TO RIGHT The tech award winners were announced at the champagne drinks reception and awards dinner



the wake structure has unfortunately worsened visibility for the drivers when the skies open.

The trial of a wet weather bodywork package last season demonstrated that the issue is a tough one to overcome. So it spoke volumes for the FIA and for F1 that, rather than duck the issue, FIA aerodynamicist **Sean Cartmale** was happy to bring the audience up to speed with the wet weather investigations. There are some promising results to report in the battle to reduce spray and improve visibility.

Al: show stealer

One thing *is* clearly visible: the imminent battle between F1's regulators and the teams, now that both sides are striving hard to get ahead with Artificial Intelligence. With the F1 squads all allied to AI partners, it is evident that AI is no longer something that's coming – it's here already.

Across the two days we were treated to four remarkable presentations on the

subject: one from a 'gamekeeper', **Simon Dodman**, Principal Aerodynamicist, FIA; three more from 'poachers': **Alan Patterson**, Co-Founder, BeyondMath; **Robin Tuluie**, CEO, PhysicsX; and **Martino Milani**, Customer Success Manager, Neural Concept 3D.

All are pushing the envelope in different directions, but each find common ground: this technology is going to change the world, never mind our sport, so we had better embrace it.

Some simulations, we are told, can be conducted a staggering 8,300 times quicker than previously, with work that used to take days now being achieved in minutes or even seconds. The current aerodynamic testing regulations, designed to help level the F1 playing field, were conceived before AI had become such an influence. With accuracy improving to the extent that the technology is driving medical breakthroughs and now even being used to forecast the weather, the governing body appreciates that its influence will be hard to police – even though it is also harnessing it



to improve the racing spectacle and safety at the same time!

The consensus was that machine learning can be a huge force for good. A technology that will certainly engage young engineers, it will be an incredible tool but one still best used with a human in the loop.

Blazing a trail

It is becoming evident that the smallest molecule in the world has a big future in motorsport, with hydrogen a topic on many people's minds. Two companies blazing a trail in hydrogen combustion brought us up to speed with their work with presentations from **Michael Muerlebach**, Director Motorsport Customer Account and Product Management, Bosch, and **Gorka Arce Alonso**, Project Manager, AVL RACETECH.

Explaining the issues they have overcome and the challenges that still lie ahead, these pioneers are intent on bringing the ICE back into the green arena through engines that retain the The World Motorsport Symposium provides a unique setting that facilitates not only information exchange on relevant topics within motorsport but, more importantly, spurs a vibrant discussion in the many informal opportunities the event provides."

Martin Popilka, CEO, P1 Fuels

noise and passion that fans adore. Their words resonated with ACO Consultant **Bernard Niclot**, who explained his belief that motorsport's experiments with hydrogen can make for a new era of road relevant technology.

Sustainable fuel is another solution showcased in motorsport. **Martin Popilka**, CEO, P1 Fuels, reminded us that, beyond the BEV trend, there are still 1.3 billion fossil fuel-powered cars on the planet. His company introduced sustainable fuel to the World Rally Championship and has supported Sebastian Vettel's Race Without Trace campaign and is intent on scaling up the technology. At the same time, he lamented governments' tendency to backtrack on the green agenda. "We have a choice," he said. "We can be part of the solution, or part of the problem..."

Felix Leach, Associate Professor of Engineering Science at the University of Oxford, reiterated the benefits of sustainable fuels. He highlighted the fact that the UK's switch from E5 to E10 fuel on its garage forecourts had saved 750,000 tons of CO2 each year – from a change that nobody had even noticed. However, he noted, the focus on BEVs is squashing innovation in e-fuel space.

Three wise men

Set against the backdrop of the COP28 summit that claimed much but delivered little, the World Motorsport Symposium indicated that sustainability is increasingly driving motorsport technology. There are a range of solutions – BEVs, hybrids, hydrogen and e-fuels – that will prove valuable for different applications and diverse industries, but to focus on just one solution alone could prove dangerous.

"Feedback has been fantastic," reported Soheila Kimberley, Publishing **BELOW** Was it networking, or just good fun? The awards dinner at the Millennium Gloucester Hotel, Kensington Director of Kimberley Media Group. "My sincere thanks to everybody, the sponsors, the staff, who made it happen. As we are just picking ourselves up now from the festive season, I want to tell a tale of three wise men.

"No, not *those* three: Frankincense, Gold, and Myrrh would clearly be deemed exotic materials in today's cost-conscious motorsport, and therefore ruled illegal! The three wise heads in my tale are an engine guru, a talented technical officer and a star aerodynamicist: now there are the ingredients for a good Christmas tale. But also the ingredients required to assemble a top-quality schedule of topics and a stellar list of speakers to both inform and challenge us at the WMS.

"Without my three wise men – Ulrich Baretzky, Pat Symonds and John Iley – there would have been no World Motorsport Symposium and I am deeply indebted to them for their phenomenal contributions."



This year's World Motorsport Symposium was an invaluable platform for fostering connections and growing relationships at the highest levels, bringing together the motorsport industry's leading minds to engage in dynamic discussions and insightful presentations. A hugely valuable event and we look forward to being back next year."

Alan Patterson, Co-Founder, BeyondMath

LAST SHOT AT THE NOON?

Win or lose in its final crack at what could be the toughest Dakar Rally yet, Audi's RS Q e-tron will be remembered. By **Chris Pickering**

T'S like the first moon landing." That's how Dakar veteran Sven Quandt described Audi's giant leap into the unknown with the RS Q e-tron when we first spoke to him about the project three years ago. Under the skin, the car even looked like a spacecraft, with its fiendishly complicated hybrid-electric drivetrain crammed in with aerospace precision.

The Audi engineers had a mountain to climb in terms of packaging. Unlike a standard T1+ Dakar car, which has one engine, one gearbox and one cooling system, the RS Q e-tron has separate motor generator units (MGUs) front and rear, each with its own gearbox. There's then a big lithium-ion battery with the associated power electronics and management system, a DTM-based combustion engine and a third MGU acting as a generator, plus cooling systems for each of those modules. To make things even more complicated, they'd have to maintain and potentially repair all of that in the middle of the vast Rub' al Khali desert in Saudi Arabia. Not deep space, perhaps. But not far off.

In some respects, it was a gamble. Audi Sport's wealth of experience in endurance racing stood the team in good stead, as did pairing up with Quandt's immensely successful Q Motorsport operation, but such a complex car was still a high-risk option for the longest and toughest motorsport event in the world.

And yet, as the team gears up for its third Dakar with the RS Q e-tron, that risk appears to have been vindicated.

Yes, they've had their fair share of bad luck. Accidents, punctures and navigational issues mean that Mattias Ekström and Emil Bergkvist's ninth place overall in 2022 remains the team's best result in the event so far. But the car has proved reliable from the outset – and quick, with six stage victories picked up along the way.

"I think we've shown that the concept was right from the beginning – especially in terms of energy management," comments Dr Leonardo Pascali, ► Safety

New seat foam

Extended frontal crashbox

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the project's new technical director. "Looking back over the last three years, and in particular the last 12 months since I've been involved with the project, there's never been a discussion where we've had any doubts."

Pascali has worked in Super sport road cars, Formula 1 and the World Endurance Championship in the past. He's hoping he will steer Audi's engineering team to victory in this year's Dakar, but he'll only get one shot. Back in the summer it was announced that Audi would close its Dakar programme after 2024 to concentrate on its forthcoming Formula 1 entry.

Does that mean the pressure is on to deliver this year? "No more pressure, but we are reasonably confident," he answers with a smile.

TOP Suspension setup has been the most time-consuming aspect of the development for 2024

ABOVE With some monster tests ahead on this year's event, much effort has been put into reducing driver fatigue within the cockpit

Changes

The fundamental success of its series-hybrid powertrain has led to a gradual process of evolution on the RS Q e-tron following its first Dakar in 2022. The main changes for last year focused on weight reduction. In its original incarnation, the car weighed over 2,200 kg, while the non-hybrid cars in the T1+ category were around the two-tonne mark. Savings across the car shed around 100 kg, bringing it close to the revised T1U weight limit of 2.1 tonnes for 2023, as well as lowering the centre of gravity.

Another notable change was the adoption of a new fuel blend. Sustainable components including bio-derived ETG gasoline and e-methanol make up 80 per cent of the content, while net CO2 savings are said to be upwards of 60 per cent compared to traditional fossil fuel.

While the powertrain hardware remained relatively unchanged, there were also significant updates to the software in the second year. This included work on the motor control to get as close as possible to the permitted power levels without exceeding them when the wheels went airborne over jumps.

The efficiency of the auxiliary systems came under scrutiny. The air conditioning system, for instance, was found to be so aggressive in its original form that it could cause the coolant to freeze if left running constantly at its maximum output, so an intermittent mode was introduced for 2023. The cooling fans and the brake servo pump were re-calibrated too, with different settings for the special stages and the low-speed liaison stages that connect them via public roads. ▶

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The 2023 evolution of the RS Q e-tron, known as the E2, also featured an entirely new body. Not a single part was shared with its predecessor - partly due to regulation changes. Cabin packaging was reviewed to increase interior dimenisons, while the front and rear decks were redesigned. Underneath these decks, the RS Q e-tron resembles an open-wheel buggy, with the lower bodywork swept in as tightly as possible in a shape reminiscent of a boat's hull. Despite its increase in frontal area, the E2 body was said to cut the total drag by an impressive 15 per cent.

New evolution

The latest evolution of the car builds on lessons learned from the 2023 event. Pascali explains: "The key things we took away from last year were around passive and functional safety. Our goal was to exceed rules targets, accepting, in some cases, to overengineering the car to maximize the safety. It's a part of Audi DNA. We had three major crashes,

When I first joined the project, it reminded me of the Apollo 13 mission where they're going through all the contingency procedures"

including some injuries, so we knew that was something that we must improve."

Comfort was identified as another major topic. Although not perhaps the first thing that springs to mind in motorsport, crew resilience is a major factor in long distance racing. Audi has made an effort to reduce both the noise and the vibration inside the cabin to improve driver and co-driver concentration. Aside from the accidents that ultimately

ended the race for two of the three Audis, punctures were another big feature of the rally last year. That's a common problem also to all competitors but the Audis are more vulnerable because of the higher stage average weight. The second stage of the event - held after heavy rain had

washed away the top surface and exposed jagged rocks below - was to prove particularly critical, with both Carlos Sainz and Stéphane Peterhansel running into issues. In total, the three Audi crews picked up 14 punctures on the first four stages.

Not all punctures are created equal, however. The Audi engineers identified three main types, Pascali explains: "If a sharp stone or rock slices the sidewall, you tend to get an immediate loss of pressure. The other possibility is that the puncture occurs on the tread pattern, and that can go one of two ways. Smaller cuts can lead to slow punctures or you can have larger cuts where you lose pressure immediately. A lot of this depends on the terrain. There are some stages on the Dakar that take you past 🕨





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volcanos, and the rocks there are particularly sharp." The opening stage of this year's event, running from AlUla to Al Henakiyah near the shores of the Red Sea, will take the crews through this volcanic terrain, so it

promises to be a baptism of fire in more ways than one. BF Goodrich has introduced a control tyre for the

T1 categories this year, which the team has been busy getting to grips with. "It's been critical for us to understand the setup with the new tyres," explains Pascali. "They have a stiffer sidewall, introduced by BF Goodrich to reduce the chances of a puncture in that aera of the tyre, but this, of course, also changes the grip and comfort, because it increases the tyre vertical stiffness by more than 20 per cent."

Compensating for the additional sidewall stiffness is not as easy as you might imagine. Its impact is primarily felt in high-frequency oscillations that are beyond the effective range of the springs and dampers in the suspension and instead damped by the deformation of the tyre itself.

"To tune [for the increased sidewall stiffness] we'd need to change the damping effect inside the tyre structure, which is not something we have access to," he explains. "With the springs and dampers, we are able to change the body platform movements, which equates to frequencies of up to 1 or 3 Hz. But the oscillations from the tyre are in the range of 8 to 10 Hz. There, the control is a little worse, but at lower frequencies we've been able to work a lot on the springs and dampers and the body comfort is now better. That suspension setup has probably been the most time-consuming aspect of the development for 2024."



The RS Q e-tron uses passive springs and dampers, but their setup philosophy is based on the Skyhook concept often used in active systems. This works around an idealised case where the vehicle's body is suspended from an imaginary hook in the sky, allowing it to maintain a perfectly fixed height as the wheels and tyres move to follow the road. "This Skyhook principle is really effective overall, but you don't get any benefit for the eigenmodes of the unsuspended mass," notes Pascali.

Serviceability is also a key concern. In addition to the engineers and mechanics working in the giant 'bivouac' encampment that follows the rally, there are the running repairs that the crews might need to make during the stages – including the new 48-hour 'chrono' stage, where they will have to camp at one of eight temporary bivouacs en route with no access to support.

ABOVE Remember the name: the technology will be recalled long after the project has ended

BELOW The team has worked hard to get to grips with a new BF Goodrich tyre that features a stiffer sidewall





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For example, simplified quick-release connectors make it easier to remove the oil pumps used on the two gearboxes. Elsewhere, new fasteners for the spare wheel cover make it easier to re-attach if the tyre inside has deformed due to a puncture. There have also been changes to the suspension uprights to prevent potentially damaging stones from getting trapped behind the brake backplates.

New rules

No other motorsport series in the world sees electrically-driven cars like the RS Q e-tron competing directly with conventional IC-only machines. Achieving parity across such a diverse field is no mean feat, especially when the terrain also varies hugely throughout the event. Generally, the T1+ and T1U categories are now considered to be reasonably well matched, but fine-tuning the balance between them is an ongoing process.

Ahead of last year's event, the T1U minimum weight limit was increased to 2,100 kg, but this was largely academic as Audi – the only team in that category at the time – was still north of that figure. Pascali believes they could now go below that figure if they were allowed to do so.

That limit still stands for this year, but the T1+ weight limit has been increased fractionally to 2,010 kg. The maximum power output for the T1U Audi has also been increased by 15 kW to 286 kW (approximately 389 hp).

There are no guarantees that it will stay this way. The Dakar organisers reserve the right to adjust the power limits for both classes after the first three stages. They do this by monitoring the longitudinal acceleration in the window between 90 kph and 160 kph (all cars are then limited to a maximum of 170 kph) following the concept to have the Equivalence of Technology (EoT).

While the decision to move the Dakar from South America to Saudi Arabia raised a few eyebrows back in 2020, the region has since proved to be a natural home for the iconic desert rally. It offers huge expanses of varied terrain, including long stages through the dunes that hark back to the rally's original incarnation in North Africa. It's certainly no less challenging, with a total length of 7,891 km this year, of which 4,727 km will be timed special stages.

"The feedback from colleagues with long experience in Dakar, looking at the presentation [of the route] is that this will be the hardest Dakar yet," promises Pascali. "For instance, there's the new 48h Chrono stage . And the way that the event is structured this year means that the support crews will need to move every day, so that will be stressful in terms of logistics."

Audi has a good record of mechanical reliability in the Dakar, but that's not to say there haven't been challenges along the way. Not surprisingly, reliability was a big topic in the early development of the car, prior to its first outing. Since then, things have calmed down, but testing ahead of the Morocco Rally in October highlighted a potential leakage issue with the cooling system, while a water pump failure in the event itself denied Stéphane Peterhansel and Edouard Boulanger the chance to challenge for a win.

"We started the Morocco Rally with some concerns but we were able to manage those in a really good way, so we didn't have any problems with those parts in the event itself," reports Pascali. "All the problems that we'd encountered during testing and race were fully understood. We think we've solved those problems and now we're confident that we're much more in control of the reliability of the vehicle."



ABOVE The last big try-out was over 900 kilometres during the five-day test hosted at Château de Lastours




Great expectations

You get the sense that while the Audi engineers have become comfortable with the complexity of their vehicle, it's still not something they take for granted.

"When I first joined the project, I saw all of the books that outline the processes you need to follow if there was a failure on the car. It reminded me of the Apollo 13 mission where they were going through all the contingency procedures," recalls Pascali. "We had all the processes written down in books, detailing how to identify a problem, contain it and implement countermeasures. I was really impressed how effective we were in this job."

In some respects, this complexity adds additional risk compared to a more conventional powertrain layout, but it's a task that Pascali and his colleagues clearly relish. He makes no bones about the fact that the RS Q e-tron is a technology demonstrator as well as a racing car.

"For us, the target is really to set new technology limits," he comments. "We

want to exceed expectations in terms of technology. If you want to do that, you need to do something special. Our aim is not just to be successful in the event, but also to demonstrate that we are able to manage such sophisticated technology following an effective path."

Although Audi will soon be withdrawing, Pascali sees a continuing role for cars like the RS Q e-tron in the Dakar: "As an engineer, I don't just see the challenge for the crew, but also the engineering challenge. In the future, I'd like to see more cars that are technology demonstrators like this. If you think back to when Renault introduced turbocharged engines in Formula 1 in the 1970s – they didn't win the championship, but they will always be remembered for introducing that technology and shaping the road car market in the following decade."

Pascali himself has worked behind the scenes in the modern era of Formula 1, as well as top-flight sportscar racing, and he sees a considerable difference in the

mentality: "These days, you don't have much freedom in Formula 1. In the Dakar or even back in LMP1 in 2014, when we had Audi, Porsche and Toyota developing the hybrid cars, there was a lot more scope to generate innovation. The main difference is having that freedom to develop new technologies to enhance the progress and then transfer them to road production vehicles."

As far as major international motorsport events are concerned, the Dakar is perhaps the last truly open platform for innovation. Over the past decade, it has seen petrol, diesel, hybrid, hydrogen fuel cell and fully-electric powertrains compete in various different classes. This year's event promises to be the closest yet, with Audi, Toyota and Prodrive all lining up with proven technology and experienced crews. All three stand a realistic chance of winning, so maybe this will be the year that Audi's moonshot finally touches down. Irrespective of the final result, Audi has defined a new path for future technologies. 🛄



The Lotus Can-Am that never was, now is! **Chris Pickering** explains, with the help of two of the key figures behind a stunning project **HE** Lotus Type 66 is something of an oddity. It's an old car that's brand new; a sports car that's a strict single-seater; and a racing car that can't actually race. But it's also a glorious celebration of the history of one of the most innovative companies in motorsport and an intriguing exercise in what might have been.

Back in 1969, Lotus was on the crest of a wave. In a little over a decade, the company had swept from a small club racing manufacturer to a Formula 1 powerhouse. In the process, it had pioneered the use of monocoque construction, wings and stressed powertrains in Formula 1, dabbled with gas turbine engines and four-wheel drive, and become the first European manufacturer to win the Indy 500 since World War 2.

Outside of the single-seater world, one of the most lucrative opportunities in motorsport was the Can-Am series. It offered substantial prize money, and huge marketing potential in the North American market, where the company's road cars had already established a cult following.

Lotus had previously dipped a toe into the North American sportscar racing scene with the V8-powered Type 30 and Type 40 – born out of the company's unsuccessful bid to develop the Ford GT40. That was before the Can-Am series had been established, however, and it seems likely that Chapman had noticed the success of British Formula 1 manufacturers like McLaren and Lola, and began contemplating another go.

Behind closed doors, Lotus draftsman Geoff Ferris was commissioned to start producing designs for



a proposed Can-Am car, which was allocated the Type 66 designation (the Type 65 before it being the Europa and the Type 67 afterwards being a Tasman Series single-seater that never actually raced).

Exactly what happened next is a bit of a mystery – nobody outside of Lotus was ever aware of the project, and before long, Chapman pulled the plug. With Lotus already flat-out in Formula 1, Formula 2, Formula 3 and Formula 5000, it's likely that the resources simply weren't there to pursue the project. And so, it disappeared into the archives, held under lock and key.

That all changed one day when Colin Chapman's son – and proprietor of Classic Team Lotus – Clive Chapman was rummaging around looking for some old Formula 1 drawings, when he stumbled across a roll of microfilm. To his surprise, one of them contained a set of drawings for a high-winged Can-Am car.

Word of the Lost Lotus soon spread, and in 2016 MOTOR SPORT magazine approached Chapman to write an article on the car for a special feature on Can-Am's 50th anniversary. As a favour, he asked Lotus design director Russell Carr if he could turn the 2D drawing into a 3D model to illustrate the article.

Carr immediately said yes, despite not having any official time allocation to devote to the car in the Lotus design studio. Instead, he took it on as an out-of-hours project, working in collaboration with head of exterior design Barney Hatt and designer Pete Reach. They were so taken with the car that they used the design studio's CNC milling machine to create a physical model that now sits on the shelf in Carr's office.

Big anniversary

Skip forward to the beginning of 2022, and Simon Lane had just joined Lotus as the head of the company's newly-formed Advanced Performance division. One of his first jobs was to identify a suitable project to mark the firm's 75th anniversary in 2023. On his third day at the company, he called into Russell Carr's office to see if he had any ideas, and that's when he was shown the model of the Type 66.

"When Russell told me the story, and especially some of the innovative Chapmanesque features that are in the design, it felt like the automotive equivalent of coming across an unreleased Beatles single," Lane recalls. "It seemed like the perfect way to celebrate the 75th anniversary."

The automotive equivalent of coming across an unreleased Beatles single"

Lane had been involved with 'continuation cars' in his previous job, so the idea of resurrecting something from Lotus's back catalogue had already occurred to him. He had his reservations about a direct copy, however.

"If you build a 1960s car, it will drive like a 1960s car, and it will have 1960s safety levels. So, it wasn't something I was 100 per cent convinced about," he comments. "My feeling [was] that we needed to approach it as a restomod, in a way that stayed true



BELOW The plan is to

deliver an authentic

Can-Am experience

while being safer and easier to use





LEFT The car has a modern sequential gearbox. Steering wheel-mounted paddles are an option, but the Type 66 comes as standard with a woodentopped gear stick

to the look and feel of the original design, but with modern engineering that would make it safe and fun."

Having secured agreement from Clive Chapman, who owns the rights to the design, the project was given a green light and Lotus assembled a team at its engineering centre in Hethel to begin the development.

The original project had been abandoned in the very early stages, which meant that precious little information remained. There were only a handful of exterior drawings of the car and no details on the intended chassis construction or powertrain. This gave lead engineer Louis Kerr and his colleagues something of a challenge, but it also gave them a considerable amount of freedom.

"All we had was a handful of concept drawings done by Geoff [Ferris]," he recalls. "We had the front end of one of these ideas and the back end of the other, and then we had a short tail and long tail, plus a high wing and a low wing."

McLaren and Ferrari had both used high-mounted wings in Can-Am in 1969, but the series had announced its intentions to ban them for the 1970 season – possibly in response to a spate of alarming accidents in Formula 1, where the wings had failed or distorted with disastrous results. It seems Ferris had re-drafted the Type 66 in response to these changes.

The design drew inspiration from Formula 1 in other areas too. Lotus was working on the Type 72 at the time – the car that was to become its most successful design in Formula 1, picking up three constructors' championships and two drivers' championships over a five-year career. Notably, the Type 72 was the first Formula 1 car to feature side-mounted radiators.

These brought a host of benefits, from reduced frontal area and lower mass, to improved weight distribution and no need to route coolant hoses past the cockpit. The Type 66 embraced this concept for Can-Am and, freed from the use of front-mounted radiators, it also featured a full-width front wing.

"I think the front wing and the side radiators are my favourite parts of the design. They were very innovative concepts at the time, and very Chapman," comments Kerr. "Keeping the side-mounted radiators in the finished design has been quite a challenge. It's an area where we've stuck to the Can-Am regulations of the time, which required opening doors on both sides of the car, so the packaging turned out to be quite tricky."

This has proved to be a recurring theme throughout the design. The Type 66 is a relatively compact car by Can-Am standards ("I was stood next to a 1971 McLaren Can-Am car recently, and the first thing that struck me was how much bigger it looked than the Type 66," notes Lane). As such, fitting everything in has proved something of a challenge – especially with the additional hardware on the 21st century car.

Deadliest era

The original Can-Am cars belong to motor racing's deadliest era. They were notoriously tricky to drive and crash protection was rudimentary to say the least. Lotus was determined to ensure that the reborn Type 66 would be safer and more accessible, so the first thing on the to-do list was to give it modern levels of crash protection. That includes side impact protection, front and rear crash cans and an FIA-compliant roll over structure.

"We've had to stretch the wheelbase slightly so we could move the driver's feet behind the front axle and get the crash structure in there. The only real aesthetic change to the design is the nose, which now extends over the front wing to accommodate that crash structure. Other than that, the car looks exactly the way that Geoff [Ferris] drew it," says Lane. A similar approach has been applied to usability.

RIGHT The reimagined car is a strict singleseater, with the original "jump seat" unapologetically ditched An anti-stall clutch is fitted as standard; there's also a modern engine management system with engine over-rev and downshift protection, along with a motorsport ABS system, power steering and traction control.

After much debate, the decision was taken to fit a modern sequential gearbox instead of an H-gate, to eliminate the risk of a wealthy owner accidentally selecting first rather than third. Steering wheel-mounted paddles are an option, but the Type 66 comes as standard with a wooden-topped gear stick, allowing the driver to shift up or down with the palm of their hand.

"One of the first thoughts was just, 'How are we going to fit it all in?'" says Kerr. "It's a lot of extra hardware to fit into what is essentially a 1960s design, without affecting the original concept. We tried very hard to package it all with only some very subtle changes."

Once the 3D model was ready, it was put into CFD. The team had already set out the key aerodynamic targets. Perhaps not surprisingly, the unfinished 53-yearold design was a little way off, but the basics were already in place.



ABOVE Simon Lane was seeking a project to mark the firm's 75th anniversary. He couldn't believe his luck

"We didn't have to make a huge amount of adjustment to get the downforce, the drag and, particularly, the balance that we wanted, although it was a little pitchy when we started," comments Kerr. "We've done that with some underbody strakes, a bit of shaping on the underbody and just repositioning the rear wing. Nearly all of the surfaces on the car are original." Aerodynamics was just starting to blossom in sportscar racing when the original Type 66 was on the drawing board, and Kerr believes that Ferris and his colleagues would have comfortably met the sort of targets that might have been set in 1969. By modern standards, the downforce targets for the new car are said to be easily achievable. Lotus has yet to release an official figure, but reports from the car's unveiling at Monterey suggest that this is in the region of 800 kg at 150 mph.

"It was nice to run the model and see that they probably weren't far away from their targets," comments Kerr. "I'd say we probably adjusted less than 5 or 6 per cent of what was there – some of the underbody design and the front and rear wings – just to get to the target."

Chassis

The drawings contained no information on the hardpoints or the chassis construction underneath the skin. Fortunately, Classic Team Lotus sits just across the road from the engineering department at Hethel, so Kerr and his team were able to reference ►



not only hundreds of period drawings, but also complete cars, such as the contemporary Lotus 72.

They were also able to speak to some of the original Team Lotus personnel. Chief among these was Geoff Ferris, who has since retired after a long career that took him to Penske, working on both Formula 1 and IndyCar projects. He doesn't remember much of the Type 66, but he's been able to fill in some of the background.

"We presented a clay model of the Type 66 to Geoff via a video call six months ago," comments Lane. "I think I'm safe in saying that he was quite taken aback that we were building this car that he'd drawn fifty-something years ago. But he's very interested in the project and he's full of stories about what it was like working for Colin Chapman at the time, and how Colin would always sail as close to the wind as possible in compliance with the regulations."

Broadly speaking, the chassis concept is one that would have been familiar to designers in the late sixties, with aluminium honeycomb panels making up the sides of the central tub. However, extruded aluminium sections are now used at the intersections, along with modern bonded joints.

One notable feature of the Type 66 is that the reimagined car is a strict single-seater. The original had a vestigial passenger seat, which Lane describes as "a jump seat and a dustbin lid". There were discussions at the beginning of the project as to whether the car should be redesigned as a full two-seater, but to do so with enough room to accommodate a large adult, plus all the necessary safety gear, was deemed impractical.

"I love the offset cockpit. Would that have been accepted by Can-Am at the time? We'll never know. But it's a typical example of Colin Chapman pushing the rules to get the best performance," comments Lane.



ABOVE The Type 66 had been re-drafted in response to Can-Am's incoming ban on the fashionable high wings "We've had a few people come up and say it can't be a Can-Am car because it's only got one seat," he continues. "I always enjoy telling the story that it had this jump seat in there originally that I think would have been deemed too dangerous back then, let alone now. Instead, freeing up that extra space has allowed us to run a larger fuel tank and put the extra side impact intrusion and crash protection in there."

Optimisation

The suspension follows a classic late sixties template, with double wishbones and inboard dampers at the front, paired with a multi-link arrangement on the rear that features long radius arms running from the back of the tub.

Kerr describes the process of refining the geometry as starting from the outside and moving inwards; with period-correct wheel sizes and the contours of the bodywork around the wheel arch defining the range of movement for lock-to-lock as well as bump and droop. After that, it was a question of running a series of iterations through a driver-in-the-loop simulator to ►

BELOW The wheelbase was stretched slightly to move the driver's feet behind the front axle



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get the hardpoints in the right place. The main parameters here were anti-dive, antilift, pitch control and heave control.

"We have a number of drivers who are specifically trained to do simulator work, because your sensory perception changes. The requirements become so much more acute to pick up on the subtle cues on the simulator," notes Kerr. "We spent a lot of time on driver position because this car is quite different to the applications we're normally simulating. For instance, the driver sits a lot more reclined, with a 55-degree back angle and their legs up a little bit. So, we had to spend a lot of time setting the simulator up and getting the cockpit environment ready."

Thousands of different iterations are said to have been tested, looking at changes in torsional and bending stiffnesses of the structure, anti-roll bar stiffnesses and geometry.

"We do some offline work initially to give us the initial direction, but then everything we do from that point onwards is with



ABOVE A development car was unveiled at Monterey Car Week in California

the drivers," Kerr says. "And the simulator technology has improved so much in recent years. We can get 90 or 95 per cent of the way there on the simulator, which means we're so much more accurate before we start building the car. That's dramatically reduced our development time on track."

Lotus uses an external simulator facility, but it did have its own test track at Hethel laser scanned last year, meaning that the drivers can evaluate the virtual car on a circuit model that's faithful to around half a millimetre.

Right at the start of the project, the target was set to match or exceed the pace of a modern GT3 car around a typical grand prix circuit. Tracks used in the digital benchmarking process included Laguna Seca, Circuit of The Americas, Fuji, Bahrain, Silverstone and Spa.

"It would have been pretty easy to go faster, to be honest. That's not the hard bit," comments Kerr. "We wanted something that would deliver an authentic Can-Am experience while being safer and easier to use."



RIGHT Lotus was working on the Type 72 at the time, the first F1 car to feature sidemounted radiators. The Type 66 embraced this concept, enabling its use of a full-width front wing



Big bangs

The beating heart of any Can-Am car is its engine, and the Type 66 is no exception. It's not known what engine Chapman might have had in mind, but Lotus had a strong relationship with Ford at the time, and the American manufacturer had several large capacity V8s at its disposal.

The Big Block Boss 429 engine used in NASCAR was good for over 600 hp, but it's thought that this would have been physically too large for the Lotus's engine bay. The Small Block went up to 351 cubic inches (5.8 litres) in production trim, but is capable of being stretched to at least 427 cubic inches (7 litres). It's tempting to imagine what might have been if the likes of Carroll Shelby or Keith Duckworth had got involved.

The front wing and the side radiators were very innovative concepts at the time, and very Chapman"

For now, Lotus is being a little coy as to what engine will be used in the reborn Type 66. It's understood to be a period-correct pushrod V8 of 5.8 litres but neither a Small Block nor a Big Block in the traditional sense. We're told it's not a Chevrolet engine, which implies Ford. One guess is that it could be a hybrid of Small Block and Big Block architecture, as is sometimes employed by US hotrodders.

LEFT A well-known engine builder – rumoured to be Roush Yates – has developed the period-correct pushrod V8

Whatever its origins, it's clear that this is not your typical crate engine. A well-known engine builder – rumoured to be Roush Yates – has developed the package, making extensive use of modern materials inside the engine to squeeze more than 830 hp out of it at 8,800 rpm with a red line of 9,000 rpm.

"It revs slightly higher than the equivalent engine might have done in period, but not massively so. It sounds exactly like the Can-Am cars did back in the day with those unequal length trumpets on the intake," Kerr enthuses.

A development car was unveiled at Monterey Car Week in California. The event was chosen partly because it took place close to Laguna Seca, which is steeped in Can-Am history, but also because it fell within weeks of the precise anniversary of Chapman completing his first car. (The company itself wasn't formed for another four years, but the Lotus Mk1 was built in 1948 and is seen as the brand's official origin.)

It's still early days for the Type 66. The focus is now on building an engineering prototype and a press car, with plans to start building customer cars in the first quarter of 2025. Just 10 cars will be produced with a price tag of £1.1 million. That's clearly a huge amount of money, but compared to the rarefied world of limited run hypercars it's something of a bargain.

The wealthy owners of the Type 66 will be offered the opportunity to take part in a series of 'pay and play' track experiences, visiting original Can-Am circuits. What they won't be able to do, however, is race it – at least not in a major international championship. Although the Type 66 has been designed to the latest FIA regulations, it will not be homologated as a GT car and neither does it meet the requirements to race as an historic.

But that's not really what this car is about. It's Lotus's birthday present to itself, a tribute to one of the most exciting periods in the company's history and, let's be honest, a money-making opportunity. And that's something we're sure Colin Chapman would have appreciated.

"A big risk, but I don't believe you should just try to replicate what's already done"

Is the world ready for another driverless race series? The Abu Dhabi Autonomous Racing League believes so. By **Chris Pickering**

RIGHT A2RL will harness an automated version of Dallara's SF23 **HERE'S** a branch of motorsport that sits right at the cutting edge of automotive technology. It's arguably more relevant to current road car development than any other discipline in the sport. And yet few people even realise it exists.

That category is autonomous racing, and although it's largely been the preserve of technology companies and academic institutions so far, it is very much a reality. The Indy Autonomous Challenge (IAC), for instance, is now entering its fourth year, with modified Indy Lights cars passing

> each other at well over 150 mph and touching 180 mph down the straights. Elsewhere, the now-defunct Roborace series ran for two seasons between 2019 and 2021, with seven

teams and 12 races in its final year.

Is the world ready for another driverless race series? The engineers and promoters behind the Abu Dhabi Autonomous Racing League (neatly abbreviated to A2RL) think so.

The series will use an automated version of the Dallara SF23. Originally designed for the Japanese Super Formula series, the SF23 is generally recognised as the fastest single-seater outside of Formula 1. Unlike the all-electric Roborace car, it retains a conventional combustion engine, developed by Indianapolis-based 4Piston Racing, along with a sequential transmission.

"One of the things we've learned from previous autonomous series was not to reinvent the wheel where we didn't have to do so," comments Dr Tom McCarthy, chief technology officer for A2RL's parent organisation, ASPIRE. "We're taking the driver out of the car, which is a huge step in itself. We didn't want to lose the noise – that gut-wrenching excitement when you hear the car coming down the straight. That's part of motorsport."

Creating an autonomous race series from scratch is a hugely ambitious target, but there's a sense of pragmatism here that bodes well for A2RL. McCarthy is also refreshingly upfront about its remit as a technology-led formula that's primarily designed to stimulate R&D and inspire the next generation of engineers.

"The idea came about when some of my colleagues in the artificial intelligence centre and the autonomous robotics centre at the Technology Innovation Institute were looking into ways to get involved in motorsport," he explains.

"A number of them have a very strong 'motorsport gene', having grown up in the universities along Italy's Motor Valley. The aim was to create a platform for real-time experiments, which would also involve the public by demonstrating the use of science in a sporting context. We wanted to get kids involved, but we also wanted to get the industry involved, so their use cases could be translated into race formats." ►



The mistake Formula E made was trying to be a sustainable version of Formula 1. We want to be a different type of sport"

Hands-on experience

Alongside developing an autonomous variant of the SF23, the team at ASPIRE were keen to ensure that there was a complete infrastructure around the series. They're currently in talks with Yas Marina circuit, for instance, to ensure the communications infrastructure is adequate for the vast amount of telemetry data the series plans to transmit. This may require parts of the 5G network to be blocked off exclusively for A2RL or it could even see the installation of a dedicated wireless network. Parts supply, trackside support and logistics would also be handled centrally through the series, taking that burden away from the individual teams.

Careful consideration has also been paid to selecting the teams themselves, McCarthy explains: "We didn't want to say, 'Send us a white paper so we can establish your technical competency'. We spent six months building relationships with organisations where that capability would be a given.

He points to the IAC as an example: "They have lots of teams from very prestigious US universities without much hands-on motorsport experience, but it's the teams from the Technical University of Munich and the Polytechnic of Milan that have emerged as the ones to beat, both of which have a very strong motorsport heritage. Our takeaway from that was that it's not good enough just to have great computer scientists, you need to make sure that the teams have that broad range of capabilities if they're going to have a realistic chance."

It's perhaps no coincidence that the Politecnico di Milano and the Technical University of Munich are among the 10 international teams so far selected. Others vying for the \$2.25 million prize include the University of Modena and Reggio Emilia, the Beijing Institute of Technology with Khalifa University, the University of California, Berkeley with the University of Hawaii, and Code19 Racing with Indiana University.

Adaptation

Adapting the SF23 has been a gradual process. One manually-driven prototype was followed by two autonomously-driven prototypes. The first priority was what McCarthy refers to as the perception layer, which is effectively the eyes and ears of the car. This combines GPS, LiDAR, radar



LEFT Teams will be issued with a software stack that delivers a basic level of functionality straight out of the box

BELOW ASPIRE's team launched the autonomous Super Formula SF23 in Abu Dhabi and optical cameras providing a 360-degree view. Italian firm Danisi Engineering worked with Aspire and Dallara on the development of the hardware stack. Another part of the Danisi group, Meccanica 42, provided help with the actuators and the driveby-wire system.

"There are lots of simple things that you need to get right before you can think about actually controlling the car autonomously," McCarthy points out. "We looked very carefully at the design of the wiring loom. Likewise, the cooling requirements for the computer."

A number of other organisations involved in the Super Formula series have also contributed knowhow – notably Tokyo-based Team LeMans. "It was a question of putting together a fairly large team of suppliers and getting them into very much a partnership," comments McCarthy. "I was in Italy when we did the physical checks last September and we had all our suppliers sitting around a table just looking at progress to date, and where we were going for the autumn shakedown. It's a big team and a diverse team, so getting them all onboard was a big deal."

Open source

In addition to the hardware, the cars will be presented to the teams with a software stack that provides them with a basic level of functionality straight out of the box. The teams will be able to ►



choose whether they build upon this existing framework or substitute their own code right from the start.

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Data collected from both the prototype cars – both autonomous and manually driven – will be shared with the teams on an open source basis to help train the AI algorithms. On top of the perception and motion control systems, the teams will have to handle strategic decisions, such as when to go for a passing manoeuvre.

Coders replace drivers

"In Formula 1, you have the race engineers and the strategists looking at monitors and screens, and feeding that information to the driver, who is controlling the car and perceiving their environment. Those elements combined optimise the overall performance. Here, those are effectively different layers of code," comments McCarthy.

The teams will be given the cars at the end of March. After that, they will have a six-week period for development and testing, during which time they will start to optimise the control of the car. Then, in the lead up to the first race on 28th April, there will be two full weeks of practice, with various challenges along the way. The simplest of these will be a single-car time trial, followed by two-car races, as seen in other autonomous competitions, but A2RL wants to push beyond that.



"The current state of the art is to have two cars racing against each other," comments McCarthy. "We want to take that as a baseline and then go further – with [more than two] cars racing simultaneously, initially through simulation [starting in January] and then on the real-world track. Our objective is to have this happen in April. Okay. That's a big risk and a big ask, but I don't believe you should start out with just trying to replicate what's already done."

Wheel-to-wheel

The exact format for these races has yet to be finalised. While Roborace used car-to-car communication to request a pass once the pursuing car got close enough, and the IAC uses a pursuit format where the defending car laps at a fixed speed, ► ABOVE With surveys suggesting that public confidence in autonomous technology is currently falling, A2RL hopes to raise awareness and appreciation of ADAS systems

BELOW The Indy Autonomous Challenge succeeded in raising the profile of autonomous racing



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A2RL is contemplating a more aggressive approach.

"The ultimate goal is to have cars that can take their own decision on whether they can defend or whether they need to concede the place," says McCarthy. "It's the same judgement call that a human driver makes when they recognise that an opposing car has track position. We can't guarantee that it will always work,

Humans are fallible. Al is also fallible, but it's fundamentally rational"

any more than we can guarantee that a human driver will always respect the rules, but we'd like to get to the point where the sophistication of the perception system is enough for the car to make that call."

This taps into one of the greatest challenges with automated and partially-automated driving in road cars, which is reacting to unexpected circumstances. Simply navigating along a well-mapped route isn't generally a huge challenge – with racing, as with road driving, things get tricky when you start throwing other variables into the equation.

"We want to allow as much as possible of what you might get in a race between human drivers," notes McCarthy. "Humans are fallible, and there's a sense here that the AI is also fallible, but it's fundamentally rational. Computers don't get the red mist and think 'I'm damned if I'm going to let that other car past'." **ABOVE** The car will retain a conventional combustion engine. As with the IAC, it will be developed by Indianapolis-based 4Piston Racing

BELOW Dallara's SF23 base car, raced in the Japanese Super Formula series, is to join the autonomous ranks Despite the sophistication of the sensors – no less than seven Sony IMX728 cameras, combined with four AF ProWave RADAR sensors and three Innovusion Falcon Kinetic FK1 LIDAR sensors – it's accepted that the learning curve will most likely be steep. As well as running in daylight, the series hopes to compete at night under artificial light, adding an extra dimension to the spectacle, as well as confronting a use case that road cars will have to deal with too.

There are no plans to restrict the performance of the car. While the teams will have to take their own decisions on how hard they're comfortable pushing, the full performance of the car will be available right from the start for those who are able to utilise it. ►



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A different model

The series hopes to appeal to fans as a racing spectacle, but McCarthy accepts that it may have to adopt a different model to conventional racing.

"I'm very conscious that there's the potential for autonomous racing to be boring as hell unless you're doing the coding," he says. "We really want to create a spectacle, but we're aware that this is likely to be an audience that is built online more than at the track. That's why we're putting a lot of work into app development and ghost car development, so the audience both at the track and online can really enhance their experience."

The aim here is to blend real and virtual reality. Fans may be given an



F The ultimate goal is to have cars that can take their own decision on whether they can defend or concede the place"

opportunity to drive the ghost car in a simulation, competing virtually against the real car on track. Likewise, the option of virtual obstacles (similar to those used in Roborace) is under consideration, which would mean that the car might have to negotiate a virtual chicane overlaid into the video footage, with no risk of a collision in the real world if something goes wrong.

"I don't see it as something people will sit in their living rooms and watch on a Sunday afternoon. But the generation we

want to influence won't do that anyway," comments McCarthy. "They will look at something on their handheld device and they will want to interact with it. So we want to ultimately influence a generation of STEM students and people that will be coming into their 20s and driving cars over the next decade. We want to interest OEMs in engaging with this future audience too.

"We realise that taking a person out of the car is a big change straightaway. So we want to offer them something



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different to Formula E or Formula 1. In some respects, I think the mistake that Formula E made was trying to be a sustainable version of Formula 1. We want to be a different type of sport. We want to sit side by side with Formula 1, but we want to deliver an enhanced experience in a completely different way, using a different method to reach our online audience."

Digital twin

So far, there has been a lot of data collection with the human-operated car, the autonomous stack has been put through hardware in the loop testing, and a digital twin of the car has successfully lapped the circuit in simulation.

"Over the coming weeks, we're going to



ABOVE RIGHT Two Indy Autonomous Challenge frontrunners, the Politecnico di Milano and Technical University of Munich, are among the 10 international teams vying for the \$2.25 million prize

RIGHT Things don't always go smoothly with autonomous racing. One of Roborace's teams famously hit the pit wall; the series hit the buffers

LEFT The SF23 was given a human shakedown in Abu Dhabi for the engineers to familiarise themselves with the car





be putting the autonomous car through a variety of tests to combine what we've done in the human-operated car and what we've done in simulation," explains McCarthy. "We know we can do it, it's a question of testing the integration and the resilience of the hardware and determining whether we need to change anything. Right now, we're on track, and the testing has yielded good data."

Once the initial shakedown testing has been completed, the hardware will be frozen for the 2024 season, but that may change in the future.

"I would like to see the series almost become a marketplace for sensor companies," comments McCarthy. "As I talk to some of the companies developing LiDAR and radar and cameras, what excites them about this project is that they can perform real world testing at speeds they're not allowed to reach on the roads. In the future, we hope to offer them a chance to demonstrate their technology on our test cars, and possibly win a place on the rig for future races."

Ultimately, A2RL's objective is to establish Abu Dhabi as a hub for hightech industries. To do so, it's taking an unashamedly academic approach, tapping into the rich seam of engineering talent that's already quietly breaking records in events like the IAC.

Whether or not autonomous driving is ready to break into mainstream motorsport remains to be seen, but it's undoubtedly one of the hottest research topics in the automotive industry. As such, there's a strong demand for fresh talent and bright ideas.

FORMULA E CHARGES INTO THE FUTURE

With fast-charge pit stops on the agenda, the new Formula E season carries the all-electric series into fresh territory. Alessandra Ciliberti, ABB FIA Formula E World Championship technical manager, gives **Chris Pickering** a glimpse of what's ahead **BELOW** With Gen3.5 already testing, the Gen3 cars are evolving quickly **HEN** Formula E debuted in 2014, it was the first time in the modern era that an all-electric car had appeared in a major international motor race. The series arrived just as EVs were starting to make an impact on the road – the Tesla Model S appeared in the UK market the very same year, transforming the image of electric cars and paving the way for mass adoption.

Despite modest speeds and a rather clunky two-car format, the first generation of Formula E was a huge technical landmark. Now, nearly a quarter of all new cars sold in Europe are electric and what was once an aspirational product for tech-savvy early adopters has become part of everyday life.

So where does that leave Formula E? As the series approaches its tenth birthday, the cars are far more capable than those early machines. Theoretically, they now boast a top speed in excess of 200 mph. With the series intent on bringing the show to the people, running predominantly on street tracks, that headline figure is not the Gen3 car's most relevant asset. Nevertheless, an impressive 275 kph (170.8 mph) was recorded on-track last season at Portland.

Top speeds might capture the headlines but, behind the scenes, the FIA and Formula E Holdings are both working hard to ensure that the series continues to push the boundaries in very area. The record-breaking Genbeta test car provides a glimpse into the future of Formula E. Developed to showcase new technologies for the series, it went on to set a new Guinness World Record for the fastest speed ever achieved indoors, using the main straight of the partially-covered circuit that hosts the London ePrix, in the ExCel London.

Evolutionary roadmap

"Genbeta has served as the perfect testbed for developing cutting edge technologies, allowing us to anticipate what the future evolutions can be throughout the lifecycle of the Gen3 car," comments ABB FIA Formula E World Championship technical manager, Alessandra Ciliberti.

One of the most significant advances on the current Gen3 racecar was the introduction of the front powertrain kit (FPK). So far, this motor generator

What was once an aspirational product for tech-savvy early adopters has become part of everyday life"

acting on the front wheels has only been used to provide regenerative braking.

Genbeta previewed the system's ability to be used for traction as well, bringing four-wheel drive to Formula E for the first time and adding the FPK's 250 kW to 350 kW at the rear, for a total of 600 kW regen power. The project also saw the Gen3 car's total battery power output increased from 350 kW to 400 kW (475 hp to 544 hp).

"Using the Front Powertrain Kit for traction at certain times has always been part of the evolutionary roadmap of the Gen3 car, so the Genbeta platform helped us to test that," comments Ciliberti. "We'd already carried out extensive testing with [chassis supplier] Spark Racing Technology and our other partners to ensure that the hardware was optimised for traction purposes." ►



New evolution

Private testing is already underway with the manufacturers involved in the series to evaluate how the FPK might be used in traction. This testing will continue throughout the coming year with the intention of introducing some degree of four-wheel drive capability in time for Season 11, which is expected to kick off at the end of this year or the start of 2025.

"At this stage, we're really interested in track testing the power and torque levels for the different use cases that we are envisaging, and generating data to then finalise duty cycles for durability testing," comments Ciliberti.

Exactly how much opportunity the teams will have to exploit this four-wheel drive capability has yet to be decided, but it won't be active for the entire race.

"The FPK will only be used for specific traction conditions. Notably, the start of the race, qualifying duels and Attack Mode laps," Ciliberti explains. "We will be intentionally limiting the FPK usage as it's only a demonstration of the technology at first, and we don't want to change the baseline characteristics of the other Gen3 car components. What we can say from the current testing is that the hardware has coped well with the use of the FPK in traction, not impacting the thermal too much."

Unlike the Genbeta test car, there are no plans to increase the total battery power output when the four-wheel drive capability arrives. Under normal race conditions – running on the rear powertrain only – the cars will remain limited to 300 kW. When the front powertrain is engaged, an additional 50 kW will be released to power the FPK. This will bring the total output up to 350 kW – the same as the current car has for qualifying and the two four-minute Attack



ABOVE & BELOW RIGHT The Genbeta was armed with more battery power, the contribution of the front motor to all-wheeldrive, and new front wing endplates, wheel fins and a wind deflector from Formula E Principal Partner SABIC



LEFT Developed to showcase new technologies for the series, the Genbeta set a new Guinness World Record for the fastest speed ever achieved indoors

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Mode activations – so the outright performance increase is likely to be fairly modest, but it should provide a useful degree of additional punch out of the slow corners where the rear powertrain alone would be traction-limited.

You might assume that the lure of having four-wheel drive for a standing start would prove too tempting to pass up, but that might not be a given.

Back in June, the closing stages of the Portland ePrix proved that the latest generation of Formula E cars are more than quick enough to hold their own on the wideopen expanses of a grand prix track (albeit in somewhat modified form). The start of the same race, however, was somewhat different, with the cars visibly slow off the line to avoid using too much energy in the early stages. It's a philosophy that's been compared to 'peloton' racing in cycling events such as the Tour de France where none of the riders wants to risk breaking away from the pack too early. Quite how the FPK usage will impact this remains to be seen.

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"We're limiting the use of the FPK in traction because we want to limit the impact on the energy balance across the races," comments Ciliberti. "So it will really depend on how the teams decide to use it. The total battery capacity will remain the same, and there's no set energy target per Attack Mode lap. It will all

be down to them to manage it." Once limited use of the FPK in traction is introduced for Season 11, the power output is likely to be frozen for the remainder of the Gen3 era. But Ciliberti and her colleagues are already actively planning the next step, with a new vehicle platform introduced for 2026/2027 (Season 13). This will also see the current four-year development cycle and the 'Gen' terminology dropped in favour of a more evolutionary approach, with the car potentially receiving new updates on a more regular basis.

Four-wheel drive

"Looking ahead, we are envisaging the future generations with more extensive use of the FPK in traction, especially for the next generation of car in 2026/2027," she comments. "The FPK will be active all the time, so the car will effectively be a four-wheel drive."

Four-wheel drive wasn't the only traction advantage on the Genbeta car. It also featured bespoke tyre design from the series' tyre partner Hankook, designed to enhance longitudinal grip. This experience will feed into a new race tyre for Season 11, which will improve



grip across the board.

The aerodynamic design remains unchanged for Season 10, but this too is due for an update in Season 11, although it's likely to be a case of evolution rather than revolution, Ciliberti explains: "Aerodynamic performance isn't the primary focus because of the nature of street tracks that we use. But what we are very focused on is to reduce drag to maximise the energy efficiency. That's something we are already looking at again in the lead up to Season 11. There will be small drag reduction for that car, but then a ► ABOVE Just how far the series has come was underlined at Portland last year, where a top speed of 170.8 mph was recorded

BELOW Future drag reduction aero improvements are planned to maximise energy efficiency







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bigger improvement for the new car in 2026/2027." The aerodynamic design of the car has been CFDled, but aesthetics play a significant part in the shape too, we're told.

"We received a strong brief from the promoters that this car had to look disruptive," says Ciliberti. "So that puts some constraints into the car design and definitely on the aero outputs that you get from it. We ran a lot of CFD iterations around the Gen3 car. And then later in the process, we also carried out some wind tunnel testing, but only at a later stage to verify the initial work that had been done in CFD."

Gen3.5 is go!

The various updates for the Season 11 car will be released as a package. Initial 'Gen3.5' testing has already taken place at the request of the FIA, but the manufacturers' official Gen3.5 test window opens this month.

In the meantime, Season 10 arrives this month (January). A number of small changes have been made to bolster the reliability of the spec components, based on lessons learned over the past season.

"If we look back at reliability of the cars during Season Nine, there has been a marked improvement throughout the season, particularly with regards to the FIA single-supplier components," notes Ciliberti. "We started with a more delicate balance, but we finished off with a marked improvement, which we're



LEFT Alessandra Ciliberti, ABB FIA Formula E World Championship technical manager, is part of a tech team already planning well ahead into the future

RIGHT Fast-charging was a big topic at Valencia's pre-season test. The impending introduction of quick-charge pit stops helped dictate the size and chemistry of the cells used in the original Gen3 battery





pleased about. And that has given us a base to work on as we approach Season 10, increasing the overall confidence in the car's component reliability."

Among these changes is a revised brake system that will split the front and rear hydraulic circuits to increase redundancy. At least during normal race conditions, the cars still carry a secondary brake system on the rear, affectionately known as 'the parachute'.

An onboard control system monitors the regenerative braking effect provided by the powertrain. Should it detect a failure with the regen capability on the rear powertrain, it automatically engages the reserve braking system.

"Separating front and rear hydraulic circuits has been quite a challenge in packaging terms. The front of the car is quite crowded in between the Front Powertrain Kit and all the other hardware in this very compact Gen3 car, but we've managed to accommodate these changes," comments Ciliberti.

The cooling package for the FPK has been upgraded a year early in preparation for its expanded use in Season 11. There have also been improvements to the thermal management of the battery packs, designed to help them keep cool A revised brake system will split the front and rear hydraulic circuits to increase redundancy"

in very hot conditions, such as those encountered in Rome last year.

Although nothing has been officially confirmed at the time of writing, it's also likely that the Attack Charge pit stops – originally slated for Season Nine – will be introduced at some point in 2024.

Attack Charge

"We are actively working on supporting the validation of the Attack Charge," comments Ciliberti. "Our focus in the technical department is carrying out the product validation alongside manufacturers so it is ready for implementation in Season 10, but the strategic decision of how and when it might be introduced will come from our colleagues on the sporting side and the Promoter of the Championship to ensure sporting relevancy."

The plan is to introduce pit stops to Formula E, with a 30-second charge at 600 kW, delivering around 10 per cent of the battery capacity. In theory, the front and rear powertrains operating at maximum power could already generate 600 kW during regenerative braking, so it's not a complete step into the unknown. Sustaining that power level flat out for 30 seconds is a different matter, however.

"When we put the tender out for the battery, one of the stipulations was that it needed to be capable of being fast charged for 30 seconds at 600 kW," says Ciliberti. "That's part of what determined the size and chemistry of the cells used in the battery. We needed a high energy cell that would also be capable of very high power levels."

These updates build on one of the most successful Formula E seasons to date, with the Gen3 cars now starting to rival their IC-engined counterparts for spectacle. Much like electric road cars, the championship has now managed to establish itself as part of the mainstream. Where it goes from here will be up to the promoters, the technical management and the manufacturers that take part, but it's clear that there are already big ideas for the future.

FORGING DECARBONIZATION IN THE DESERT

Olivia Hicks reports from Chile's season finale on Extreme E's attempt to bridge the gap between utilities and environmentalists

N early December, a record number of fossil fuel representatives descended on the United Nations annual climate summit in Dubai. The days following included energy suppliers and oil extractors pushing for a measured approach to scaling down fossil fuel use, while climate activists pulled for the extermination of the globe's reliance on non-renewables altogether.

Nearly 14,500 kilometres away, one motorsport series bridged the gap between climate-vulnerable communities and energy companies that strive to decarbonize.

Racing boxy SUVs with utility giants' names as bumper stickers across the tawny desert clay of Chile sounds like the furthest thing from sustainable. But, in the most extreme corners of the world, Extreme E is steps ahead of the rest of the sporting industry.

The all-electric off-roading series' third season came to a close in the Atacama Desert on the same weekend COP28 commenced in the United Arab Emirates. Extreme E's brief three-year lifespan has been dedicated to shining a light on corners of the world most impacted by the effects of climate change. As a pioneer in both sustainability and equity, the series' newest initiative funnels new-hires directly from the Racing for All programme – a way to diversify the motorsport workforce by providing students of colour with career development as inspired by The Hamilton Commission.

Napkin inspiration

Since Extreme E founder Alejandro Agag scribbled the rough outline for an environmental and equality-focused racing competition on a napkin in 2019, the series has made headlines for giving male and female drivers equal opportunities and spearheading legacy projects to address ecosystem destruction in race host locations.

The warm weekend highlighted the copper mining industry's role in electric vehicle production as well as how local organizations, like Antofagasta Minerals, are reducing water usage to make mining less impactful.

But as the series pushes for electrification and renewable alternatives, team owners like Veloce Racing's Daniel Bailey argue the need for energy companies' expertise and infrastructure to make the global transition.

"I think it's important that we have to empower any kind of business that is trying to transition into a low carbon economy [to] try and do it effectively," Bailey insists. "We have to make it a positive environment for them to talk about doing that, and not a negative one."

Bailey launched Veloce Racing in 2019 as an offshoot to the company's stake in simulated racing. Both branches boast a lengthy cast list of talent and partnerships with Formula 1 backing on the Esports side including Alfa Romeo, McLaren ►

Despite cries of discontent at the attempts to scrub clean their oily images, the big players hold the ticket to a green transition"

> LEFT Extreme E's third season concluded in the Atacama Desert on the same weekend COP28 commenced in the UAE

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Shadow and Mercedes AMG, along with F1 driver Lando Norris' Esports and lifestyle brand, Quadrant. Veloce extended its resume to include a spot in the W Series, the all-female racing competition, until the championship entered administration in 2023.

As one of the 10 teams that make up the Extreme E grid, the squad holds its own amongst Lewis Hamilton's X44, Nico Rosberg's RXR and Jenson Button's JBXE teams with Red Bull's Chief Technical Officer, Adrian Newey, steering Veloce as lead visionary.

The team cites its mission as "disrupting the racing industry" through sustainability and gender equalityfocused racing. Bailey says the company is 50% more female than the standard Esports and gaming industry and any competitions held at Veloce's London headquarters are offset to meet the company's annual net-zero carbon status. While its Esports side of the business boosts that undertaking, Extreme E offers direct ties to the energy industry.

Veloce's car wasn't hard to spot across the weaving track as the team's title sponsor, E.ON, branded the chrome paint job. E.ON is one of Europe's largest energy providers with 48 million customers and 1.60 million kilometres of energy network infrastructure – a head-scratching distance equivalent to driving around the circumference of the earth 26 times.

The partnership builds on E.ON's plans to become climate neutral by 2040, a secondary term for reaching zero carbon emissions.

The company's latest annual report claimed seven per cent of greenhouse gas emissions stemmed from company-owned sources, known as Scope One and Two, including company power and heat generation and three per cent of those emissions derive from company-controlled fuel combustion. Ninety-three percent of emissions originate from outside leased sources, such as natural gas sales from other utility companies. These Scope Three emissions are more difficult for energy companies to control and, therefore, complicate the emissions accounting process. Only recently were companies required to report Scope Three emissions.

Like most utilities, E.ON has faced a backlash in the past for high energy prices and scepticism of its interest in transitioning to renewable sources, but the company looks to reflect its mission via outspoken climate action plans. In March, it announced it would expand its budget dedicated to switching to renewable sources and power grids by six billion pounds to a total £27.8 billion investment. As Europe's largest energy network operator, E.ON has also pushed against the UK's plans to roll back renewable infrastructure progress.

Clean energy agenda

For UK residents, the electricity sourced from E.ON is 100% renewable, according to the company.

The business venture has provided both Veloce and E.ON with ample promotional material to push a clean energy agenda, but Bailey says the partnership is far from greenwashing. The two pair up for educational workshops about women in motorsport at E.ON's UK headquarters and have plans to work together on a legacy project in the future.

"What I love about them is they aren't a sticker on a car to try and just say, 'We partner with [Veloce] because we're an energy company and we want to look great," Bailey says. "They're actually really activating it, which I think is where the real power comes from."

Having an energy company as a title sponsor also doesn't hurt when Extreme E is attempting to usher >

ABOVE The Veloce Racing team celebrates its third win of the year, enough to secure third in the championship standings



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in an era of fully renewable resource use. While the racing series' bring-yourown-bowl practices paint an extremist environmental image, Extreme E suggests a different reality where compromise, in order to enact change, is key.

For Bailey, the big names in the industry can't be shut out. "If you don't engage the key stakeholders to make a change in this world, then we're never going to be able to make a change," he says.

"And that's what I see with Extreme E. We're here in Antofagasta in a mine, talking about how we need to make mining more sustainable because if we don't then it's all good, me putting my recycling out (which I obviously do) and driving an EV (which is brilliant), but if companies like E.ON don't want to change then I'm not even a drop in the ocean as to what needs to be done."

Hydrogen may be the secret ingredient to foster that compromise and encourage companies to retire their polluting personas.

Unlike other racing series that aim to build a deep-rooted and enduring sport identity, Extreme E is constantly evolving. In just a year, the series will retire its "E" for an "H" as it transitions from a platform for electric vehicle development to one for hydrogen-powered cars.

The trailblazing Extreme H chassis is currently being tested. While the hydrogen fuel cell car's specifics are under wraps, the battery size and capacity aren't likely to exceed the current Extreme E Odyssey 21. The novel fuel cell technology, however, is expected to come with a string of advantages. **RIGHT** Veloce's history in gaming, particularly racing simulations, opens a new area for E.ON. This is a younger generation, likely to be digitally native, and to engage in the race to save the planet

BELOW Mechanical issues following a collision in the second round of qualifying meant Saturday's racing ultimately ended the team's title hopes



"I think the secret of hydrogen and green hydrogen specifically, is that it allows you to create mobile batteries in remote locations or in a variety of different locations," Ali Russell, Extreme E's managing director, says. "I think that's where it has its real, real power."

Hydrogen opportunity

Just like Extreme E and Formula E's roles as electric vehicle testing grounds brought in auto manufacturers, energy corporations and tech start-ups, hydrogen offers a space for sport and energy authorities to come together to discuss climate resilience.

Following the Extreme E season finale, Extreme H, the Fédération Internationale de l'Automobile (FIA) and the Formula One World Championship announced plans to roll out a hydrogen working group. F1's identity as an industry pioneer – developing road-ready technology before it hits the streets such as regenerative braking and carbon fibre architecture – along with its commercial partnerships and the FIA's governmental leverage allow for a path forward in hydrogen mobility.

Electricity, its source and sponsor, is the beating heart of Extreme E and its future as Extreme H. From green hydrogen powering the race car charging stations since season one, to the paddock acting as a microgrid, energy company investment shoots teams like Veloce up the championship order while also appealing to their commercial interests.

Even Extreme E's CEO admits the decision to switch to hydrogen is in part commercially driven.

"If it's not commercial, you're not going to save anything," Agag says. "The only thing that will work are things that work commercially.

"We see a big business opportunity in hydrogen because there's so much momentum around hydrogen going on in the world and because we're going to be the only ones; because we're the first ►





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ones to be there."

Hydrogen's role as a storage trunk and transporter of electricity, rather than a source, allows for sponsors to have the best of both worlds. They can build upon an established electric vehicle research and development ground, while getting a front seat to the possibilities of hydrogen.

Covering both bases

"You're covering both elements. You've got an EV, where [E.ON has] a big EV business from a charging infrastructure perspective," Bailey says. "But then you're also the first testbed for hydrogen fuel cell technology, especially when we move to a World Championship in 2026."

"I don't think there's a silver bullet in this space," Russell adds. "I think there's a multitude of different solutions in terms of mobility."

The switch to hydrogen reflects what Russell says is a belief that the racing series can take hydrogen to new heights and become a platform for energy and utility company research, investment and development.



ABOVE E.ON has begun the installation of a new solar panel array at Edinburgh Zoo as part of the wildlife conservation charity's commitment to reduce its carbon footprint by 60% by 2030 and be net zero by 2040

"We believe that hydrogen will be adopted, but what we believe is a racing series devoted to hydrogen will accelerate that adoption," Russell says.

Just as hydrogen is the pinnacle of possibility for motorsport, it also lies at the intersection of decarbonizing the energy sector as a whole. As UK and EU emissions slowly crept up in scale rather than dropping off following the COVID-19 Pandemic, the pressure to slash reliance on fossil fuels is heightened. Green hydrogen offers one more viable option in a broad spectrum of renewables necessary to reach countries' and companies' 2030, 2040 and 2050 carbon-neutral deadlines.

The European Union aims to reach a carbonneutral status in just 26 years and produce 10 million tons of green hydrogen by 2030, according to the European Commission.

Hydrogen is also projected to carry steep profit margins.

Following the conference, utility companies' stake in hydrogen development came into question. The term hydrogen is an umbrella with both "green" and "blue" forms distinct in their production processes. While green hydrogen stems from using renewable energy sources like solar and wind power to break down water molecules to create a gas, blue hydrogen relies on natural gas as an initial power source. As the hydrogen sector looks increasingly like a green gold mine with an estimated market value of £106.94 billion by 2032 according to Precedence Research, climate activists have become unsettled at utility companies' presence at the table and their money-grabbing habits, despite what knowledge they can provide.

It's no wonder then that energy ►



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How Extreme E has developed hydrogen for paddock power

IN just three years, Extreme E has made strides in integrating hydrogen into the paddock and potentially acting as a test centre for energy companies.

In Extreme E's first season, hydrogen reliance was low. The power generation system relied on a hydrogen fuel cell only to power the electric race car charging stations while generators fed with renewable diesel, or Hydrotreated Vegetable Oil (HVO), comprised the bulk of the energy used for race weekend operations.

Battery storage capacity was ramped up for the second season, with the generators being hybridised.

"We, from the beginning, had a plan to use more and more battery energy storage systems," Andy Welch, Extreme E's utilities manager, says. "The first step was to hybridise the generators, so that rather than a generator running for 24 hours a day, burning fuel [HVO], we put it with a battery, so the generator would store its energy in a battery."

In Senegal, Welch said the series cut its generator and fuel use through this hybrid process to a mere hour and a half of use each day. The battery storage allowed the series to power broadcasting for the other 22-and-a-half hours. The fuel cell technology, a system with a capability of two megawatt hours, remained the same in the first two seasons, but as Welch discovered team and personnel power usage patterns, the capacity of the batteries was easier to stretch.

In season three, hydrogen took the driver's seat as the main source of power. "What we have now is a world-first, not just for temporary events, but it's a bespoke system where it's a DC [Direct Current] and AC [Alternating Current]

BELOW Harnessing methanol as an energy carrier enables Extreme E to produce hydrogen that is green at the point of use

microgrid," Welch explains. For broadcasting, where failure is not an option, three energy sources now go into the batteries: "It's supplied by clean energy from the fuel cell system. It's supplied by solar energy from the panels. And it's supplied by AC from the backup generators."

The Extreme E paddock acts as a micro power grid to show energy and utility companies what could be.

Methanol, Welch says, is the hydrogen carrier at the forefront of possibility. The technique is popular in the marine sector, where it would be hard to transport compressed gas, and holds promise to slash the shipping industry's carbon emissions. The chemical's gasoline-like consistency is what makes it most appealing.

Extreme E partners with the American-based companies Element 1 and Kaizen Clean Energy to fuel the paddock's "nervous system" of cell technology.

"The system takes a premix of methanol and water," Welch says. "The reformer converts it into green hydrogen. The fuel cell immediately receives that green hydrogen and turns it into electrical energy. So there isn't at any point any quantity of stored hydrogen gas of any significance, no high-pressure gas. And so the truck can bring the hydrogen carrier, methanol, to the site in containers, where we turn it into hydrogen. We use it to make the electrical energy we store in the battery system and use it to power the event. It's a really neat solution."

The system is a step forward in easing concerns about the storage, transportation and availability of hydrogen as a gas form and could ultimately offer a spectrum of options for national power grids.






companies are lining up for a spot at the table – whether it's talking policy in Dubai or funding hydrogen research in the middle of the desert.

This year, the FIA joined Formula E, the only global sport in attendance in 2022, at COP28. The conference allows for global superpowers, nations most impacted by rising sea levels, the top energy suppliers and environmental action groups to discuss policy on the horizon. For a series like Extreme E, the summit matches a mission to push forward sport, all while flagging the attention of policymakers and industry heads.

"What we're saying is, we don't want to get involved in aerodynamics, we want to get involved in hydrogen," Russell says. "I think that's what gives governments and companies an opportunity to get involved because a lot of governments are looking at how they move their economies. What do they do to become more self-reliant on renewables? How do they store renewables? Green hydrogen, what are the opportunities there?"

Energy companies' presence in climate circles left a bad taste in environmental stakeholders' mouths as climate pacts rolled out over the conference with "ifs and buts" attached. COP28 initiated a climate action pact holding 50 oil and gas producers accountable for slicing emissions. However, the fine print left some close readers sceptical.

Progress markers remain undefined as companies are only required to cut Scope One and Two emissions, according to the pact. However, the International Energy Agency, Environmental Defence Fund, International Methane Emission Observatory and the U.N. Environmental Program are said to act as regulators.

The group included industry moguls

familiar with the motorsport scene. BP, Aramco, Shell and Exxon were just four of the 50 companies who signed on.

Despite cries of discontent at the attempts to scrub clean their oily images, the big players hold the ticket to a green transition. It just may take some time.

"You can't move a historical business, a multi-decade business, which has grown through various different economic and climate cycles, [and] suddenly expect it to transition to be completely renewable on day one," Bailey says.

In Extreme E, teams like Veloce are offering utilities not just a spot at the table, but also putting them to work in the kitchen.

"The sticker or the branding is the tip of the iceberg," Bailey says. "I want to foster an environment in which these corporates can come and communicate about the positivity they're trying to put in both their business [and] also externally."







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Artificial Intelligence will learn from the data-rich environment of F1. But, asks **Sergio Rinland**, will F1 learn from its past mistakes?

NE of the main topics discussed at the World Motorsport Symposium was Artificial Intelligence (AI). It's a subject that is being debated in many disciplines, from art (music, writing and film) to medicine, and from investment banking to defence.

There are many questions raised, but two of them are gut reflexes that just won't go away: Is AI going to take over from humans and leave us unemployed? How can we control what is developed?

The answer to the first question has already been given by two writers of the 19th century. Italian Carlo Dossi said: "To consider intelligent the one who knows many things by heart is like deeming wise the one who has a large library at home." And Russian Fyodor Dostoevsky said: "Intelligence alone is not nearly enough when it comes to acting wisely."

What Al does is 'Machine Learning'. The machine learns that for certain inputs there are certain outputs and then applies that logic to determine outputs from non-tested inputs as long as those inputs are 'within' the measured input range, in a similar way as interpolation, with great precision.

Once the machine has learned what the outputs are for certain inputs, it no longer needs to do the computing-intensive calculations (in the case of motorsport, CFD, FEA or simulations); it does very fast calculations based on neural network logic.

So, I would not worry much about AI taking over from humans; at least not from *all* humans!

For motorsport, AI is and will be – it is already being used widely! – a fantastic tool to help design and race engineering. Not so different to the leaps forward enabled by CAD, CFD, and FEA. AI is the next step to doing the menial and boring work much faster than before, allowing engineers to concentrate on what is important in problem-solving decisions.

AS for the second question, the rule-making and the control process are not always straightforward. Motorsport history is littered with tales of engineers' **BELOW** Al will be ideal for trawling the data generated by F1, be it at the racetrack or in the virtual world ingenuity that contrived to circumvent the rules. One example of rules backfiring was when, in 1934, the FIA's predecessor, the AIACR, thought that by limiting cars to a maximum of 750 kg they could limit engine size and power. So they left the engine rule free. The consequence was the 600+ HP monsters from Auto Union and Mercedes Benz of the pre-WWII era.

Another example is the Sports Cars rules in 1969. The CSI ruled that to be eligible to race 5L sports cars, the constructors needed to produce a minimum of 25 cars. The rules were devised with Ford GT40s and Lola T70s in mind. They underestimated Porsche and Ferrari building 25 5L prototypes each!

Today, our controlling mechanism is the ATR (aerodynamic testing regulations), which sets a baseline for the number of wind tunnel runs and CFD CPU used based on the constructors' championship position. Hence, Red Bull, for winning in 2021 and 2022, had the least number of WT runs and computer CPU they could use. Nevertheless, they developed the most aerodynamically advanced car in F1 history. How come?

If RB is using AI to accelerate and extend what they do in WT and CFD, it would be no surprise, given their current dominance. Does this diminish the genius of Adrian Newey and his collaborators? Certainly not! Another well-intentioned regulation backfired, as in 1934 and 1969? Perhaps....

I hope the FIA regulates AI with greater prowess than they did CFD and wind tunnels. The teams had to spend fortunes developing tools to maximize 'WT blowing time', and minimize/manipulate CPU use. These techniques had no application in any other industry, hence were useless, just to comply with the rules.

Now AI is already in use and it will be regulated, as is everything else in the quest to curb spending. All we can hope is that the rules allow F1 to lead the way in developing AI tools and not try to limit its use, sending development in the wrong direction.







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