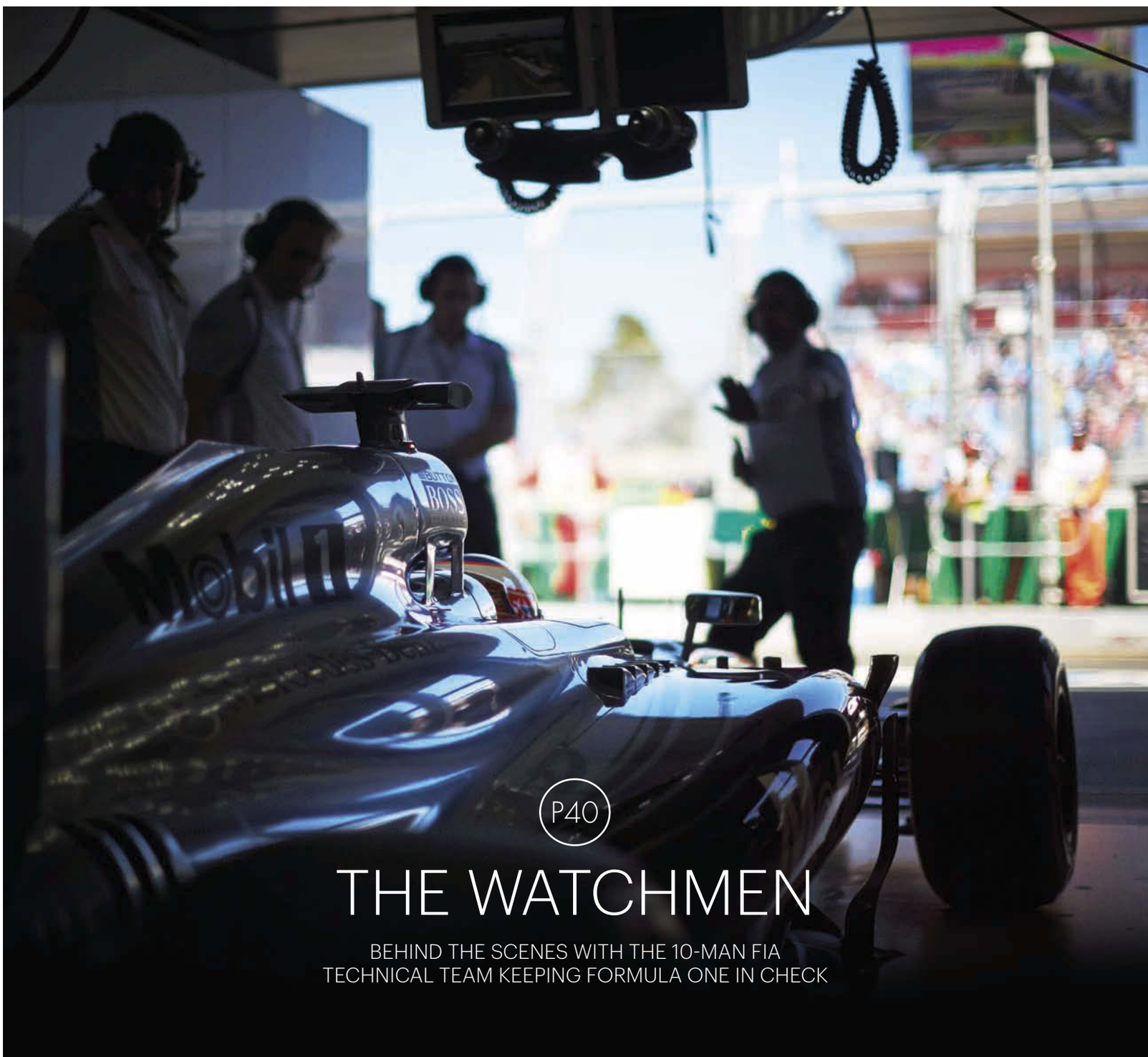
INTERNATIONAL JOURNAL
OF THE FIA: ISSUE #6

AUTO



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THE WATCHMEN

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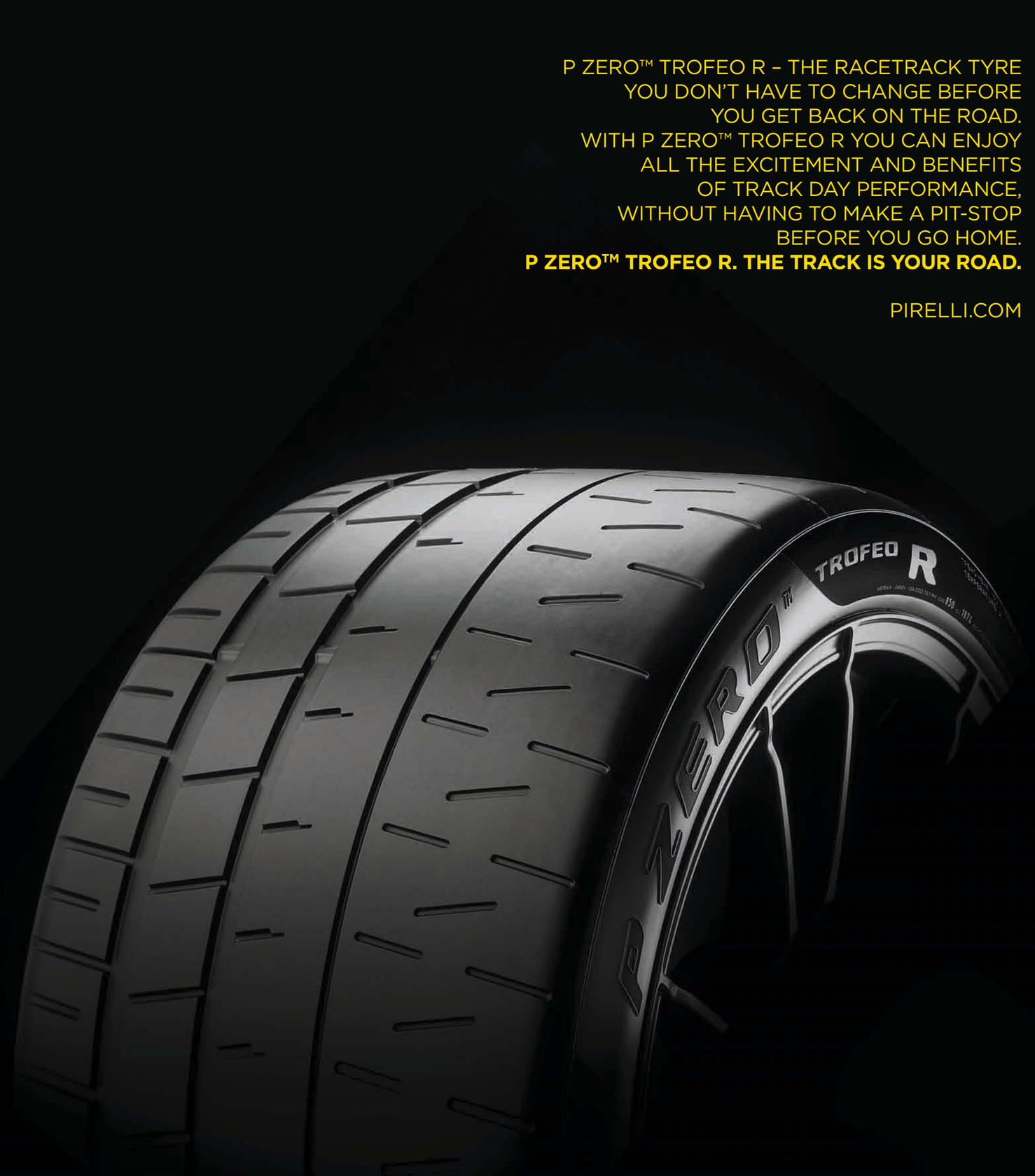

ISSUE #6

AUTO

INTERNATIONAL JOURNAL OF THE FIA

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We would like to thank the following for their help with this issue of AUTO:
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THE FIA
The Fédération Internationale de l'Automobile is the governing body of world motor sport and the federation of the world's leading motoring organisations. Founded in 1904, it brings together 236 national motoring and sporting organisations from over 135 countries, representing millions of motorists worldwide. In motor sport, it administers the rules and regulations for all international four-wheel sport, including the FIA Formula One World Championship and FIA World Rally Championship.

THE FIA FOUNDATION
The FIA Foundation is an independent UK-registered charity that supports an international programme of activities promoting road safety, the environment and sustainable mobility. It was established in 2001 with a donation of $300 million from the FIA and is governed by a Board of Trustees. Among its activities, the Foundation participates in various UN road safety and environment related partnerships and is a member of the UN Global Road Safety Collaboration.

THE FIA INSTITUTE
The FIA Institute is an international not-for-profit organisation that develops and improves motor sport safety and sustainability. It leads projects that encourage the rapid development of new and improved safety technologies; that facilitate higher standards of education and training; and that raise awareness of safety and sustainability issues. The Institute was established in October 2004 and funds its activities through annual grants from the FIA Foundation.

BRAVE NEW WORLDS

The car has been a mirror of its times, reflecting cultural trends and responding to continual technological changes. Indeed, motoring and motor sport have often been the pacesetter in both regards.

Formula One has a long history of innovation, and in 2014 that capability is being pushed to the limit as environmentally conscious new engine regulations test the teams' technical capability.

Implementing and enforcing the sport's complex new rules is no easy task, as the 10 men of the FIA's trackside technical department reveal in our exclusive behind-the-scenes look at how F1's governing body maintains fairness and legality in the world's top single-seater racing series.

The automobile industry is also gripped by the urge to innovate as demonstrated at the world's top motoring and technology shows. From the fascinating concept cars of the Geneva International Motor Show to high-tech developments at the US Consumer Electronics Show, cars are now safer, more efficient, interactive and intelligent than ever.

There is still room in the heart for the glorious machines of the past. It is, however, an increasingly expensive space. The classic car market is booming and values are soaring as AUTO reveals.

The Mini is a defining car of motoring's first century, and in a new series examining some of motor sport's great moments we celebrate the car's historic win in the Monte Carlo Rally 50 years ago.

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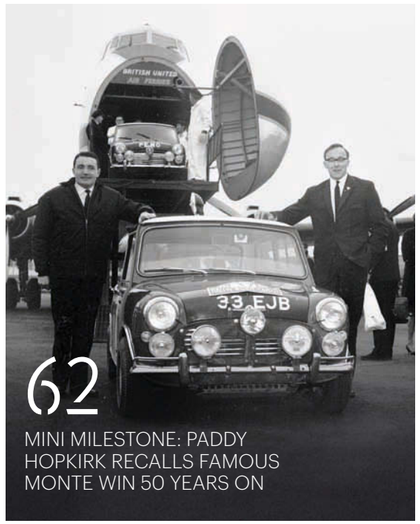

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Legends of Le Mans

EXHIBITING EXCEPTIONAL ENDURANCE

At an event that routinely mixes cutting-edge automotive innovation, hyper performance and dazzling shows of motoring glamour it's hard to top the endless unveilings of wildly imaginative concept cars, lightning-fast supercars and technically brilliant city runabouts that characterise the Geneva International Motor Show.

This year, however, FIA World Endurance Championship promoters the ACO managed to do just that with a triple-pronged event that saw Porsche launch its much-anticipated 2014 WEC challenger the 919 Hybrid, the reveal of the official 2014 Le Mans poster and topping it all off the opening of a special exhibition of legendary Le Mans 24 Hours race cars, supported by Rolex.

Representing the ultimate in concept vehicles the 21 Le Mans prototypes on show included cars from every era of the iconic race, from the first winner – the 1923 Chenard et Walcker Sport, a 3.0-litre machine driven by two of the French manufacturer's engineers, André Legache and René Léonard – to last year's technologically advanced hybrid-powered Audi R18 e-tron Quattro.

In between was a selection of the most jaw-dropping racing designs to ever grace a circuit. From the 1930s came the Alfa Romeo 8C, which took four consecutive Le Mans wins, the 1933 example on show having been driven to victory by Raymond Sommer and Tazio Nuvolari. The post-WWII period was represented by Enzo Ferrari's sublime 166MM, which won the 1949 race in the hands of Luigi Chinetti and Peter Mitchell-Thomson, the second Baron Selsdon.

It was in the 1950s and '60s that sports car racing's golden age began, however, and the exhibition gave visitors a chance to marvel at legends such as the Jaguar D-Type, Ford's incredible GT40 and the mighty Porsche 917K.

Recent decades have been no less impressive, as demonstrated by Mazda's rotary-engined monster the 787B and the Porsche GT1 – the last of the company's models to race at Le Sarthe before the marque's return this year.

LA SARTHE SPECIALS

A glorious collection of 21 Le Mans cars on show in Geneva included the Rondeau M379 (1980 winner), Porsche 956 (second in 1982) and the rotary-engined Mazda 787B (winner in 1991).

Innovation

EMOTION IN MOTION

A tiny 3-metre-long and 1.6m-wide footprint, no steering wheel, body colours that can be changed as desired and an artificial intelligence you can "connect with emotionally" – is this the shape of motoring to come?

Toyota isn't saying whether it believes all the attributes of its FV2 concept will form the future of its product line, but it is convinced that many of the ideas featured in the revolutionary vehicle "capture the spirit of Toyota's fun-to-drive philosophy".

First up is the lack of a traditional steering wheel. Instead, the FV2 is operated by the driver shifting his or her body intuitively to move the vehicle forwards or backwards and left or right – much as a motorcycle rider might lean into a corner.

Then there's the augmented reality screen, which displays all the relevant control information on the windscreen. This is allied to intelligent transport system technology that connects the FV2 to nearby vehicles as well as the highway infrastructure.

However, the most radical idea contained in Toyota's concept has to be the idea of the driver establishing a real emotional connection with the car, similar to what "a rider has with a horse".

Based on the company's Heart Project, which envisages a future where, in addition to simply talking and listening, humans and artificial intelligence will be able to engage in emotional communication, the FV2 incorporates technology that uses voice and image recognition to determine the driver's mood. It also uses an accumulated driving history to suggest destinations and can present driving skills information to assist the driver.

CLUED-UP CAR

Toyota's FV2 concept car incorporates technology that uses voice and image recognition to determine the driver's mood, helping to create an "emotional connection" between man and machine.

AUTO NEWS

In this issue we report on FIA President Jean Todt's push for road safety funding, view some of the most exciting concept cars to emerge from the Geneva International Motor Show, look at the work of the 2014 FIA Institute Young Driver Excellence Academy and highlight new smart road technology being pioneered by Nissan and Toyota

CONNECTING CARS IN PURSUIT OF SAFER ROADS

Autonomous vehicles could be a regular feature on our roads by the end of the decade according to participants at the International Telecommunication Union's (ITU) Future Networked Car symposium held at the Geneva Motor Show. The ITU is the leading United Nations agency for information and communication technology.

Welcoming the developments underway in the development of driverless cars, FIA President Jean Todt said: "Connected cars are revolutionising our daily mobility by providing safer, cleaner and smarter ways to travel."

President Todt added that the FIA is committed to working with stakeholders from across industry, as well standards and regulatory sectors to make sure this next-generation vision is realised, while at the same time taking into account consumer concerns with regard to data and privacy questions.

He warned that with car sales rising rapidly in emerging markets, and road fatalities also expected to rise, "our goal should be to ensure that more cars worldwide can benefit from advanced technologies."

The high level panel was made up of representatives from the ITU, FIA, UN, car manufacturer Infiniti, auto technology company Delphi and vehicle communications experts Ygomi. Panellists heard that components for automated driving have reached a level of maturity that will allow for roll-out in the near future, and that agreements on international technical standards and regulatory requirements are being put in place.

"We are on the cusp of a true revolution in personal transportation" said ITU Secretary-General Hamadoun I Touré. "Combining the will of the vehicle and Information and Communications Technology (ICT) industries we can create a paradigm shift as profound as that brought about by the introduction of mobile telephony. The time is right to address the final challenges so that this incredible possibility is accessible to everyone."

Addressing the earlier 'Bending the Curve' symposium on improving global road safety, FIA President Todt spoke of the need to focus on those countries hardest hit by road fatalities.

"While there are fantastic advanced technologies for safer vehicles being developed today, we need to remember that over 90 per cent of road fatalities take place in developing countries," he said. "Here we need to focus on getting the basics right – seatbelts, helmets, infrastructure, legislation and education."

According to the World Health Organisation (WHO), only 28 countries, covering 7 per cent of the world's population, have comprehensive road safety laws on key road safety risk factors, including drinking and driving, speeding, and failing to use motorcycle helmets, seat-belts, and child restraints.

The discussion also focused on encouraging the private sector to get more involved in efforts to reduce road fatalities as funding falls short for the second half of the UN Decade of Action on Road Safety 2011-2020. Outlining possible solutions, the FIA President said that stakeholders "must be creative" and pointed to the example of innovative financing mechanisms as one of the most promising ways to raise resources.

FIA President Jean Todt discusses road safety in Geneva

MEDICAL EXPERTS TRAIN AT LE MANS

The Fédération Française du Sport Automobile (FFSA) has hosted an extrication training course at Le Mans – its first event as an FIA Institute-appointed Medical Regional Training Provider.

The two-day course in January provided expert tuition in extrication skills for medical teams from a host of countries. Delegates listened to a series of high-level presentations from senior motor sport medical experts, including the FIA Medical Delegates.

This was followed by practical sessions where medical crews gained further knowledge and experience in extrication techniques before facing a final assessment and debriefing. Each team that successfully completed the course was given a certificate by the FIA Institute recommending them to operate at FIA world championship level for the next two years.

In all, 20 extrication teams were trained from countries across Europe including Spain, the UK, Portugal, Belgium, Holland and Germany. They were joined by delegates from around the world who were there to observe the training, including representatives from Japan, Argentina, Australia, the USA, Canada and South Africa.

FIA Institute President Professor Gérard Saillant, who is also President of the FIA Medical Commission, addressed the delegates, emphasising the importance of such training. "Extrication in motor sport is a medical practice that requires a very specific set of skills, and its exercise is something the medical motor sport community has perfected over many years," he said.

"The Institute has developed this course in order to share these skills with as many medical teams as possible, and we look forward to a situation when further RTPs are approved and able to deliver this training within their own geographical regions."

TYRES THAT TALK

Goodyear Dunlop is developing a tyre that 'talks' to the car to improve performance and safety. The chip-in-tyre technology uses a battery-less microchip embedded in the tyre to communicate with a car's on-board computer.

The car receives information such as tyre pressure and temperature, which allows it to refine its systems and offer the best performance in terms of cornering, braking and stability. Potential improvements include reduced stopping distances when the ABS is activated, improved yaw stability and a better response from stability control systems.

HELMETS FOR KIDS

An FIA Foundation-supported road safety programme is helping to protect Vietnamese children from injury by handing out helmets.

The 'Helmets for Kids' handover ceremony involved 1,100 children receiving motorcycle helmets at the Van Phuc Primary School in Hanoi. The helmet donations, to children who travel to school on the family motorcycle, are just one part of the programme's holistic approach. Children and their teachers are taught about traffic safety and learn how to wear their helmets correctly. The behaviour of students and continued use of the helmets is also regularly monitored.

HRH Prince Michael of Kent and UK Ambassador to Vietnam Anthony Stokes handed out helmets to some of the children. They were joined by FIA Foundation Director General Saul Billingsley, AIP Foundation President Greig Craft and CEO Mirjam Sidik, Deputy Director of Hanoi Transportation Department and standing member of the Hanoi Traffic Safety Committee Nguyen Xuan Tan, and Nguyen Hiep Thong, Deputy Director of Hanoi Department of Education and Training.

Prince Michael said: "Improving road safety and reducing casualties requires permanent vigilance, regular reinforcement of messages and constant innovation. All of these factors are evident in Vietnam's approach, and I applaud Vietnam's strong commitment to building on its road safety achievements."

From top to bottom: the Maserati Alfieri, Honda's FCEV Concept and the Quant e-Sportslimousine

CONCEPT CITY

From the dream-like to the desirable, the world's car manufacturers unveiled some stunning concept vehicles at the Geneva Motor Show

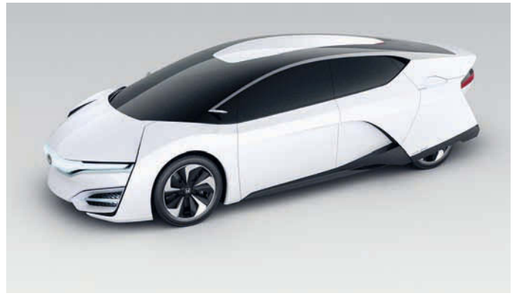
With a super saloon that claims to harness the power of an ocean, a machine based around a highly durable carbon-fibre reinforced plastic frame and a clutch of aspirational sports model, the Geneva International Motor Show once again played host to some amazing new concepts.

Topping the list was the Quant e-Sportslimousine nanoFLOWCELL, an impressively long title for what could be an equally impressive machine.

The Lichtenstein-based manufacturer says its four-seater gullwing coupé develops 912bhp from four electric motors (one for each wheel) that work on flowcell technology. The company describes that as "a combination of a battery and a fuel cell using liquid electrolyte, which are kept in two tanks and pumped through the cell. At the heart of the system a membrane separates the two electrolytic solutions, but allows electrical charge to pass through and thereby produce power for the drive train".

Out of the research lab and onto streets, Maserati unveiled its pretty Alfieri concept, while Hyundai showed off its Intrada concept that utilises a carbon-fibre reinforced plastic frame to reduce weight, add strength for better safety and improve efficiency.

Across the show dozens of manufacturers brought innovative, interesting and potentially exciting designs into the public arena. Here are some of AUTO's favourites.



PHOTOGRAPHY: DPPI

MIDDLE EAST HOSTS FIRST WOMEN IN MOTORSPORT FORUM

The first regional Women in Motorsport seminar, in Qatar, has been hailed a success.

Organised by the Qatar Motor and Motorcycle Federation (QMMF) in partnership with the FIA Women in Motorsport Commission, the Doha-based event in February was attended by almost 50 people from across the Middle East and North Africa (MENA) region along with invited guests and speakers.

The seminar was hosted by Nasser Khalifa Al Attiya, QMMF President and FIA Vice-President for Sport in the Middle East, who was joined by FIA Deputy President for Sport Graham Stoker and Women in Motorsport Commission President Michèle Mouton. It was aimed at encouraging women to get involved in the sport both regionally and internationally.

"To activate a task force in the MENA region, in all aspects and including women specifically, is my first challenge as Vice President for Sport," said Khalifa Al Attiya. "From the seminar it is clear that the women present are passionate about achieving their goals. This is a big achievement for us and the Middle East."

PIRELLI AND OMP SECURE EXTENSIONS TO FIA AGREEMENTS

The FIA has extended its agreements with Formula One tyre supplier Pirelli and racewear manufacturer OMP Racing S.p.A.

Following a World Motor Sport Council meeting Pirelli and the FIA agreed a new three-year deal starting this season.

It included new measures for tyre testing following work by the Italian company and the FIA with the F1 teams. As a result one of the 12 days of pre-season testing was dedicated to wet tyre testing. In addition the teams must use one of their eight days of in-season testing specifically for tyre testing.

OMP Racing, meanwhile, has had its deal as Official Supplier of Racewear to the FIA extended to continue through 2014 and 1015.

The Italian company, a world leader in creating accessories and components for motor sport, supplies technical racing clothing to FIA officials and safety car drivers across a range of the federation's series.

'The FIA is pleased to be able to continue its relationship with OMP," said FIA President Jean Todt. "Safety is always at the heart of the FIA's motor sport mission and it is crucial that our event officials have access to equipment that meets the rigorous standards we set in this regard."

FIA FOUNDATION'S NEW DIRECTOR GENERAL

The FIA Foundation has appointed Saul Billingsley as its new Director General. Chosen by the Foundation's Board of Trustees, Billingsley will be tasked with advancing the charity's portfolio of road safety, environmental and motor sport safety projects.

Billingsley joined the Foundation in 2002 and has since designed and co-ordinated global road safety campaigns such as 'Make Roads Safe', as well as managing the Foundation's grants programme.

"The FIA Foundation is supporting some exciting and innovative programmes and research into road safety and fuel efficiency, initiatives which involve or are highly relevant to FIA motoring clubs," he said. "I want us to do more to connect the Foundation's knowledge and networks to the activities of our members, and to enhance the important work the FIA and motoring clubs are doing."

NEW TECHNICAL CENTRE WINS PRAISE FROM FIA PRESIDENT

FIA President Jean Todt has opened the federation's new Logistic and Technical Centre near Geneva in France following 18 months of refurbishment.

Designed as a technical hub for the FIA's major championships, the new 9000 square metre facility centralises operations that have until now been spread across a number of sites.

"For some time it has been our intention to centralise our logistical and technical operations under one roof, and it is my great pleasure to at last see that wish fulfilled," said the President. "This new facility will not only provide a platform for increased technical excellence but will also allow the FIA to better plan its motor sport operations, which will achieve significant cost savings."

As well as providing much-needed office space for logistics and technical personnel, the facility will also house support vehicles and equipment sent to events. This includes the radio and weather vehicle, two catering trucks and two technical trucks that attend each Formula One grand prix in Europe as well as equipment and vehicles used in the World Rally Championship, World Touring Car Championship and World Karting Championships.

The site will also house the FIA's homologated equipment, electronics and IT supports, mechanical systems and archives.

SECOND FIA SPORT CONFERENCE TO BE HELD IN GERMANY

Hopes are high for the second FIA Sport Conference to be held following the success of last year's inaugural event.

This year's conference will be based at the ADAC headquarters in Munich, Germany, from June 24-26 and will include the new FIA Motorex forum, designed to allow motor sport industry experts and business people to meet and exchange ideas. The central theme will be 'Growing our sport, ASNs & Industry in partnership'.

Last year's conference, at the Goodwood circuit and conference centre in the UK, was attended by more than 70 National Sporting Authorities (ASNs) and 250 delegates from around the world.

It focused on how the FIA and its members could create a stronger world motor sport. It also provided a launch pad for the new FIA motor sport development programme, designed to better promote events and attract competitors, officials, volunteers and new audiences.

CARS FAIL GLOBAL NCAP TESTS IN INDIA

Global NCAP, the FIA Foundation-backed new car assessment programme, has conducted the first independent crash tests of some of India's most popular small cars with damning results.

All the models tested, including those from major manufacturers such as Ford, Hyundai and Volkswagen, received zero stars for adult protection in a frontal impact at 64km/h. They included India's best-selling car, the Suzuki-Maruti Alto 800, as well as the Tata Nano, Ford Figo, Hyundai i10 and Volkswagen Polo. These five models accounted for around 20 per cent of new cars sold in India last year.

Global NCAP tested the entry-level version of each model, none of which were fitted with air bags. In the Suzuki-Maruti Alto 800, the Tata Nano and the Hyundai i10, the vehicle structures collapsed to varying degrees. The extent of the weaknesses were such that fitting airbags would not reduce the risk of serious injury. The Ford Figo and VW Polo had structures that remained stable and, with airbags fitted, would provide more protection for the driver and front passenger.

Volkswagen has now withdrawn the non-airbag version of the Polo from sale in India.

VOLVO TRIALS SHOPPING-TO-CAR DELIVERY SYSTEM

The phrase 'fast food' may soon have a new meaning after Volvo trialled new technology which allows people to buy goods remotely and have them delivered to their car.

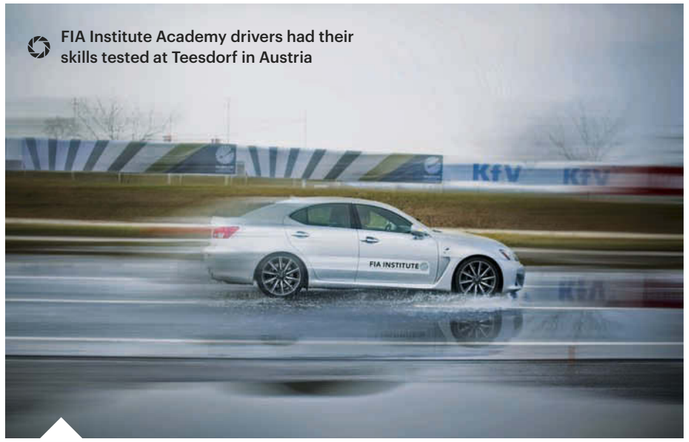
The system, showcased at the recent Mobile World Congress communications conference in Barcelona, operates on smartphones and tablets through which a car owner is informed when a delivery company wants to drop off or pick up something up from their vehicle.

Having chosen a delivery time and location, the car owner hands out a digital key and can track when the car is opened and locked. Once the pick-up or drop-off is completed the digital key ceases to exist.

The system is based on Volvo's On Call telematics app, which can remotely heat or cool the car, view its location or check its fuel level via a mobile phone.

The technology was tested during a pilot programme in the US, with 86 per cent of participants agreeing that the 'roam delivery' system saved them time.

"By turning the car into a pick-up and drop-off zone we solved a lot of problems delivering goods," said Klas Bendrik, chief information officer at Volvo Car Group.



FIA Institute Academy drivers had their skills tested at Teesdorf in Austria

TEAMWORK AND SAFETY TOP THE BILL AT ACADEMY WORKSHOPS

Members of the 2014 FIA Institute Young Driver Excellence Academy headed to the French Alps for teamwork training and an Austrian circuit for safety education during two workshop events.

In Chamonix the drivers faced a series of climbing and orienteering tests aimed at improving preparation and team building. The workshop started with classroom tuition explaining the basics of alpine planning and teamwork. It then moved onto the mountains to put these skills into practice.

Sports psychologist Hugh Richards and sports scientist Dr Tony Turner joined the group to offer expert advice on the issues that they faced.

To complete the workshop, the drivers faced a gruelling race up the 2,000m Prarion Mountain with a number of tasks to complete along the way. Planning and strategy helped the two-man teams calculate potential routes up the peak, while their teamwork and coaching skills were utilised in other challenges involving survival and safety techniques.

"It was an exciting and challenging week in Chamonix," said India's Akhil Rabindra. "We spent a lot of time developing team building and behavioural skills, as well as learning the importance of communication."

Robert Reid, Academy Performance Manager, said: "The Chamonix workshop brings out the determination, drive and desire of the participants. All 10 drivers left with a clear picture of what they needed to work on to improve their results both on and off the track."

The drivers then headed to Teesdorf in Austria to focus on a key aspect of the Academy programme: road safety. For four days they were immersed in all facets of road safety, learning through practical and classroom-based assignments. It is expected that they will become road safety ambassadors during their careers.

Taking to the track, the drivers were tested on variable road surfaces to learn how to deal with driving hazards. The Academy also provides behaviour-oriented road safety training.

South African rally driver Henk Lategan said: "It's a real eye-opener understanding what the safety features of a car can do and the consequences for yourself and other road users if used incorrectly. The driving tasks have shown me just how hard it is even for a race driver to cope without them, and I definitely have a new-found respect for road safety technology."

Alex Wurz, Academy Performance Manager, added: "The road safety workshop is a crucial component of the Academy. It teaches the participants key road safety skills and encourages them to share it with the wider world."

PHOTOGRAPHY: DPPI

McLAREN'S USES F1 TECH TO IMPROVE AIRPORT EFFICIENCY

McLaren Applied Technologies (MAT), part of the McLaren Group, is working with a consortium of companies to improve efficiency and the environmental impact at Heathrow Airport.

The consortium won a four-year contract and McLaren is contributing its expertise in data management and simulation techniques, developed during Formula One.

Geoff McGrath, Vice-President of MAT, said, "For decades McLaren has led the F1 world in the use of advanced simulation technology to gain a competitive advantage. This world-leading expertise is now being used to improve the efficiency of complex systems in a range of industries, in this case by providing cutting-edge decision support tools to be used at Heathrow Airport."

The project will also see MAT involved in the development of software to help reduce the amount of time planes spend circling the airport and improve their movement on the ground. The technology will be used to optimise the arrival and departure of aircraft, ultimately helping to cut CO2 emissions and provide a better customer experience.

CARBON MANAGEMENT PORTAL SET FOR LAUNCH

The FIA Institute is launching a Carbon Management portal to enable motor sport teams, circuits, National Sporting Authorities and other stakeholders to calculate, manage and compensate for fuel emissions.

The online programme has been tailor-made for the motor sport sector and developed according to world-leading standards and carbon neutral roadmaps, such as the Green House Gas Protocol, Kyoto Protocol and the ISO14064.

The Cloud-based solution allows users to securely input their emissions data. The portal will then provide a downloadable report showing annual emissions. To ensure data has been inputted correctly, this report is then submitted to a team of experts.

A carbon management plan for future improvement will be generated, detailing the most efficient way to cut emissions.

Even with carbon management some emissions cannot be avoided. To this end users will have at their disposal a webshop of Institute-approved Carbon Credit programmes. This will enable them to contribute to development projects, regional projects or projects linked to infrastructure and transportation provided by the volunteer carbon market. The projects have been specially selected by the FIA Institute.

TOYOTA HELPS TO PAVE THE WAY FOR WIRELESS CHARGING

Recharging electric or hybrid vehicles could simply be a case of parking your car if new technology developed by Toyota proves successful.

This month the Japanese manufacturer will start testing a new wireless battery charging system that works by transmitting electricity through a coil in the ground to the car. It involves a pad that sits in a parking space and which can withstand being driven over. Charging begins once the car is aligned with it.

To help the driver align the car correctly, Toyota has developed a function for its Intelligent Parking Assist system that shows the position of the transmitting coil.

The test involves three plug-in hybrids in Aichi prefecture. It will assess user satisfaction, misalignment rates and charging behaviour.

NISSAN PLANS SMART REARVIEW MIRROR FOR ROAD AND TRACK

Nissan is developing a Smart rearview mirror with an LCD monitor that not only provides clear visibility in various conditions but allows the driver to switch between the monitor and the traditional rearview mirror.

The technology will be used in Nissan's ZEOD RC that is due to compete in this year's Le Mans 24 Hours in June, as well as in other NISMO race cars.

The increased visibility is designed to bring important safety benefits. A high-resolution camera mounted on the back of the car provides the driver with an unobstructed view of the rear flanks, allowing them to check blind spots and other traffic conditions.

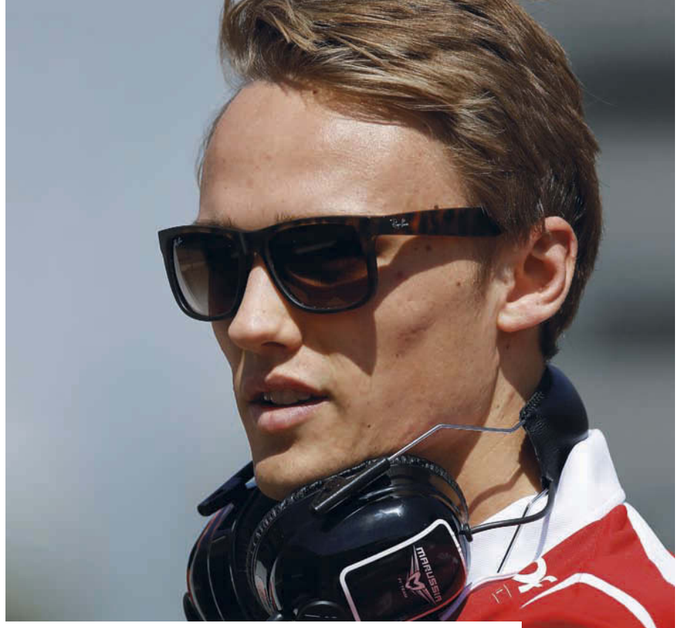
"It will give our customers the best possible view no matter what the road conditions are or how tall the backseat passengers are," said Andy Palmer, Chief Planning Officer and Executive Vice-President of Nissan.

NISMO President Shoichi Miyatani said: "Retaining a clear view for the race driver is of utmost importance. In that sense the Smart rearview mirror will be a powerful tool for our Nissan NISMO drivers. Also, we have high expectations towards improving the cars' aerodynamic design thanks to the Smart rearview mirror, thereby expanding the possibilities of race cars to a new level."

AUTO ASKS

HOW DO DRIVERS AND TEAMS STAY MOTIVATED WHEN COMPETING AT THE BACK OF THE FIELD?

Battling for honours at the sharp end of a championship comes with built-in incentives, but what's in it for those running further down the order? Three dedicated competitors explain where their goals lie



The F1 racer

MAX CHILTON

DRIVER, MARUSSIA F1

As you come through motor sport, working your way up to Formula One, you get used to fighting at the front of the field or qualifying on pole. Then suddenly you're in F1 with one of the smaller teams and the goal cannot be to win races or titles. This is the biggest difference between F1 and every other formula.

So you have to set yourself new goals. You focus on racing your team-mate or the cars around you... Unless you get lucky and go straight into a top team as a rookie, like Kevin Magnussen has [at McLaren] this year. The majority of drivers, even world champions, start at the back and work their way up.

Wherever you are on the grid, you have to present yourself in a professional way, because even though you've reached F1 it's still a proving ground. You have to prove that you are worth your place on the grid.

At the start of last year, my rookie season in F1, I didn't have a specific personal goal – it was more of a team goal, for Marussia to score their first point, whether it was my team-mate Jules [Bianchi] or me who achieved that.

Halfway through the year I knew there were a few things I could work on with my driving. For example, I could feel in qualifying that at times I was driving well, but I needed it to all come together. I've always been strong in qualifying, but I needed to prove that in F1. I out-qualified Jules a couple of times, and it was great to get a rookie record of finishing all the races.

This year we have the same team goal: to score a point. That's definitely number one. And I have a couple of my own goals too. Performance-wise, the target is always to beat your team-mate and to feel satisfied with your driving and racing – to feel that you've got the most out of the car.

Your goals can change very quickly in a season. If we finished fourth in Melbourne, then the goal would be to get our first podium.

But wherever you're racing, personal preparation is the same. Fitness-wise, I've been training six days a week since December, as have Fernando [Alonso] and Jenson [Button] I'm sure. That's the same for us all, wherever we are on the grid: you're always flat out.

The F1 team member

GRAHAM WATSON

TEAM MANAGER, CATERHAM F1

The goal for us is to be in the same show as everyone else – not racing in our own little battle behind nine other Formula One teams. We want to be in the mix.

In terms of morale for the guys, we have to work out specific things like "let's be the best we can at pit stops". Everyone is using similar pit-stop equipment, so budget isn't an excuse. We might not break the two-second barrier like McLaren, but we can get into the high twos. And if we can do that at every stop for a whole race, then we can say we've done that well.

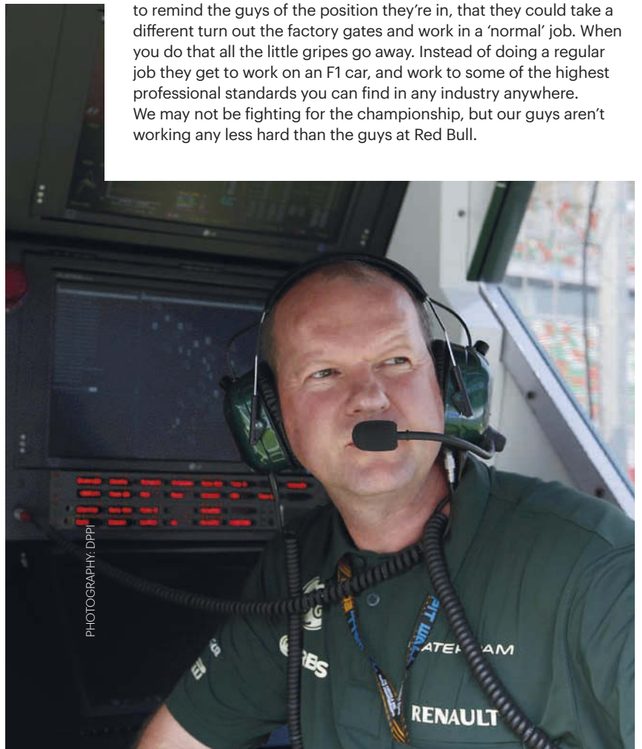
You can compare yourself in other ways with teams that use the same equipment, too. We use the same gearbox, engine and hydraulics as Red Bull, so the differences in performance are elsewhere in the chassis. That's where the guys in the factory are having their own battles – to find aerodynamic gains, even if there's nothing we can do about that in the field.

With that in mind, we have to be realistic about the battles we can win. So measuring ourselves against Red Bull probably wouldn't be a great idea, but we could try to measure the delta [deficit] to Red Bull over a season and ensure that we're closing that delta – or at least make sure it's not increasing.

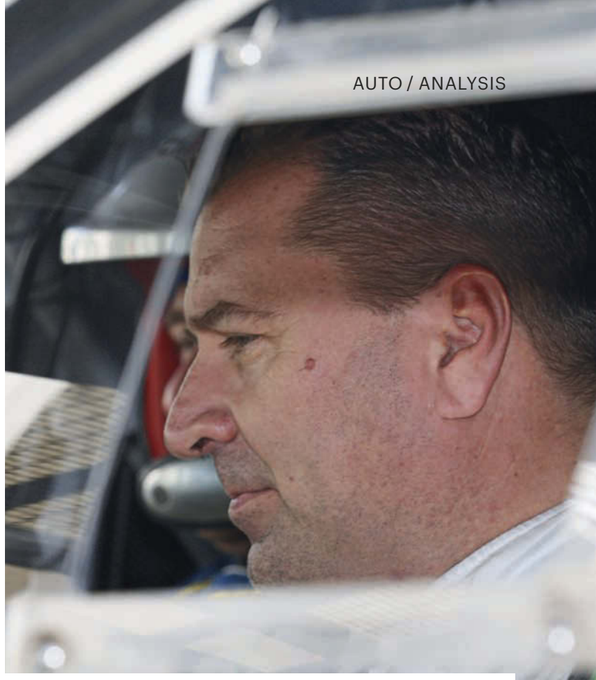
You can spend a whole race without the mechanics seeing their car on TV, and that can be hard, because we're all striving for perfection and we're passionate about what we do. And as long as you have the whole team believing in the project, you'll never have a problem with motivation.

One target we have this year is to get into Q2 more often, which is hugely important for us and one of the many battles within a battle that will go on all season.

We live in a slightly false world in the F1 bubble, and it's useful to remind the guys of the position they're in, that they could take a different turn out the factory gates and work in a 'normal' job. When you do that all the little gripes go away. Instead of doing a regular job they get to work on an F1 car, and work to some of the highest professional standards you can find in any industry anywhere. We may not be fighting for the championship, but our guys aren't working any less hard than the guys at Red Bull.



PHOTOGRAPHY: DPPI



The rally privateer

MARCO TEMPESTINI

DRIVER AND RALLY ACADEMY BOSS

Rallying has been a passion of mine from the very beginning. When I was a child I liked cars very much, and when I was 20 I felt I was ready to drive. But my father did not agree, so I dedicated myself to other sports and my business, and did not begin driving until I was 29 years old.

In a typical year I will do around 15 rallies: the full Romanian championship, plus six or seven events in a bigger championship like the European Rally Championship.

Every time I take the start of a rally the motivation is there because you want to be a driver. You try to do better every time and do the best you can.

In the Romanian championship we go to try to win or to be on the podium. But in the ERC for sure the level is higher and we know we cannot go and win. But this does not change anything because we still go to enjoy the rally and drive as fast as possible. And because we cannot win, we find a target like being faster than the next driver.

My biggest problem is I am a businessman first, a driver second. Although I was quite fast in my early career, I could not really concentrate like the professional drivers.

Of course you can concentrate for the two days of the rally, but when I am doing the recce, I cannot only be focused on the rally. There are times when I have to stop the recce for 20 minutes to answer the phone, which is not the best preparation. And there have been some rallies I've had to miss because there has been an important meeting to go to. But this is the compromise, and in the end real life is more important than a second life.

My son, Simone, is also a driver and will do the Junior World Rally Championship this year and some ERC events. He is 19 and is trying to make a career from it, and I will give him all the support I can.

We also have the Napoca Rally Academy, which we set up in 2008 to help young Romanian talent. We will support Simone and Florin Tincescu, who is competing in the ERC Junior Championship. Hopefully other drivers realise that if they work hard their dreams can also come true. We employ mechanics and provide safer driving classes and team building courses. It's a real motor sport business. ■

McLaren's test run of the P1 in Sweden's frozen north served practical as well as promotional purposes – the car has to be able to cope with extreme weather conditions

Road car technology

TESTED TO EXTREMES

When it comes to ensuring a new car will perform at its peak in extreme conditions, the lab is still no substitute for being out on the road

TEXT: MATT YOUSON

McLaren recently released a video showing its hybrid P1 supercar in all its glory. The short film looked and sounded like a high-concept car advert. But with the entire run of 375 vehicles sold before the first production model rolled out of the factory, McLaren really doesn't need to advertise.

The prototype, clad in dazzle paint, was powering around a test track bulldozed into a frozen lake. However, McLaren didn't go to the expense of taking the P1 to Sweden's arctic north purely to shoot dramatic footage. The car was being put through its paces in sub-zero temperatures as one of the last steps in its development programme. It's a process every new car from every major manufacturer goes through.

Northern Sweden and Finnish Lapland are sparsely inhabited, but in villages like Arjeplog (pop. 1,977), where McLaren was testing, the population doubles in the winter months as automotive engineers arrive to run programmes evaluating everything from tyres to electronic stability control software. The basalt tiles of domestic proving grounds do a good job of simulating low-grip conditions, but ride and handling evaluations on the region's frozen lakes are still the gold standard when it comes to signing off a new car.

The testing season in the frozen north typically lasts from November to April. For programmes that demand extreme cold all year round the work will shift south of the equator to Chile or New Zealand, but for many the summer months in the northern hemisphere offer the chance to test at the other end of the temperature spectrum. After experiencing -40°C in the Arctic Circle, engineering teams head for +50°C in the deserts of the Middle East and the American West. Jaguar Land Rover has just opened a new engineering test centre in Dubai to further enhance its hot weather vehicle research. McLaren took the P1 to Death Valley in the Mojave Desert, but exotic locations aren't solely for the benefit of glamorous supercars: everything from SUVs to superminis gets the same treatment.

In one sense this is more surprising: McLaren, for all its vaunted technological prowess, is a low-volume manufacturer with the resources appropriate to its niche. The mainstream automotive industry, tasked to selling cars by the millions and with immense resources amortised across those sales, can surely recreate those conditions in a regulated environment? Not so, says Steve Monk, director of vehicle evaluation and testing at Nissan's Arizona Testing Center (ATC).

"We certainly do more testing in the lab than we did in the past, but that's mainly a question of efficiency and the desire to bring products to market faster. We've got smarter on bench tests but it never replaces real-world confirmation.

"The lab can get you the direction you need, and give you the parameters and capacities, but for the final validation we still rely on real-world confirmation, be it on the proving ground with specific usage patterns or out on the road. I might be a little biased – I've been a vehicle test engineer almost my whole career – but I don't see a day where we can completely abandon a final validation in real-world conditions."

Nissan's empirical testing regime criss-crosses the globe. In addition to ATC it has two primary proving grounds in Japan, one in Motegi and another at Rikubetsu on the island of Hokkaido. Rikubetsu is reputed to be the coldest town in Japan with average temperatures during the winter dropping below -20°C. At the other extreme Nissan has just opened a new proving ground in Thailand.

In the Americas, however, the company has more than enough extreme climates on offer within the United States. Alongside its programme at ATC it goes where the weather is.

"One of the original charter purposes of the Arizona proving ground was hot weather testing, and that's still a big part of the activity because in summer we get very consistent temperatures ▶

Nissan relies on cold weather testing for information that can't always be attained through laboratory simulations

"I DON'T SEE A DAY WHERE WE CAN ABANDON A FINAL VALIDATION IN REAL-WORLD CONDITIONS."

STEVE MONK, NISSAN

Jaguar Land Rover's new test centre in Dubai is one of five research facilities around the world.

A HOT TOPIC

How do you run the heating in your electric car without draining the battery? Kia has the answer

While validation forms the core of testing in extreme climates there is still room for original research, particularly when the car industry moves out of the comfort zone it has with internal combustion. Electric vehicles present a whole new range of issues, with performance and battery life dropping away at both extremes when out of the 'Goldilocks' zone. The problem for electric cars doesn't just relate to chemical reactivity of the batteries, but is also influenced by human factors, in that drivers are going to use power-sapping AC or heaters more as outside temperatures become less comfortable.

Cold weather is a headline issue for the first generation of mainstream electric cars, with range figures for many halved for winter driving in temperate zones – which is why McLaren engineers in Arjeplog would have been rubbing shoulders with a team testing the new electric version of the Kia Soul compact car (above). Due for launch later this year, the Soul EV will feature an innovative HVAC system designed to combat the battery drain of running an immersion heater.

Kia's new heat pump allows the Soul EV's HVAC system to harness the waste heat given off by electrical components. Instead of relying on the electricity from the battery to heat the cabin to the driver's desired temperature, the heat pump recycles energy emitted by the electronics to increase the efficiency of the heating and ventilation systems. By reducing the load on the battery, the heat pump cuts energy consumption from the HVAC system and increases the car's overall driving range.

Working in conjunction with the heat pump, the Soul EV is fitted with a new smart air intake control system, which monitors and controls the amount of air entering and exiting the car, as well as the humidity level in the cabin. It recycles air that has been heated or cooled by the HVAC system, then introduces the optimum amount of fresh air to the cabin.

By better controlling air flow inside the vehicle, the HVAC system can cool or heat the cabin more efficiently and minimise the use of heating or air-conditioning during a drive. The system relies on a humidity sensor, temperature control and an intake actuator to monitor and control the flow of fresh air to the cabin.

above 40-45°C," says Monk. "The proving ground in Hokkaido is often used for winter testing, but in North America for cold weather extremes we test in Fairbanks, Alaska. For many years we worked in Canada, and then Minnesota, but in the last few years Fairbanks has become our hub and we will run durability testing there for most of the winter. Meanwhile we might also be on the roads in Death Valley or at high altitude in Colorado."

Asked to explain why testing outdoors beats a laboratory simulation, Monk alludes to the many variables faced in real-world driving. "A good example would be working with HVAC (heating, ventilation and air conditioning)," he says. "One of the big challenges in the lab is simulating the combination of extreme cold temperatures and a heavy sun load – as you might see in Colorado at high altitude on a crystal clear day. Programming the control parameters for an auto HVAC system to cope with those conditions is difficult and we'd want to put the vehicle into the real-world situation to validate our work."

The perception of advancement within the automotive industry tends to be geared around new technology, whether that be the next killer infotainment app or a smarter active safety system. In reality, however, much of the technological advancement within the industry is geared around the iterative improvement of existing technology: expanding the operating window of the vehicle and improving its durability across a wide range of conditions. The former is a valuable tool in drawing customers to a brand, but it is the latter that retains them across several generations of vehicle.

Monk – who also holds the title of chief marketability engineer for the Americas – puts real-world testing at the forefront of developing vehicles that create the sort of customer satisfaction which, in turn, delivers strong brand perception. "It's not simply a question of establishing general performance: marketability demands we evaluate all the conditions our products might encounter," he says. "Customers don't give you a break if it's -20°C or +40°C outside. In extreme conditions they expect their vehicle to function as it would if the temperature were 20°C. Technically, that's not what happens – but we have to accommodate their demands.

"A good example is engine cold start. Years ago, when we were still dealing with carburettors, and into the first years of fuel injection, cold starts with long crank times or a start failure were common. Customers won't give you a pass for that anymore: when they start up in the morning, even though their engine has soaked all night at extremely low temperature, they expect their car to start first time. It places specific demands on the electrical system, fuel management and engine start management systems. Getting confirmation that those systems work in any conditions they're likely to face is very important to us from the point of view of customer satisfaction."

There are dozens of other examples: Nissan tests in Death Valley not only because of the temperatures but also due to the steep gradients. It is possible to simulate a three-tonne SUV pulling a three-tonne trailer up a steep gradient in 50°C temperatures, but it's not a substitute for going out and doing it.

It is not, Monk asserts, so much a question of widening the envelope of conditions in which a vehicle functions, but ensuring it functions optimally across a wider range of conditions. And with the car industry concentrating on global platforms and world cars, that means creating vehicles that don't suffer from decreased durability or performance because their owners take them into extreme climates.

"I think it's absolutely a reasonable expectation from customers," says Monk. "Our vehicles sell in Arizona and Alaska, and in locations with even more severity. Our real test is to understand what those conditions are and how best to ensure our designs meet those challenges." ■

F1 tyre technology

PRESSURE POINTS

Formula One's new regulations don't just affect the teams, but the tyres too. So how does sole supplier Pirelli meet durability and performance targets while also preparing to race at unfamiliar circuits in Austria and Russia? AUTO finds out

TEXT: ANTHONY PEACOCK

Creating a new Formula One tyre starts not quite with a blank sheet of paper, but certainly with a blank computer screen. Tyres, after all, can be whatever people want them to be: a rock-hard millstone that would theoretically last all season, or a super-sticky qualifying tyre that would burn up within half a lap. Both of these extremes are possible, along with anything in between.

It all therefore centres around the brief – what's desired by the sport to create exciting and unpredictable racing. And this season the brief for the FIA Formula One World Championship is to provide two pit stops per race and encourage overtaking: essentially the same mandate that has been in place since Pirelli made its debut as the series' official tyre supplier in 2011.

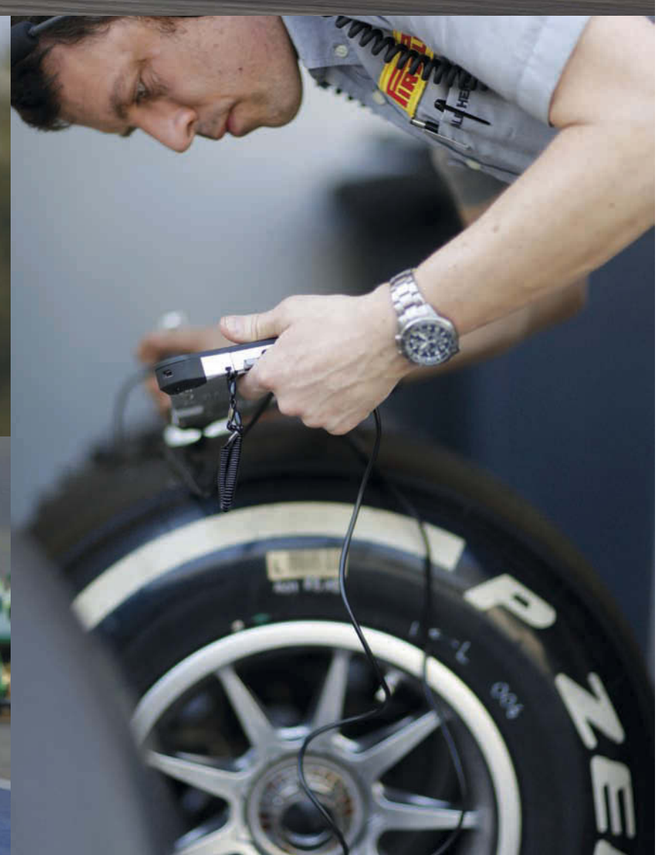
But while core tyre philosophy remains the same, everything else in F1 has changed. The power delivery of this season's new-look cars is completely different, with massively increased torque at low revs from the 1.6-litre turbocharged engines, complete with sophisticated energy recovery systems that produce double the amount of power (around 160bhp) provided by last year's KERS.

Complicating matters further, the cars have considerably less fuel to play with – which means that drivers might not be flat-out all the time – and the 2014 rules stipulate decreased aerodynamic downforce.

The tyres to suit this new generation had to be ready before the first car had even turned a wheel. ▶

"WHILE CORE TYRE PHILOSOPHY REMAINS THE SAME, EVERYTHING ELSE IN F1 HAS CHANGED"

Williams driver Valtteri Bottas tests the new generation of Pirelli tyres in Bahrain. BELOW LEFT: Pirelli motor sport director Paul Hembery. BOTTOM LEFT AND RIGHT: Pirelli engineers test track and tyre temperatures.



PHOTOGRAPHY: DPPI, LAT

"It's a situation we've been in before," says Pirelli's motor sport director Paul Hembery, matter-of-factly. "In 2010 our Formula One contract was confirmed in June. Just two months later we had our first prototype tyre running on an F1 car. And seven months after that we started our first grand prix."

Back then Pirelli used a modified 2009 Toyota for testing. Downforce may not have been quite representative, but at least the power curve was the same. This year's challenge has been the biggest yet.

Rather than actually seeing the effects of the new formula on the tyres, these had to be calculated in advance using simulation software. This led to what is almost certainly the first Formula One tyre that has been entirely designed before being fitted to the competition car for which it is destined.

"We relied on a series of computer models, which precisely simulated the new loadings we expected to find with the 2014 cars using data supplied by the teams," says Hembery. "On that basis, we were able to virtually design tyres that were suited to those characteristics, altering all the constructions and compounds compared to 2013.

"Of course, we were able to do some on-track testing last year to evaluate the performance of certain elements of the design, but we obviously had to wait until the first pre-season test at Jerez in January to see how the whole package would run on the new cars. And we always said that depending on the data we obtained from pre-season testing, we would make any necessary changes to the tyre in time for the first race. As sophisticated as these modelling techniques are, there's never a substitute for real on-track testing."

Time, though, is at a premium in F1. At the first Jerez test, the teams completed a collective 6,508 kilometres of running – compared to 15,634km last year. Hardly ideal if you're committed to understanding and possibly changing the specification of a brand-new tyre in the space of less than two months.

The main changes for this year have consisted of making all the tyre compounds slightly harder while maintaining the same levels of grip from last season. This is in order to decrease the number of 'marbles' on the circuit – balls of rubber that come off the tyre as it degrades – and ensure that the number of pit stops does not increase, despite the extra demand on the tyres. Primarily this comes from the extra wheelspin that more torque inevitably brings.

For the same reason, tyre construction has been altered to present a flatter contact patch against the surface and get more of that power down cleanly onto the track.

The tyre compounds were assessed on track during private tests with Pirelli's own car throughout last year, the Toyota having been replaced by a 2010 Renault R30. Audi works driver Lucas di Grassi and ex-Toro Rosso racer Jaime Alguersuari were retained as test drivers, having cultivated a remarkable feeling for the vagaries of different tyres.

During testing the engineers start with a base tyre – which is a known quantity – then benchmark the behaviour of various prototype tyres against what they know.

"Testing on track is all about trying out a range of structures and compounds in conditions that are as consistent as possible, then measuring the tyre's wear rate along with its performance, also taking into account feedback from the test driver," says Hembery. "Putting all these things together you can reach some meaningful conclusions. However, the collaboration with the FIA and the Formula One Strategy Group, and the modification of the regulations, enabled us to test last December in Bahrain and opened the door to in-season testing. This improved our ability to test with the most recent and relevant cars. That's more important than ever this year."

It's not just the challenge of a new set of tyre regulations that Pirelli faces, but also two brand-new circuits in Austria and Russia.

"TESTING ON TRACK IS ALL ABOUT TRYING OUT COMPOUNDS AND STRUCTURES IN CONDITIONS THAT ARE AS CONSISTENT AS POSSIBLE, THEN MEASURING WEAR RATE AND PERFORMANCE."

PAUL HEMBERY, PIRELLI

The two countries could not present a bigger contrast, yet the preparation for unknown territory is the same. Two Pirelli engineers inspect the track in advance, bringing with them laser measuring equipment that calculates the abrasiveness of the asphalt by examining closely the shape of the stones that make up the aggregate. These readings are taken at several points over the circuit to ensure a representative picture, and asphalt samples are also brought back to headquarters. This allows Pirelli to predict the likely wear rate, taking into account other factors such as track layout and likely ambient temperatures.

All these calculations are strictly theoretical, because a fresh surface alters considerably with more cars driving over it and rubber being laid down onto the track. A new circuit can also gradually release oils from the asphalt onto the track surface, making it greasier than expected.

Being sole tyre supplier to Formula One is not an easy job. There are few plaudits for success yet an extraordinary amount of publicity if even the slightest thing goes wrong.

But if it were easy, then everyone would do it. ■

World rallying

STARRING ON THE BIG STAGES

Robert Kubica made an incredible comeback from career-threatening injuries to win last year's WRC2 title and was then voted the first ever FIA Personality of the Year. Now the ex-Formula One star is aiming for even greater prizes at rallying's top level

TEXT: BEN BARRY PHOTOGRAPHY: THOMAS BUTLER

CHANGING MAN

Former F1 star Kubica has successfully reinvented himself as a rally driver following his life-changing accident in Italy three years ago.

The FIA World Rally Championship service park sprawls across a desolate airstrip on the outskirts of Hagfors, Sweden. Sitting in the middle of vast open landscapes blanketed by evergreens and pockmarked by frozen lakes, it's a long way from the glamour of Formula One. In fact, Hagfors is a long way from anywhere, three-and-a-half hours out of Stockholm and a further hour north of Karlstad. Unless you're part of the small local population, it takes dedication and passion to get yourself here. But none of that compares with the resolve shown by ex-F1 driver Robert Kubica since his terrible rally crash three years ago.

Competing on Ronde di Andora in Italy ahead of the 2011 F1 season, the Polish driver's Škoda Fabia careered off-line towards an Armco barrier. The barrier should have absorbed some of the impact; instead, a mounting bracket failed and an exposed piece of Armco speared into the cockpit, severing Kubica's right forearm and badly injuring his leg. He hasn't raced in F1 since. Now the sport that halted Kubica's F1 career could be aiding his return.

When AUTO arrives at Hagfors, the 29-year-old's Ford Fiesta rally car is hoisted up for service while mechanics buzz around. An engineer leans by the driver's door, Kubica remains in the driver's seat to download his feedback, his right hand immobile on his thigh as he mimics a car sliding on snow with angular swoops of his left hand. And it's his left hand that grasps at the roll cage and pulls his body over its chunky bars. Kubica limps slightly as he walks towards us, cautiously offering his fragile right hand to shake. I comment on how impressive his ability in a rally car is, especially given his injuries.

"My life has changed as a driver, but mostly it's changed in daily life," he explains. "When I am driving a rally car I don't see my limitations, it distracts me. Then I go back to the hotel and I see my limitations. There are things that are out of my control, and you live with them or you just depress yourself. I live with them because I can still do things that make me happy and I'm really glad I have this opportunity."

Kubica returned to rallying in 2012 and has made swift progress since then. He won last year's WRC2 title in a factory-supported Citroën DS3 run by PH Sport. After a tough start on the first round in Portugal he went on to dominate the class, winning in Italy and Finland before wrapping up the title in Spain with a round to spare, which allowed him to make his WRC debut in Wales. Now Kubica has switched to a Ford Fiesta prepared by M-Sport for his first full WRC campaign. It's a big step up.

"Rallying is quite a complicated discipline because there are so many variations and your experience plays a big role," he says. "On a circuit you organise a test day and do 150 laps, you try different things, different set-ups. In a rally you do two passes on the recce, then drive at full speed. If someone has done the stages already, he knows the characteristics of the road. It's a big challenge and hopefully one day I will be satisfied with what I have achieved. But no-one has ever come to rallying, especially from a different sport, and been fast straight away."

Kubica showed his speed on Tarmac at the season-opening Rallye Monte Carlo, but it is loose surface events that pose the biggest challenge.

"If someone had told me one year ago that I would be driving in Monte Carlo for the first time in WRC and would be leading after two stages by 36 seconds, I'd say he was mad. Maybe people think I was leading because of tyre choice but I had exactly the same tyres as the others. But it would be crazy to expect me to fight with the top guys on gravel or snow. Experienced drivers know more or less what to expect from the grip level at a corner; I don't know until I'm there and it might be too late by then. ▶

"This is my first time in Sweden, and the stages are very fast and quite narrow. There are fewer snowbanks this year and many over-crest, blind corners. Normally my pace notes are fine, but I don't know the grip level, whether the crest will unload the car, if I will jump or not. Definitely when you are starting a new stage for the first time you have many doubts."

Kubica is learning quickly, however, a combination of outright speed and mental maturity fast-forwarding him through the ranks. "You just have to look at the way Robert prepared for the 2013 season to see what it all means to him," says M-Sport team boss Malcolm Wilson. "He has a desire and a hunger that you don't see in many drivers."

It isn't just Wilson who believes in the Pole's skills either. Former World Rally Champion Marcus Grönholm joined Kubica on a test and declared him the most naturally talented driver he had ever sat next to. Mention this praise to the self-deprecating Kubica and he'll deadpan that "maybe he didn't sit next to very many drivers".

Kubica has special FIA dispensation to use a modified paddle-shift gear change, which is positioned to the left of the steering wheel for operation by his uninjured hand, not the right as was previously the case in WRC cars. But new-generation WRC cars' sequential transmissions are controlled via a gearstick located in a similar position to that of a road car, which raises the possibility of Kubica driving an unmodified right-hand-drive WRC car.

"I WOULD PREFER TO BE IN F1, BUT TO DO WRC, IT'S AN EVEN BIGGER CHALLENGE."

ROBERT KUBICA

"On Tarmac it would be possible, but on gravel it would be very difficult because I need two hands on the steering wheel, or it would be dangerous. The range of operation with the steering wheel on gravel is far greater, and often the ruts and lines grab your steering wheel. But I've considered a right-hand-drive road car to help my rehabilitation."

Despite his passion for rallying dating back long before his crash, Kubica still yearns for a return to Formula One, as he reveals when asked how it feels to beat Sebastian Vettel and Sébastiens Loeb and Ogier to the FIA's inaugural Personality Of The Year award.

"It's nice to get the recognition because the award was chosen by journalists," he explains. "But of course I would prefer to be nominated because I have been in the top three in F1. I worked a long time to become an F1 driver and then to fight for the top places. Definitely I would prefer to be there, but in the end I am a racing driver and I am having the pleasure of driving. To do WRC, it's an even bigger challenge than F1." ▶

TOP LEFT: Kubica made his F1 debut for BMW in Hungary in 2006. MIDDLE LEFT: The Pole scored his sole F1 win in Canada in 2008, 12 months after his huge crash at the same circuit (below). MIDDLE TOP: fans at pre-season F1 testing wish Kubica well following his 2011 rally accident. ABOVE: collecting the 2013 FIA Personality of the Year Award. TOP RIGHT: success with Citroën led to a WRC2 win last year, and a switch to Ford power for a full-on WRC assault this year (below).

"MY SKILLS AS A DRIVER ARE QUITE HIGH, BUT MY EXPERIENCE AS A RALLY DRIVER IS LIMITED."

ROBERT KUBICA

The rotation and flexibility of Kubica's right forearm are the biggest barriers to an F1 return: tighter corners and the confined space of a single-seater cockpit require more mobility in the lower arm than he currently has. But a production-based racing car allows Kubica to compensate for this with a wider-ranging movement of his shoulder and upper arm. It was hoped that surgery would increase mobility but so far it hasn't yielded the desired results.

"Last year I dedicated all my season to driving and I stopped with surgery. Okay, there are a few things I might improve by [having] surgery, but if I kept doing it I would have to wait to come back to driving. There is also the risk that by doing too much surgery you get worse instead of better, and if you keep going from hospital to hospital, clinic to clinic, doctor to doctor, it can get quite annoying."

A series of tests in the Mercedes F1 simulator last year confirmed that Kubica could race at most F1 circuits, despite his injuries. Those proving impossible were the tracks with slower, tighter corners such as Monaco, Singapore, Hungary and Canada – the latter described as being "at the limit". Even those obstacles might be overcome, however, by fitting a faster steering rack to compensate for Kubica's restricted movement. So would Kubica consider stepping into an F1 seat should another driver be injured, much as Vettel deputised for him after his shunt at Canada in 2007?

"I will give everything to come back to F1," he says, "and until there is no possibility I will keep my chances alive. But as long as there is no chance that I could do a full season, I don't want to do it. I know how I felt after my test with Mercedes in DTM. I did a good test and had a lot of fun, but then you wait for more and you would like to achieve more."

Wasn't he tempted to stay at Citroën with Loeb and return to the track in the World Touring Car Championship?

"I'm not interested to come back to the circuit in that championship," says Kubica. "I'm not saying it's not a good championship, I just don't see myself there at this stage of my life and recovery. I did the test with Citroën in the touring car, but it felt strange. It was my first time driving a front-wheel-drive car on the circuit. I had to recalibrate everything. Often, when you get understeer with a rear-wheel-drive car, you go on the power and try to turn the rear of the car, but it makes it worse in a front-wheel-drive car.

"Definitely if I came back to touring cars, I would like to do DTM. I was very impressed with the feeling the Mercedes gives to the driver. The chassis reminds me of F3 at times: it has very big downforce for a touring car."

For 2014, Kubica is 100 per cent dedicated to rallying, citing that it wouldn't be fair to his sponsors and partners to "treat rally like a hobby". For now, the speed is there, but the consistency isn't. Yet he is adamant he won't slow down.

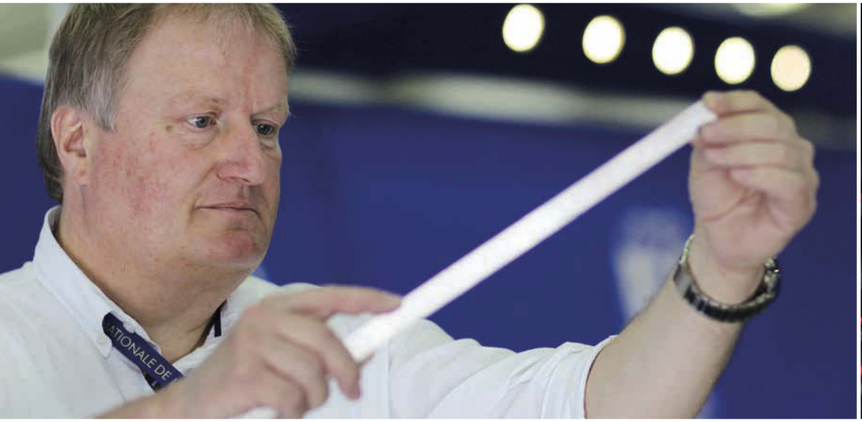
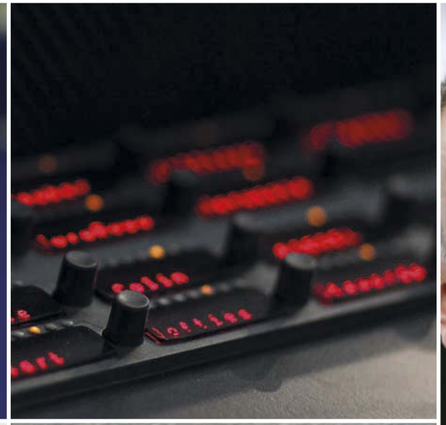
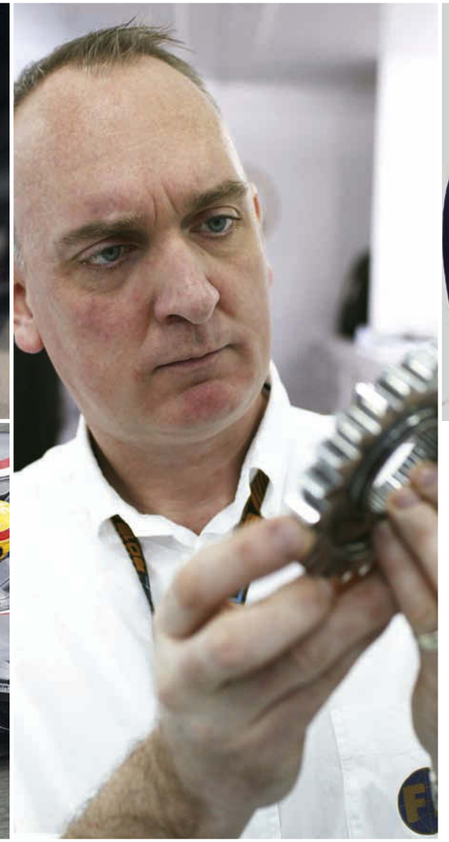
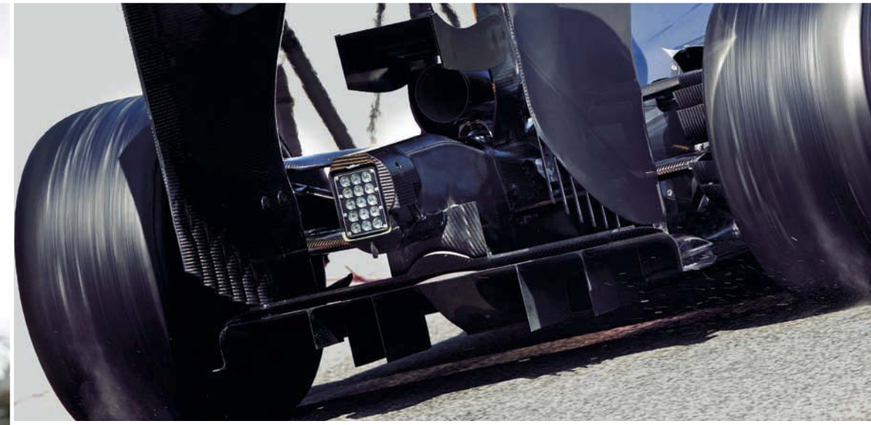
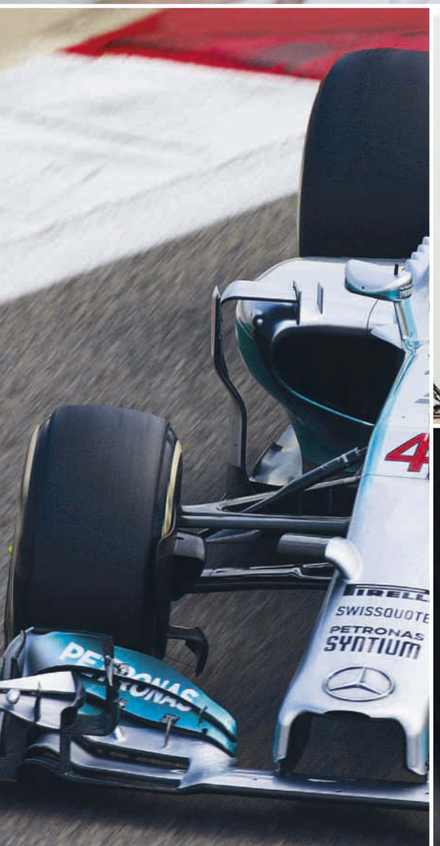
"I'd like to finish the rallies, because every kilometre I waste by crashing I'll have to do for the first time next year if I'm still here. But slowing down is not the solution because to learn how to drive at the top level you need to drive as fast as you can. My main problem is that my skills as a driver are quite high, but my experience as a rally driver is limited."

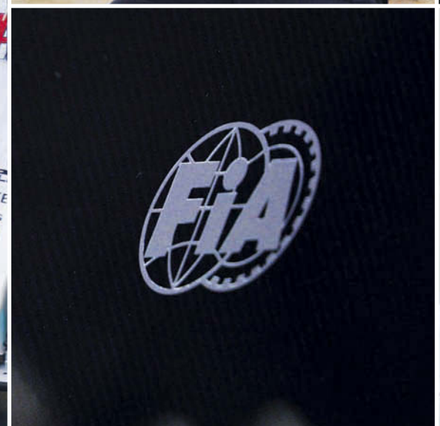
With that Kubica climbs back into his Fiesta and heads off into the forests. He shows strong speed given his limited experience, but mistakes see him spend 23 minutes stuck in snowbanks to finish a disappointing 24th overall.

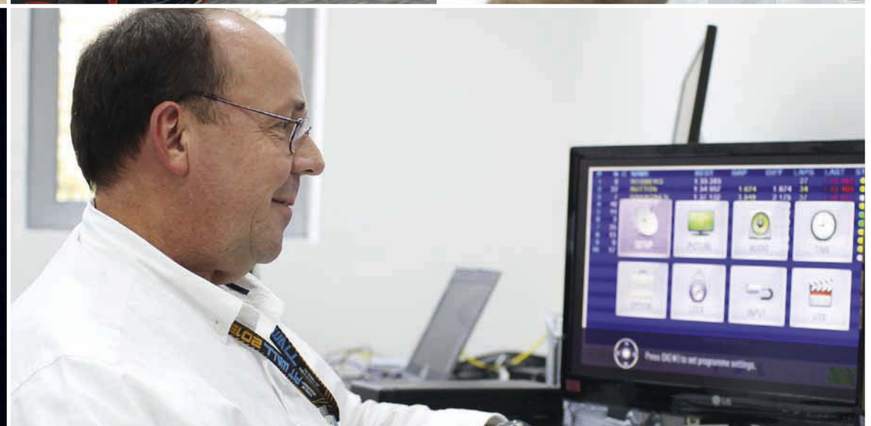
It's errors like these, caused by his lack of experience, that currently hold back Kubica the rally driver, not his injuries or lack of speed. Once that consistency comes, Kubica will be a force to be reckoned with. ■







THE WATCHMEN

With Formula One going through its biggest set of regulation changes in history, ensuring a level playing field just got a lot harder for the FIA technical team at grands prix

TEXT: JUSTIN HYNES PHOTOGRAPHY: JAMES MOY

The final moments of Formula One Grands Prix are, on the surface, fairly chaotic. As the chequered flag falls, team members flood the pit wall to wave home winners. The victorious swoop towards them in acknowledgement of a job well done, podium finishers pump the air in celebration, and the rest of the field sweeps by to complete slow-down laps on their way back to the pitlane.

There, the frenzy goes into overdrive. A flood of cars pours towards parc fermé, the area where drivers must halt once the race has ended. On the other side of hastily-erected barriers, a swarm of team members and TV crews jostle for position as the top three drivers clamber out of their cars to soak up the admiration before making their way to the podium.

However, look past the champagne spray and adrenaline-fuelled chest bumping and in the midst of the chaos, organisation is once again taking ▶

hold. Up and down parc fermé, a small crew of officials checks each car, making sure they're safe. Car data is then downloaded for analysis, all of which must be done before the final result is published.

It's not just in the heated moments after the flag falls that these careful checks take place, either. From the moment the cars arrive at each grand prix circuit, the FIA's 10-man technical crew is on alert, steadily working through a series of tests to ensure that each car conforms to F1's regulations – making sure the playing field is level. Ten men, up against the ingenuity and brain power of thousands of the brightest minds in motor sport, all of whom are seeking to push the rules as far as possible in pursuit of the infinitesimal time advantages which define victory in Formula One. It's a hugely demanding task, but one that in 2014 has become even more complex.

This season sees the sport undergoing the biggest regulation change in its 60-year history. The arrival of a new V6, 1.6-litre turbocharged hybrid power unit featuring extensive energy recovery systems means the FIA technical team is dealing with a radically different F1 landscape.

"It's a different world, it has nothing to do with the old cars," says technical delegate Jo Bauer, who heads up the 10-man team that reports to race director Charlie Whiting. "The whole area we are involved in is completely different. We learned a lot through [pre-season] testing, and we need to be organised just to get through it. It's going to be difficult and time-consuming this year, but we are prepared."

The shape of grand prix weekends has largely been fixed in recent years, with the main body of the technical crew setting up at a circuit on the Wednesday before the race (Tuesday in the case of long-haul events and Monaco) and the software analysis team setting up a day later. The FIA technical area is established in the pitlane garages, with a measuring platform installed, the trucks that are home to the technical crew for the weekend are readied and the fuel-testing laboratory is set up.

"On Wednesday, everything has to be operational by lunchtime," explains Bauer. "The teams then have the choice to come to us and do private deflection tests [in which car elements are tested to check they meet tolerances] or any measurement checks they would like to do, but they have to book this in advance.

"Then, on Thursday at 8.30am, we are at the track for initial scrutineering. We brief the scrutineers and the platform crew, and then start at 10am. This is largely to check that all the cars meet our safety requirements.

"Every country provides 30 scrutineers and we split those into a platform crew, tyre checkers and garage scrutineers. Each car is scrutinised and this has to be done before 4pm when we submit a report to the stewards who then publish the entry list."

A weekend of old would then involve the technical team working steadily through a regime of checks. These would include testing fuel samples from the teams before and after each track session, logging engine use, inspecting seals on components the teams were not permitted to interfere with – such as gearboxes and engine control units – checking tyres and doing software checks on car systems. The work would go on throughout the weekend.

But while the methodology remains the same for 2014 – "we carry out regular checks on all aspects of the cars during the weekend," says Bauer – the shape of the technical team's workload has changed dramatically.

Chief among the team's challenges is F1's new power unit. From 2006 until this year, F1 raced with a normally-

> "IT'S GOING TO BE DIFFICULT AND TIME-CONSUMING THIS YEAR, BUT WE'RE PREPARED."
> JO BAUER, FIA TECHNICAL DELEGATE

aspirated 2.4-litre V8 engine, the specification of which was frozen for '07. A known quantity, the V8 provided teams with little room for manoeuvre, as FIA software analyst Olivier Hulot admits: "It was settled. It had been around for years, so the software inside the standard ECU (engine control unit) was the same for everyone. You could play with a few parameters for control of the V8, but that was it."

Fast-forward to 2014 and the game has changed – even the word engine has been ousted in favour of the new term 'power unit'. It's an apt description for an engineering marvel the like of which has never before been seen in F1.

Aside from the 1.6-litre internal combustion engine, the power unit is made up of two energy recovery systems – one harvesting energy from the car's braking phase (as with the old KERS) and the other recovering energy from exhaust gases and attached to a new turbo. These systems have required a rethink of the standard ECU brought to the sport by the FIA in 2008.

"Prior to this year all the control software, everything that was managing the engine – the gearbox, differential, clutch and so on – was standard code. The teams had no ability to change that code," says Alan Prudom, who heads up the FIA software analysis team at the races. "This year the teams have been given more freedom, in that they are able to write some of their own code. It is still within the same standard ECU as last year, but there are some areas we've set aside for which the teams can write code. That's primarily for things like the management of energy recovery systems, the way the energy is balanced around the unit. They can have an influence on choosing strategies for the way in which engine power is delivered, what proportion is from the internal combustion engine and what comes from the battery and the associated motors.

"There's also a fair amount of freedom on some of the newer technologies such as the turbo management. However, most of the chassis side of things like the gearbox control and clutch differential is still standard software that the teams can only configure, they can't actually change it."

These advances mean that whereas before analysis of a team's use of the ECU was relatively straightforward, this year the FIA technical team must sift through a vast amount of code to ensure teams are conforming to the rules.

"A lot of the work we do for a grand prix is preparation, it's before the race weekend," explains Hulot, who is responsible for ECU checks. "Pre-season we visit all the teams, all the engine suppliers and check how they're connecting the standard ECU to their car systems.

"Then before each race we look at how they configure the standard parameters, making sure this is in compliance with the regulations. Before each session we verify again the configuration of the standard issue." ▶

JO BAUER
FIA TECHNICAL DELEGATE

Bauer has been the FIA's technical delegate since 1997 and leads the technical team at grands prix. He admits that 2014 is a big year for F1's administrators. "It is a lot more work. We have had to employ another person to top up the software department to deal with data analysis because of the new fuel regulations. We need to support each other, the software department and the hardware department, to cope with sealing all the power unit components, and tracking them. The workload after the race is much greater. Normally we finish five hours after the chequered flag but now it can be seven or eight hours before we finish, at least at the start of the season. So the race is not over when the chequered flag is shown. For us there is still as huge amount of work to do."

RICHARD DARKER
TECHNICAL ASSISTANT

Responsible for sealing, recording and checking gearboxes during a grand prix, Darker also performs car checks across the race weekend and looks after the checking platform. "Teams can request to come down to us and use our equipment to check out a front wing, rear wing or anything they feel is necessary. Within the event itself, after qualifying we'll choose three to four teams randomly and we'll do a specific test on them depending on what Jo Bauer has seen or wants to do. On the Sunday morning before the race, I would then choose four to five teams to bring down their front wing and I'd do deflection tests on those."

KRIS DE GROOT TECHNICAL ASSISTANT, TYRES

De Groot looks after tyres during a grand prix, starting with allocation and the preparation of checking devices. he also briefs the scrutineers. He downloads and analyses data from the checking devices after each track session. He follows tyre use and deals directly with F1's sole tyre supplier Pirelli in this regard. He also checks that the teams are using the tyres in accordance with instructions from Pirelli (concerning temperature, camber and pressure). Finally, he's also involved in setting up the FIA's legality checks platform.

ALAN PRUDOM SOFTWARE ANALYST

The FIA's chief software analyst at races, Prudom is responsible, along with his colleagues, for approving electronic units that don't form part of the standard engine control unit. He also manages the SECU data on the FIA's server and the information retrieved from each car's SDR (Scrutineering Data Recorder). It's work that was particularly intense as the team's geared up for the start of the 2014 season.
"There were issues, which is natural with such new technology but it meant that the teams' designs were evolving literally day by day," he says. "That level of development will carry on through the season. The goalposts are always moving, sometimes slowly, sometimes quickly and luckily we can respond fairly rapidly most of the time."

And the analysis doesn't stop there. During each session the FIA's software analysts have access to live data from the cars, which they look at throughout the weekend, searching for signs of untoward performance.

"We have dashboard-type displays that give us warnings when somebody is running close to the limit in terms of a specific regulation," explains Hulot. "Largely it's an exercise in trying to minimise post-event analysis, because after the event it's too late."

Allied to analysis of the ECU is an examination of the control units of the new energy recovery systems themselves, a task managed by Andy Leitch.

"The kinetic energy recovery is basically the same as the old KERS– you have the same control electronics going between the battery and the motor. But then it's doubled up. You've got a second motor generator unit on the turbo and also the size of the motors has increased. So instead of 60kW it's now 120kW," he says.

"In terms of what we'll be looking for, there are limits on how much power the kinetic recovery motor generator (MGU-K), can provide. There are also limits on how much energy can be taken in and out of the battery. From a safety point of view we've put a maximum voltage of a thousand volts to be used, so we're making sure the teams don't exceed that, which they shouldn't do by design. There's also a maximum speed permitted for the turbo motor."

Again the analysis is a mix of pre-race checks and data examination performed in real time.

"The weight of the battery is defined so a team can't have a really light battery that's got high capacity. There's no point in them spending a lot of money trying to get a special battery made that's going to be a bit lighter because it won't help – you'll end up having to put ballast on [the car] to compensate," he adds. "Those design elements are checked before the start of the season.

"On the car itself we have two sensors: one for the MGU-K and one in the battery to measure how much energy goes in. During running we're looking at those to see how much energy, how much power, how much voltage is present. And if our sensor fails the teams have to provide a model of the power they're using, which I can then verify."

All these systems are also locked, either by physical or software seals, so that the teams are prevented from making adjustments.

Prudom admits that the complexity of the new units has increased the responsibilities of the FIA's software team, with an extra software analyst taken on to help shoulder the burden. "I've been working in this area of Formula One for 20 years and these are by far the most complicated engines I've dealt with – by a factor of two or three," he says. "They are a far more extreme design than, say, the previous V8s were. So it is extra work for sure and I think everyone, the teams and ourselves, is on a learning curve with them."

And the learning curve has been steep. Pre-season testing saw every powerplant manufacturer suffer reliability issues, with Renault the worst affected. Despite the difficulties, however, each manufacturer was bound by the new rules to homologate its power unit on February 28th.

"This work was undertaken by our engine expert John Marson," says Bauer. "Each team must submit a reference power unit that we can check against whatever they're doing during the year. Basically, it's the closing of the boxes, so to speak. After that point the only option for the manufacturers to alter the power units is on the grounds of reliability, safety or cost, and that request must then be submitted to the FIA for approval. ▶

"John also looks after power unit checks at the races, making sure that the right components are being used, as the teams are restricted on the number of certain elements they can use," he adds.

While the engine is undoubtedly the most dramatic change to this year's regulations, there have been significant alterations elsewhere such as in fuelling, with cars now limited to 100kg of fuel per race and with efficiency also promoted through fuel flow restrictions. Those changes and the reintroduction of turbocharging to F1 have given fuel analyst Peter Tibbetts a new environment in which to work.

"The first change is in the fuel approval process because every team has to have their fuel pre-approved. Last year we were having the density checked at three different temperatures to get a density temperature curve plotted. The fuel flow meter measures volume and we have to convert that to mass because the regulations are measured in mass," he says. "Therefore we have to get a temperature density curve during the fuel approval process, which is then programmed into the fuel flow sensors.

"At the circuit, because the fuel flow sensor is mounted in the tank, we have to check that the sensor has got the correct FIA seal and that it's been calibrated with the correct fuel," he adds. "Some teams have more than one fuel pre-approved for the season and a sensor can be calibrated against two or three different fuels. We have to make sure that the correct calibration line is put into the software in the fuel flow sensor so that it is measuring the correct fuel."

The return of turbos to the sport has also changed the types of fuel used.

"The fuel composition has changed quite a lot," says Tibbetts. "It's much better to have a heavier, more dense fuel for a turbocharged engine than with a normally-aspirated engine."

All these on-circuit checks, which take place after every track session and before and after the race, are carried out in Tibbetts' travelling laboratory. "I normally set up in one of the 'track shacks' for flyaway races or in one of the trailers in Europe," he says. "And what I set up is an instrument called a gas chromatograph. This is used to separate the fuel into its individual components so we can see exactly what's in there. I'll get a fingerprint, a pattern of peaks unique to that fuel, and when I take a fuel sample I can overlay that pattern against the one I have for the reference fuel and compare the two. They should overlap completely.

"The samples are taken in the garage where we've got marshals making sure nothing's touched on the car, apart from filling it up with petrol and changing oils and fluids – and things that Jo Bauer allows to be done due to damage or something. I'll go along an hour before the race, take a sample, and then take it back to the gas chromatograph, and I'll set the samples up to run during the race. I take three more samples at the end of the race. During the weekend every team is sampled at least once. I generally take 12 samples over the weekend and there are 11 teams, so even if I take a sample from a team they know there's a chance I might go back and take another one."

Changes, too, have occurred in the gearbox where, as technical assistant Richard Darker explains, Formula One's teams are also being tested.

"This year the cars have eight forward gears, which is new, and the teams have to nominate the ratios they will use in their gearboxes during the year," he says. "It's pretty tough. Last year they had 30 plus gears to choose from and now they've got only eight. They'll choose those, we'll seal the gearbox and they'll run each gearbox for six events." ▶

JOHN MARSON TECHNICAL ASSISTANT, ENGINES

Marson seals, records and checks the engines used at a race. He visits the teams to do engine homologation checks, including intensive checks to compare components from a race engine with the relevant parts from the homologated engine. John supports the software department in downloading and analysing standard ECU and SDR data after each session. He also sets up the FIA legality checks platform and looks after the 3D-measuring system.

ANDY LEITCH SOFTWARE ANALYST

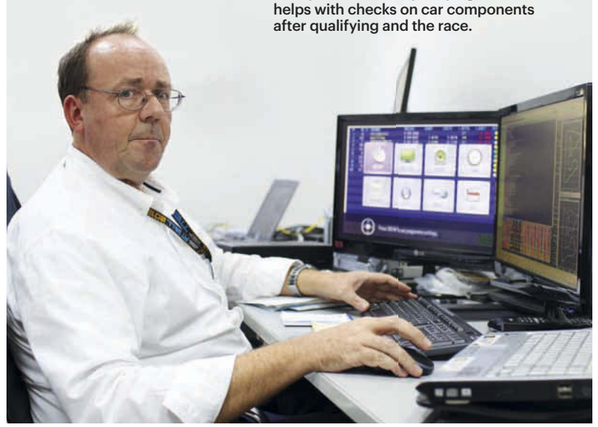
Responsible for checking the operation of the teams' energy recovery systems, Leitch is likely to be one of the paddock's busiest men this year. His work not only involves ensuring the systems conform to the regulations but also sees him briefing track officials and marshals on safety procedures. "I will brief the marshals, just to give them some advice on how to handle the cars. It's quite straightforward: we just ask all the marshals to always wear some safety electrical gloves underneath their protective clothing."
Leitch also checks the electrical safety of the cars at the end of each race. "In previous years the cars had a light on the dashboard just in front of the driver, but that wasn't immediately visible. So this year the cars have safety lights just above the driver's head, below the camera. Green means it's switched off and everything's safe, orange means it's safe but the high voltage system is energised, so the car could move unexpectedly, and then, if there's a fault the light will go red."

OLIVIER HULOT
SOFTWARE ANALYST

Responsible for checking each car's standard ECU, Hulot also looks after DRS configuration at events. Additionally, this season he's in charge of F1's new brake-by-wire system. An issue reported with the old KERS was that energy recovery during braking could upset the rear balance of the car leading to handling issues for drivers. That has been remedied through an electronic system that measures how hard the driver presses the brake pedal. The system uses that data and information gathered from the energy recovery taking place to determine the correct amount of brake pressure to apply. "With brake-by-wire, we're simply going to monitor the pressure requested by the standard software," says Hulot

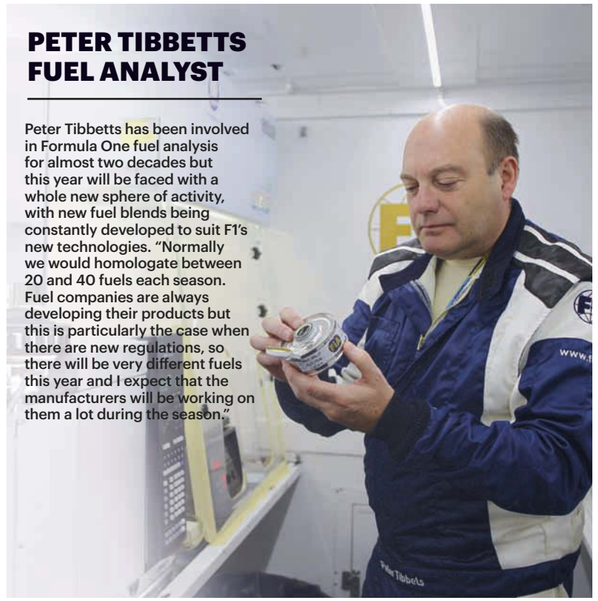
SIMON BUSBY
SOFTWARE ANALYST

Busby is responsible for the SDR (Scrutineering Data Recorder) and configuring SDR parameters for each grand prix. He also approves and seals electronic units that are not part of the standard ECU for the teams, together with his software analyst colleagues. He analyses standard ECU and SDR data after each session and checks chassis transponders after qualifying. He also helps with checks on car components after qualifying and the race.



PETER TIBBETTS
FUEL ANALYST

Peter Tibbetts has been involved in Formula One fuel analysis for almost two decades but this year will be faced with a whole new sphere of activity, with new fuel blends being constantly developed to suit F1's new technologies. "Normally we would homologate between 20 and 40 fuels each season. Fuel companies are always developing their products but this is particularly the case when there are new regulations, so there will be very different fuels this year and I expect that the manufacturers will be working on them a lot during the season."



There are 'get-out-of-jail' clauses, however. Normally teams are only allowed to change certain elements inside the gearbox during a race weekend if they can prove to Bauer they've been damaged. For 2014, however, that rule has been relaxed, with teams now getting five opportunities during the season to open the gearbox without proof of damage being required. Also, for this year only, teams have been given the chance to re-nominate their gear ratios once during the season, although after that change is made they must race the remainder of the year with the new set.

Unusually, it means that for Darker it will be a more straightforward season than in the past. "It's a good year for me!" he laughs. "Normally, the teams would see what gear ratios they wanted out of the 30, and then two hours after second practice they would send a list to me and Jo. Then on a Friday night I'd go round and seal every gearbox. This year I won't have to do that as the ratios are set from Melbourne."

But where one door of complexity closes, another opens. Darker also takes care of deflection tests and looks after the weigh bridge in the FIA garage, where he'll spend long hours checking the correctness of the cars against new bodywork and chassis regulations.

"Teams can request their own time to come and use our equipment, to try out a front or rear wing or anything like that. After each practice session cars can be weighed, and after qualifying the top 10 cars will be weighed. Then we'll choose three to four cars and do a specific test on them."

Deflection tests have been the area of most scrutiny in recent times, and the possibility that teams have used wings that illegally flex under load to provide improved downforce has been heavily investigated.

"We saw it a lot in pre-season tests, this aero-elasticity," says Bauer. "Of course the teams can run what they like in testing, it's not regulated, but it is from Melbourne onwards. I saw some things on the cars we wouldn't accept this year, like spring-loaded flaps. It's not something they should put on a car. Having a spring action for any mechanism with an aero influence is not permitted."

This is the eternal contest between competitors and adjudicator, however, a battleground where the teams are constantly in pursuit of an area within the definitions of what an F1 car is that can be re-imagined and exploited for a gain in lap time. In opposition, the FIA technical team is there to determine whether that re-imagination conforms to the rulebook or contravenes it.

Bauer is sanguine about the nature of the game, though. "This is how it is," he says. "They have some very clever people and it's our job to try to understand how they work.

"If we see something, I'll discuss it with Charlie Whiting, and if we don't like it we'll advise the team to fix it. If we spot it in free practice we'll ask for it to be changed by qualifying. If they don't or if we find after qualifying that something significant is wrong, then we'll report it to the stewards as we have done in the past."

Bauer does admit that due to the difficulties of getting the hugely complex 2014 cars up and running he expects fewer attempts to push the rules envelope – at least initially.

"At the moment they're all trying to simply understand their cars, so I think at least in the first half of the season it's less likely. However, that doesn't mean we won't get to the stage of the teams trying to find loopholes again. As I said, they have all these incredibly smart brains working there, and we have to match them somehow.

"It is a constant battle," he concludes. "You can never un-invent the things they bring to cars, but you can make it harder for them to achieve the things they'd like to achieve." ■

MILLION DOLLAR MARQUES

The value of classic cars is rising faster than ever. ***Ben Barry*** *explores a new world of $50 million Ferraris and Gullwing goldmines*

Six years ago, not long before the recession bit hard, I assembled a selection of Porsche homologation specials for a photo shoot, then invited multiple Le Mans winner Derek Bell to drive them. Bell was particularly drawn to one car, the 1973 911 2.7 RS. He loved it, wore a broad grin as he lapped Rockingham race track, but couldn't quite believe its value. "One hundred and eighty thousand pounds?" gasped Bell. "Lovely car, but that's an awful lot of money for an old 911."

Last summer I drove that 2.7 RS again, and its agreed insurance value – not a nominal figure, but a sum that the insurance company was contractually obliged to pay out – had risen to £275,000.

Property stalled, stocks proved unpredictable and interest rates flat-lined, yet the prestige classic car market rocketed during the financial crisis. Auction sales of classic cars in the United States topped $1.2 billion (£720 million) in 2013, 25 per cent up on 2012 and nearly double pre-financial crisis levels. Last year, a Ferrari 250 GTO smashed previous records to sell for $52m (£31m). Aston Martin DB5s have seen tenfold increases in value over the past decade.

Prestige auction houses such as Bonhams and RM Auctions have never had it so good. "It's been great," says Max Girardo, head ▶

"SOME MODELS HAVE DOUBLED OR TRIPLED IN VALUE. IT'S GIVEN A LOT OF ATTENTION TO THE CLASSIC CAR SCENE"

MAX GIRARDO, RM AUCTIONS

auctioneer at RM Auctions, an organisation that sold approximately 1,000 classic cars last year. "Prices have gone up and up, some models have doubled or tripled in value, and it's given a lot of attention to the classic car scene."

Uncertainty elsewhere, restricted supply, and the widening appeal of sporting events such as the Mille Miglia and the Goodwood Revival – as well as prestigious concours events like Pebble Beach – have all driven the market.

"If I'd bought an imaginary portfolio of collectable classics five years ago ranging from a Mercedes-Benz 300 SL Gullwing to a McLaren F1 – iconic cars with limited build numbers – I'd be looking at a 2.5-fold growth in value," estimates Phil Bell, editor of *Classic Cars* magazine. "The problem is that as an enthusiast I'd rather keep the cars than bank the profit."

Not everyone sees it the same way, however. "More and more of our clients are looking at classics as a good place to put money," says Paul Michaels of Hexagon Classics. "People are spreading their risk: stocks and shares, diamonds, art... And it's now accepted that a good classic car is a solid investment. You can almost guarantee that a classic will appreciate in 12 months. I'm not talking about an MGB, but a high-end collectors' car."

For some, the spiralling prices are reminiscent of the 1980s boom that preceded '90s bust, when 'yuppies' bought classics as investments, driving prices ever upwards, only for the Wall Street crash of 1987 to ripple through markets and eventually tip those unsustainable prices into freefall. But trade experts – both those who stand to make money from ever-increasing values and impartial observers – are confident that this is not another bubble.

"The difference between the current boom and the one in the '80s is that buyers seem much better informed, chasing the best of the best rather than throwing money at also-ran models or poor examples," says Phil Bell.

"Of course, markets tend to be cyclical, and the resurgence of other asset classes could draw pure investor money away from the classic car market. But I see that playing out as a softening of the current boom, maybe a small dip. The reality is that there are ever-more people in the world with the resources to play at the top end of the classic car market, and they're chasing a finite resource. Long-term that can only mean growth."

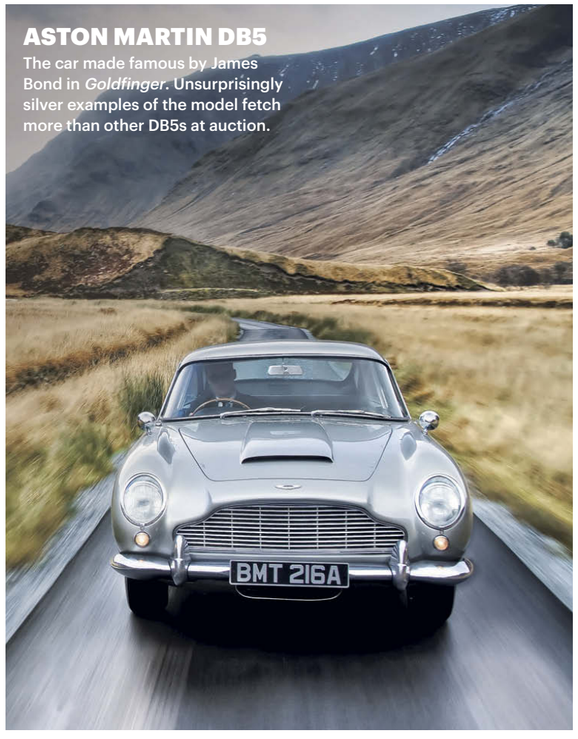
"The market has not over-expanded," adds Michaels. "It was dormant for a long time after the early '90s. Back then people borrowed money on a whim at up to 90 per cent of the car's value to make a profit. Now lenders don't usually go above 50 per cent, so people are far less likely to get in a rocky position. They've got more equity in their vehicles."

So what makes a great classic investment? Michaels recommends the bedroom wall test. "If it was a poster on kids' walls, that will make it a future classic," he says. "Post-war kids put Astons on their walls, and then you've got James Bond's DB5. The James Bond effect is such that a silver DB5 is worth more than other colours. There's an emotional aspect to it."

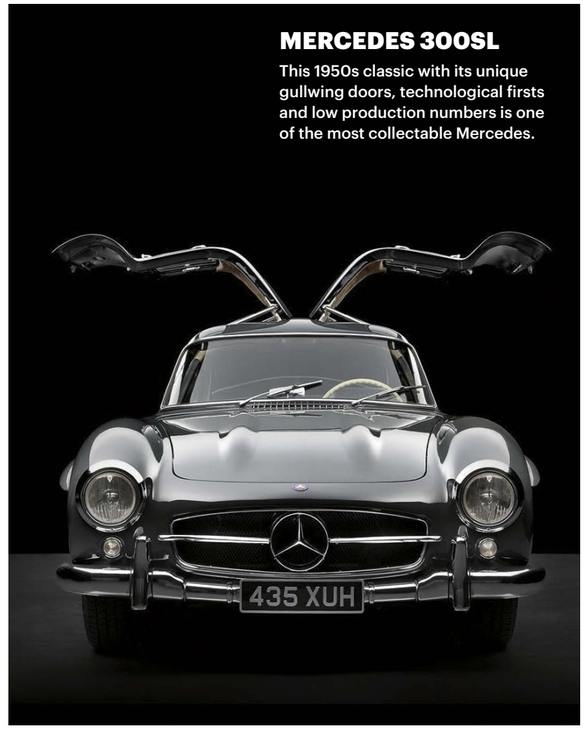
In fact, post-war models from the 1950s, '60s and '70s have shown the strongest gains, resonating with buyers who grew up in the era and now have the resources to buy a car synonymous with their childhoods. Limited supply, iconic badges, game-changing technology, peerless motor sport heritage, breathtaking design and fine driving dynamics all increase the likelihood of striking gold.

Some relatively affordable models have shown consistent incremental gains, such as post-war Alfa Romeos or Jaguar E-types. RM Auctions, for instance, recently broke ▶

FERRARI 250 GTO
The Holy Grail of classic cars... One example broke all records last year to sell for $52m, but then there are only 39 250 GTOs in existence.



ASTON MARTIN DB5
The car made famous by James Bond in *Goldfinger*. Unsurprisingly silver examples of the model fetch more than other DB5s at auction.



MERCEDES 300SL
This 1950s classic with its unique gullwing doors, technological firsts and low production numbers is one of the most collectable Mercedes.

UNDER THE HAMMER
Business is strong for prestige auction houses such as Bonhams and RM Auctions . Last year, RM Auctions sold approximately 1,000 classic cars.

PROTECTION AND PRESERVATION

One FIA group is working hard to keep classic cars on the road

The FIA's International Historical Commission (CHI) was first established three decades ago, and Michel de Thomasson has been its president for 10 of those years. With his team of 30 or so volunteers, de Thomasson aims to protect historic cars and ensure they can continue to be used in the modern world.

"The classic car market is developing very fast," he says. "More and more people are interested in them and prices have gone up a lot in the last four or five years, but we feel we have to protect these cars against two main issues: people who don't like them for road safety reasons, and others who accuse them of being polluters."

De Thomasson argues that the extremely limited mileage that historic cars travel and the cultural and historical importance attached to them far outweighs such concerns. He also cites a recent European investigation that found historic vehicles account for just a quarter of one per cent of all automobile emissions.

The Turin Charter – recognised by the FIA and drafted by the Fédération Internationale des Véhicules Anciens (FIVA) – encapsulates the goals of the CHI, giving recommendations as to the use, preservation and restoration of historic vehicles. It provides a coherent framework for their long-term survival, educating legislators and owners alike.

Working closely with FIVA, the CHI also compiled a list of Automobile Museums and special collections around the world, which is available at www.fiaheritagemuseums.com. The aim is to provide practical information on automobile museums for motorists, travellers, historic vehicle enthusiasts and motoring fans in general. FIA Clubs worldwide help to keep this list up to date.

all records for an E-type, selling one for $450,000 (£270,000) in New York, but the underlying trend has seen great examples of this classic British sports car increase from under £100,000 four years ago to £180,000 today.

Other than Aston Martin's DB5, classic Ferraris have been the star performers of the new boom, but not all have performed as consistently as others or are likely to repeat their gains over a similar period. Investors need to be canny.

"A Ferrari 275 GTB/4 has taken its whole life to get to £1m, then 18 months to get to £2m," explains Michaels. "You won't see that again in two years. But then you've got the Daytona, which seems too cheap at £500,000. It's the last great front-engined Ferrari, and it's 25 per cent of the value of a 275 GTB/4 and the only Ferrari worth less now than it was in the last boom. There's no logic to it. In a year's time they could easily hit £1m."

No Ferrari is more highly sought than the 250 GTO, the undisputed Holy Grail of classics and one that ticks every box. "There are only 39 in the world – you're in a club, it's beautiful to look at, magnificent to drive, and you can race it or drive it on the road," says Girardo.

Bell agrees: "For something guaranteed to seduce with its looks, set your every nerve-ending tingling when you drive it, conjure up heroic images of great racing victories and act as an entry ticket for the most exclusive events, I think $52m looks like a bargain compared to, say, a painting," he says. "And you can drive it to the pub."

People really do race and drive 250 GTOs, sometimes with predictably expensive consequences. In 2012, US billionaire and GTO owner Christopher Cox was involved in the world's most expensive car crash. His GTO, with its entire front-end removed, was being rebuilt at Ferrari Classiche when I visited in 2013. Established in 2003, Classiche is Ferrari's bespoke restoration division, the Italian manufacturer shrewdly tapping into the burgeoning values of its own back catalogue and offering owners the peace of mind of having their classic serviced and restored by the original manufacturer.

A key tenet of the Classiche business model is certification, with Ferrari validating the identity and authenticity of all road cars over 20 years old and every race car it has ever produced. Again, the logic is shrewd. "If someone is selling a car for several million dollars, why not spend a little more to authenticate it?" asks Christos Vlahos, who manages Classiche's US and Eastern markets. "For a buyer, it could seem suspicious."

Buying, enjoying and investing in a classic needn't mean spending seven- or six-figure sums, however. So which classic would Bell buy with a notional £30,000 to spend?

"It would have to be the 930-generation Porsche 911 Turbo," he says. "It seems an overlooked icon to me. That budget might not buy the purer first-generation 3.0-litre cars of the 1970s, but it should get you the even more powerful 3.3-litre version built from 1977-1990."

Before you rush to the local dealer with your life savings, however, we'll turn to Bell for a few final cautionary words.

"It's easy to be seduced by the classic car proposition – something that's a thrill to own and can make money," he says. "But the latter part of that equation depends on choosing a superb example of the right model, and keeping it in top condition. Allow it to deteriorate and the value will slump. Take on any significant restoration work and you could spend what the finished car will be worth, or more.

"The route to success means becoming an expert, or enlisting the services of one, buying carefully and finding a good specialist to look after your car. Get it right and it's a life-enhancing experience."

Get it wrong? You need only ask the investors who bought high in the early 1990s. ■

STYLE FACTORY

Ferrari has its own bespoke restoration division, called Ferrari Classiche. The Italian manufacturer has shrewdly tapped into the burgeoning values of its own back catalogue and offers owners the peace of mind of having their classic serviced and restored by the original manufacturer.

BATTLE TO BREATHE

The FIA Foundation is working with other global bodies to fight the growing problem of dangerous pollution levels in developing cities. And transport is as much a solution to the problem as one of the main causes

TEXT: AVI SILVERMAN

In India's capital, it's not the weather that people talk about so much as the air. For many, taking a clear breath is becoming an effort. Media reports from the city in recent weeks have suggested that it is facing apocalyptic levels of pollution. Doctors are regularly quoted in the press as saying that Delhi has been turned into a pollution zone so deadly that its children have the lungs of chain smokers and all the associated respiratory ailments.

Air quality readings seem to be attracting as much, if not more, interest than weather forecasts. In January, air pollution levels reached a critical high. Across the city's monitoring stations levels were categorised as threatening 'emergency conditions' for health. Of course, toxic air is not an issue peculiar to Delhi. In recent weeks, sections of the global media have been playing out a kind of macabre contest for the world's most polluted city with debate intensifying over whether Delhi or Beijing is higher up the rankings.

Fleeting interest from the world's media aside, the important point is that air pollution is becoming an ever-more acute issue for fast-emerging, rapidly urbanising economies. It is already of vital concern for sustainable development and it is an issue upon which transportation provides both a major cause and a key part of the solution. It sits with road traffic injury as a growing global policy concern, a focus on the negative impacts of the growth of transportation that need to be managed, and an increasing health burden for populations in low and middle income countries.

Air quality in the fast-developing regions of the world is one of the core issues addressed in the FIA Foundation's new 'Safe, Clean, Fair and Green' programme for sustainable mobility. Focusing on policy areas such as air pollution, road safety and fuel economy, at the core of the programme is a rejection of the business-as-usual approach to mobility. There is a recognition of the need to move on from the current model which is jeopardising public health, harming the environment and actually makes less economic sense in the longer term.

In collaboration with the FIA Foundation, the UN Environment Programme has been at the forefront of developing this new, more sustainable approach to transportation policy globally. On air pollution, dramatic gains can be made with cleaner fuels and vehicles. Road transport is one of the single largest contributors to air pollution. Proportions vary according to the city in question, but ▶

'DEHLI HAS BEEN TURNED INTO A POLLUTION ZONE SO DEADLY THAT ITS CHILDREN HAVE THE LUNGS OF CHAIN SMOKERS.'

it tends to be responsible for between 30-70 per cent of pollutant emissions. By the same token, however, road transport is also an area where, with the right policy approach, one of the greatest contributions to improving air quality can be made.

Anumita Roychowdhury of the Centre of Science and Environment (CSE) is a leading figure in research on Delhi's air pollution. According to Roychowdhury some progress on air quality had been made a decade ago with the introduction of Compressed Natural Gas (CNG) for the city's vehicle fleet. But this was short-lived.

"The gains from the introduction of CNG in 2000 have been lost," she says. "We are heading for dark days if policy-makers fail to wake up to the growing environmental health hazard. The new Euro-IV technology, which is the latest we have for cars, is still 10 years behind the technology being used in the US and Europe."

The CSE is a partner with the FIA Foundation in the UN Environment Programme's (UNEP) Partnership for Clean Fuels and Vehicles (PCFV), which aims to tackle air pollution resulting from road transport. The stakes are high not just for Delhi but other emerging cities. According to the latest research from the Global Burden of Disease published by *The Lancet*, 3.2 million people worldwide are killed each year by air pollution, with Asia accounting for the largest proportion of fatalities. Yet the health impacts could be dramatically reduced with relatively straightforward measures to clean up fuels and vehicles as prescribed by the PCFV.

The battle for cleaner air is very much a global one as far as UNEP is concerned. The PCFV has already had some notable achievements in promoting clean fuels. UNEP's partnership, with the FIA Foundation as a principal member, has succeeded in eliminating lead in fuels worldwide. The elimination of lead is one of the least known but most significant success stories for global health. A coordinated campaign led by the PCFV resulted in the phase-out of leaded fuel. An assessment of the programme by the California State University found dramatic benefits including 1.2 million fewer premature deaths, lower levels of criminality and improved performance in education among children.

As Achim Steiner, executive director of the UN Environment Programme explains: "Air pollution linked with dirty fuels and vehicles needlessly claims the lives and compromises the health of millions of people day in and day out. It is clear that the elimination of leaded petrol has been an immense achievement on par with the global elimination of major deadly diseases. This will go down in history as one of the major environmental achievements of the past few decades. It is a triumph of diplomacy and public-private collaboration."

The PCFV's task now is to mount a similar offensive on sulphur in a bid to clean up the air worldwide. To tackle particulate emissions, reducing the sulphur content of fuel is essential. To achieve this, the PCFV is addressing both fuel and vehicle technologies together in a 'systems approach', reducing sulphur levels and tackling diesel particulate emissions. The objective is to reach a sulphur target level in fuels of 50 parts per million. Complementing this is the promotion of vehicle technologies such as the use of particulate filters. The partnership has already been working with countries around the world in the reduction of sulphur levels in fuels and the aim is now to expand this work. Emphasis is to be placed on helping countries reach ▶

SAFE CLEAN FAIR & GREEN

NEW GOALS ON GLOBAL TRANSPORT

The FIA Foundation is busy planning for a greener future

The Millennium Development Goals (MDGs), which have driven international cooperation on tackling major health and education issues, reducing poverty and promoting human development, expire at the end of 2015. The United Nations is currently leading a global debate on what should replace the MDGs. The FIA Foundation wants to see targets and new partnerships to promote safe and sustainable transport included in the post-2015 'Sustainable Development Goals'.

The FIA Foundation's agenda is for 'Safe, Clean, Fair and Green' mobility for all. It believes that prioritising road safety and air quality can create safer and cleaner environments, reduce road traffic deaths and injuries, and prevent millions of premature deaths and serious illnesses caused by respiratory disease and other 'non-communicable diseases' related to a lack of exercise. On road safety, the Foundation is pushing for a 50 per cent reduction in road fatalities and injuries to be included in the new Goals. On air quality, the Partnership for Clean Fuels and Vehicles' (PCFV's) technologies and policies are aimed at achieving a target within the post-2015 Goals of bringing urban air pollution within World Health Organisation limits to an additional 1.5 billion people globally.

Prioritising vehicle fuel economy, the FIA Foundation plans to tackle climate change, improve air quality and reduce the world's reliance on fossil fuels, helping to deliver 'Sustainable Energy for All'. Here the target post-2015 is to double the global rate of improvement of energy efficiency in transport.

A focus on fairness – whether it is providing safe pavements for pedestrians, affordable and accessible public transport, or ensuring that car makers design safe vehicles for all consumers no matter where they live – is at the heart of the Foundation's approach. The FIA Foundation is an active leader in practical programmes and partnerships such as Share the Road and the PCFV which are designing solutions for 'Safe, Clean, Fair and Green' mobility. It is leading and supporting efforts to secure this agenda in a post-2015 development framework.

Research has suggested that 3.2 million people worldwide are killed each year by air pollution, with Asia accounting for the largest number of fatalities.

Children race through Dehli's streets as part of the Raahgiri Day event organised by residents.

the more advanced levels of emissions standards for vehicles as found in the EU.

"We know that the work is far from over," says Steiner. "The action led by the PCFV which is now underway is vital to tackle other health hazardous vehicle emissions, such as the unacceptably high levels of sulphur still found in fuels."

UNEP wants to see the PCFV's approach taken forward and extended so that harmful air pollution caused by vehicles can be tackled and significantly reduced.

Rob de Jong, the UNEP's head of transport, directs the PCFV's work. "We have now turned to the next phase of the challenge," he says. "As we look at the world map, there are still far too many countries with high levels of sulphur in fuels. This is simply not acceptable. So we're working with our partners, including the FIA Foundation, to clean up fuels and vehicles globally, reducing the level of harmful sulphur and particulate emissions.

"Emerging economies and urban centres around the world are witnessing dramatic increases in harmful particulate emissions, with the transport sector a significant contributor. Combating sulphur, just like leaded fuel, is entirely achievable but we need coordinated action."

For de Jong and UNEP, the PCFV is a leading example of what's required for a shift to a more sustainable approach to mobility and transport in the years ahead – the Safe, Clean, Fair and Green programme. It is in line with his philosophy on development as a whole.

Steiner wants to see the negative effects of development addressed, avoiding activity which results in the unintended consequences seen far too often, particularly action which results in further impoverishing the poor – the very people in whose names development programmes, technologies and policies are implemented. The concern is that often, too, development that is intended to bring economic progress also impacts on the environment. Of course in the long term all this undermines the objectives first intended, costing society much more.

As de Jong explains: "We see this with transportation. The current approach is unsustainable. In low and middle income countries, with the pace of development, transport and motorisation is expanding at a phenomenal rate. We're witnessing a rapid expansion of the vehicle fleet and vast development of road infrastructure. Too often this is poorly planned, unregulated and unsafe. The consequences are disastrous in human, economic and environmental terms."

Essentially, the aim is to see a paradigm shift in transportation, one which has safety and sustainability at its core. With air pollution, coordinated policies are needed globally in clean fuels and vehicles. Similarly, health and sustainable development objectives also inform UNEP's support for a new approach to safe transportation.

UNEP works with the FIA Foundation on a key road safety initiative known as 'Share the Road'. It's a project which epitomises the new approach to sustainable mobility. Essentially, Share the Road encourages investment in safe walking and cycling infrastructure and aims to integrate this fully within urban planning. There are multiple benefits, as de Jong explains: "With Share the Road we have been introducing safe walking and cycling facilities. These are low cost but effective infrastructure improvements such as separate lanes for cyclists, safe pavements and crossings for pedestrians. The objective is to link this with planned mass public transport facilities, to fully integrate this safe infrastructure in urban planning.

"There are of course multiple benefits with an approach like Share the Road. Safe infrastructure means a cut in road traffic injuries, relieving a burden on poorer members of society who are the worst affected. Indeed there are wider health benefits, with greater potential to encourage physical activity and tackle obesity. And in helping to move people from vehicle dependency we can also have an impact on air pollution, complementing the PCFV efforts.

"This infrastructure provides the access to jobs and services benefiting society and the economy. And it helps encourage a shift from transport that produces unsustainable levels of pollution and emissions to one which is cleaner for people and planet alike. It's not rocket science, but it is an example of the planning and investment that all too often is not being made. It gives us a glimpse of the advances that we could make by including measures like it in the new framework for global development."

The UNEP has played a leading role coordinating the briefing on sustainable transport, which was sent to the Governments meeting in New York to draft proposals for new 'Sustainable Development Goals'. Complementing this was the FIA Foundation's 'Safe, Clean, Fair and Green' programme, highlighting initiatives such as PCFV and Share the Road, along with broad agendas on road safety and fuel economy. The new Sustainable Development Goals will be finalised towards the end of 2015 and will then determine global policy priorities and financing for development. For those designing the Goals, the imperative is to find solutions – ways to tackle the big emerging challenges of the 21st century such as air pollution and road traffic injury. The task now is to further incorporate such initiatives into the new global agenda for development that is currently being negotiated at the United Nations.

"This exemplifies the approach that the UNEP has been taking when it addresses transport and mobility in the next phase of global development after 2015," says de Jong. "It's one which is entirely consistent with the FIA Foundation's 'Safe, Clean, Fair and Green' programme for the Sustainable Development Goals. This is a holistic approach and one which provides a new vision for development that truly benefits society, the economy and the environment."

Amid all the high-level focus on policy it's the impact on society and ultimately on people's lives that must not be forgotten. Dehli's residents are concerned that their streets are too often blanketed in smog, but hope is by no means lost. The public, it seems, has been taking the policy makers' words out of their mouths, already putting them into practice, demonstrating that a safer, cleaner vision of the future is perhaps achievable sooner than some may think. Even while air pollution was reaching record levels this year, people were taking to the streets in Delhi, calling for action.

Every week over several months now, Delhi's residents have been opening up the streets to people and closing them to traffic in a scheme to promote walking, cycling and exercise called 'Raahgiri Day'. Local resident Manas Fuloria says the aim is to seize the initiative in reducing pollution, making the streets safer and promoting healthier lifestyle choices. Standing in a cordoned-off street in the Delhi neighbourhood of Gurgaon, Fuloria struggles to make himself heard, not over traffic but among screaming children playing around him: "Yesterday the road was a river of cars and fumes, but today we have a river of people," he says. "Everybody is out with their kids and their parents, and it is a lovely sight to see them just having some fun." With this, the people of Delhi are showing what the vision can deliver on the ground, development centred on the needs of people, clearing the air and offering hope for future generations. ■

THE RIGHT MAN FOR THE JOB

The UN's Achim Steiner has a strong track record in tackling global environmental issues

Achim Steiner, executive director of the UN Environment Programme, is a major figure in international policy making. He has led the UN's Environment Agency since 2006.

Before joining UNEP, Steiner was director general of the International Union for Conservation of Nature from 2001-06, and prior to that secretary general of the World Commission on Dams. His career has included assignments with governmental, non-governmental and international organisations around the globe, including India, Pakistan, Germany, Zimbabwe, the USA, Vietnam, South Africa, Switzerland and Kenya. He has worked at grassroots and international level to address the interface between environmental sustainability, social equity and economic development.

Steiner, a German and Brazilian national, was born in Brazil in 1961. He has a BA from the University of Oxford and an MA from the University of London with a specialisation in development economics, regional planning, and international development and environment policy. He also studied at the German Development Institute in Berlin and the Harvard Business School.

During Steiner's tenure as UN under-secretary-general and UNEP executive director, UNEP has made significant strides from the launch of the Green Economy Initiative in 2008 to strengthening UNEP as part of the Rio+20 outcome, establishing the first international science-policy platform on biodiversity and ecosystems, adopting the milestone Minamata Convention on mercury, and producing influential environmental assessments and tools to guide political negotiation processes and policy development worldwide.

MINI'S GOLDEN YEARS

Alec Issigonis's little car ruled in the 1960s - particularly on the rally stages around Monte Carlo. And as time has passed so the Mini's appeal has endured

TEXT: DAVID EVANS

Fifty years on and he remembers it as clearly as if it were yesterday. Paddy Hopkirk will never forget the day the Mini changed his life.

Between the start and finish of the 1964 Monte Carlo Rally, the Belfast boy became a national hero. Fleet Street gave over its front pages and Sunday night television was his. But it wasn't all about Paddy – with that famous win came the realisation of the Mini's true potential.

"Nobody gave the Mini any chance," says Hopkirk. "It was up against the Mercedes, Porsche, Renault, Citroën and Saab. And here was this little Mini, which was originally designed to take midwives and district nurses around Britain. After Monte Carlo, everybody wanted one."

As the end of the last millennium neared, the Mini was voted the second most important car of all time behind Ford's Model T. Mini designer Sir Alec Issigonis would probably cede that one to Henry Ford, but not much more.

Having worked in secret on the Mini for two years, Issigonis delivered his plans to the British Motor Corporation (BMC), which put them into production in 1959. And almost immediately there was a desire to see the car competing.

BMC's competitions department was based out of Abingdon, close to Oxford in the UK, and headed up by Marcus Chambers. But Chambers remembers there wasn't much of an appetite for the original Mini.

"A Mini 850 was delivered," he recalls, "and it stayed in the car park for several days, nobody rushed to drive it..."

Why would they? The 850 could only muster 34bhp from its 848cc engine and lined up next to it in the car park would have been a variety of Austin Healeys, with the 100-Six and 3000s offering six or seven times the power.

But once they took the plunge, the Mini delivered. Especially once John Cooper came along. Having helped change the face of Formula One with the Cooper Climax, Stirling Moss and Jack Brabham among others, Cooper turned his attention to his friend Issigonis's small car. And the focus ▶

Paddy Hopkirk powers the Mini along the harbour front at Monte Carlo in 1964, en route to a front-page news win.

of that attention would come under the bonnet. While Cooper was credited, BMC's Cliff Humphries was also an essential part of the Mini's engine development programme.

The 848cc capacity was increased to 997 by the addition of a longer stroke, with twin carburettors boosting power towards 60bhp. Straight-cut gears helped strengthen the transmission to deal with the added grunt, while disc brakes at the front helped to slow it from previously unseen speeds.

The 850 had been homologated in September 1959 and offered little in the way of success, with Nancy Mitchell posting 54th place on the car's international rally debut in Portugal. However, all that changed two years later with the arrival of the Mini Cooper.

"It was a beautiful car to drive," says Hopkirk, "and it was new technology at the time, with the engine placed over the top of the driving wheels."

Prior to the Mini the propshaft had been king, but Issigonis binned that in favour of a far more compact engine-transmission layout – which included the gearbox being housed in the sump. Only Saab's 96 competed in a similar front-engined and front-wheel drive format, although Lancia followed in 1966 with the Fulvia. Elsewhere, however, it was all about oversteer for the Healeys, Porsche's 911, the Alpine-Renault (which did have the engine's mass over the driven wheels – just at the back of the car) and the Lotus Cortina and subsequent Escorts.

"The traction you could get from the Mini, particularly in really tricky conditions, was sensational," continues Hopkirk. "And the handling was incredible."

It wasn't long before that incredible handling was put to good use. With the team now run by Stuart Turner, Rauno Aaltonen was drafted in and came close to landing second overall on the 1962 Monte Carlo Rally. Unfortunately, he rolled out near the finish.

It was Sir Stirling's sister (and the soon-to-be Mrs Erik Carlsson) Pat Moss who removed the monkey from the Mini's back with victory on the 1962 Tulip Rally, an arduous and well-attended Dutch international.

A year on and the 1071cc Cooper S arrived. Not only did this car offer more power, but importantly it offered extra torque, allowing it to carry more speed through the corners – especially with a left-foot-braking Finn at the wheel.

This was the car that Hopkirk used to win the Monte in 1964, arguably the Mini's greatest ever result. Hopkirk himself feels his third place on the Tour de France a season earlier was almost as big a turning point.

"We were at Earls Court for the motor show," says Hopkirk, "and I'm really not sure the folk at Longbridge (the Birmingham base of BMC) had much of an idea about the way motor sport was working. The French came over and were expected to buy one or two cars, but they were buying 200... The Tour de France rally and then, obviously, the Monte Carlo got BMC a huge amount of publicity. All those trendy Parisians wanted to be seen driving about in a Mini." ▶

"THE TRACTION YOU COULD GET FROM THE MINI WAS SENSATIONAL. AND THE HANDLING WAS INCREDIBLE."
PADDY HOPKIRK

Hopkirk and co-driver Henry Liddon's giant-slaying victory on the '64 Monte Carlo Rally was the first of three in the principality for the British marque.

MINI MARVEL
Hopkirk's Mini was a focal point at Monte Carlo in '64. Right: Hopkirk celebrates victory with co-driver Liddon, fresh off the plane and back at base (below). Far right: John Lennon takes a spin in band mate George Harrison's psychedelic Mini.

A CAR FOR THE STARS

The Mini was the automotive face of the Swinging Sixties, and therefore a must-have for the rich and famous

Clint Eastwood, Twiggy, King Hussein of Jordan, Spike Milligan and The Beatles make for quite an eclectic mix. But they were all brought together by a common love of one car: the Mini.

The world came alive in the 1960s and the Mini provided the ultimate automotive wake-up call. BMC couldn't build them quick enough for a nation – and a wider world – rediscovering disposable income and the open road. And the story's still going strong today. The Mini was different to anything else when it arrived in 1959. It was small, funky and fun.

Sold across the world, everybody wanted a Mini. At a time when swinging London was fast becoming the cool capital of the world, this car brought a slice of Carnaby Street to roads around the globe.

And if there was ever any danger of sales dipping, the big screen provided a timely boost in 1969 with the release of *The Italian Job*. The world delighted in watching Michael Caine direct three Mk I Cooper Ss around Turin to give the Italian police the runaround.

Today the stars still can't say no, whether it's a classic Cooper or a new-shape Countryman. English fashion designer Paul Smith and former The Jam frontman Paul Weller have both designed colour schemes for Minis, while Madonna wrote about her Mini Cooper in the song *American Life*.

Cult status isn't hard for a car to achieve, but few motors have managed to go on to become a style icon in the way the Mini has.

Hopkirk's Monte win was huge news, but it also marked the end of the 1071 car. The ultimate Mini, the 1275cc version, was waiting in the wings. By the start of 1964 the Mini was a ubiquitous tool in motor sport. Courtesy of the widespread distribution of the car, much of the development work was done privately, but with teams sharing information with Abingdon and vice-versa. The 1275 S, which offered as much as 100bhp in Group 2 form, was much more a product of the competitions department.

And it was a winner on its debut, when Timo Mäkinen won the Tulip Rally in 1964. One of Timo's finest performances came on the following year's Monte Carlo Rally, when he destroyed the opposition amid blizzard conditions to score the Mini's second consecutive win in the Alps. But there was more to the Mini than winning in the mountains. Three consecutive 1000 Lakes victories provided ample proof of the car's abilities on fast gravel, while a Hopkirk Acropolis Rally victory in 1967 showed it could handle the rough stuff as well.

Between those years was the chance of a Monte hat-trick in 1966. It looked like the British-built machine had achieved it in fine style – following trademark thorough preparations for the team and cars – with a podium lock-out for Mäkinen, Aaltonen and Hopkirk. But in post-event scrutiny all three cars were infamously kicked out, leaving Citroën driver Pauli Toivonen the winner. The problem with the Minis? They were found to be running non-dipping, single filament quartz iodine headlamp bulbs instead of double-filament dipping bulbs.

At the time Mäkinen said: "None of us dreamed the stewards would turn the results upside down – and for such a stupid reason."

One British official went further, stating: "This will be the end of the Monte Carlo Rally."

It wasn't, of course. And neither was it the end of the Mini on the Monte Carlo Rally. Aaltonen came back and won in 1967.

During this golden age of motor sport, it wasn't uncommon for drivers to switch codes regularly during the same season. Hopkirk, for example, was a regular in the British Saloon Car Championship and Aaltonen shared a Mini with Bob Holden to win the Gallaher 500 at Bathurst, Australia in 1966. Later that year Formula One World Champion Graham Hill drove a works Cooper S on the 1966 RAC but failed to make the finish, retiring in the Lake District.

As the '60s wore on the Mini struggled to maintain its pace against increasingly powerful rivals from increasingly committed manufacturers. BMC's competitions department was closed in 1970 and that appeared to be the end of Mini in the World Rally Championship.

That was until British preparation firm Prodrive built a Mini John Cooper Works WRC in time for the 2011 season. The car worked well out of the box and scored two second places at the highest level. While the factory effort has ended, Minis are still seen in private hands in the WRC, while the '60s are revisited around the world in historic events.

Other makes can claim a richer and better-rewarded history in motor sport, but few rally cars still evoke such emotion as the Mini. And its legacy grows greater as the years pass by. ■

AUTO REPORT: CES 2014, LAS VEGAS

A FUTURE IN SAFE AND SUSTAINABLE HANDS

Laser lights, solar hybrids, hydrogen power - car manufacturers are using the Consumer Electronics Show as a launch pad for new automotive technologies, many of which are geared towards creating a safe and sustainable future on our roads.

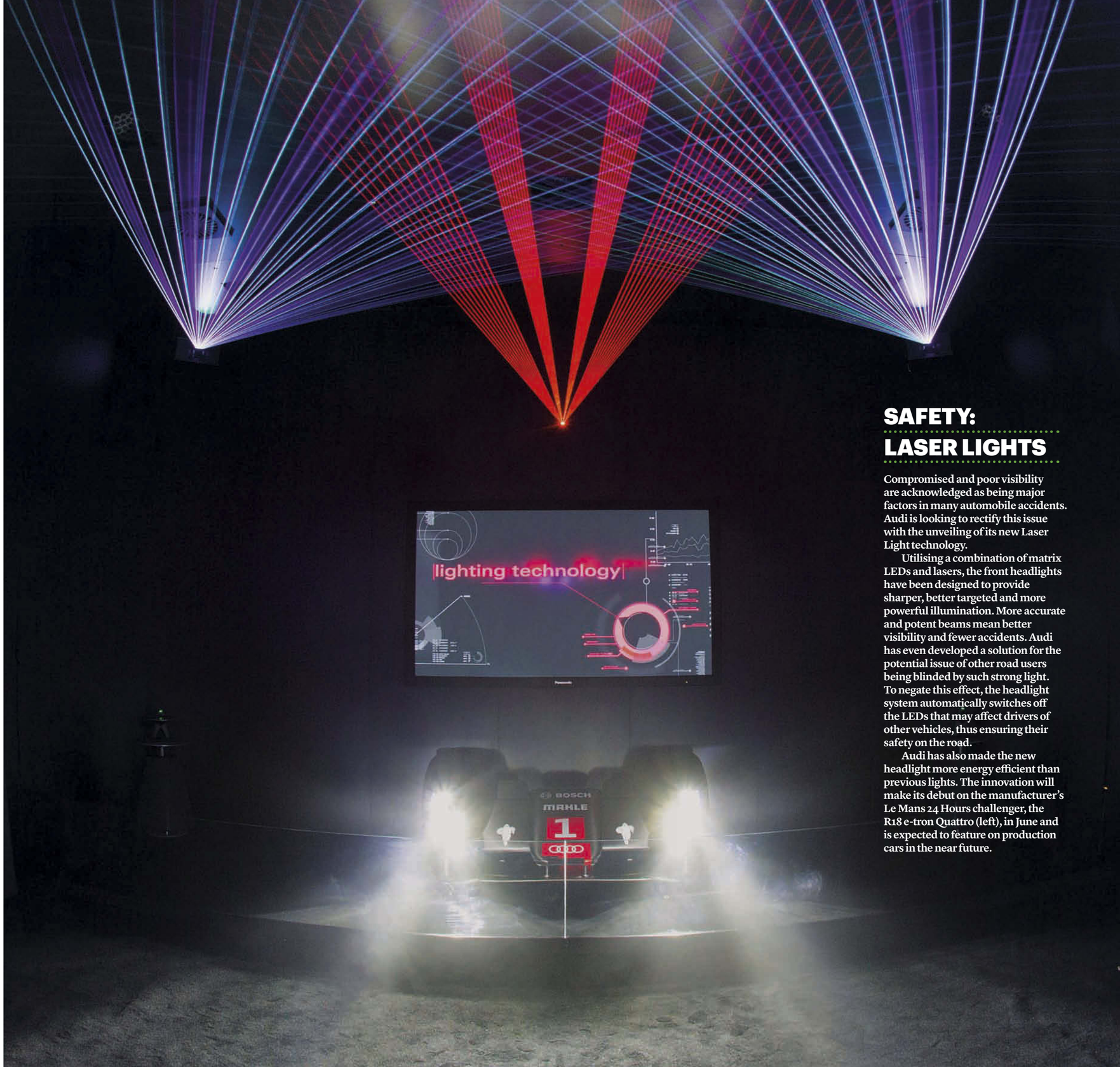
TEXT: MARC CUTLER

The opening months of a new year are critically important for car manufacturers, a time when the latest technological advances are announced and exhibited. In the past, these technologies have been displayed at auto shows globally. But a new forum has emerged for car makers to launch their latest innovations.

The Consumer Electronics Show (CES) has been held annually since 1967 but car manufacturers have recently commandeered the platform to present their latest advances, many of which are facilitating improvements in road safety and sustainability.

Starting with a small automobile presence in the mid-2000s, the Las Vegas-based show now attracts some of the world's largest car makers including Audi (which gave two keynote addresses), BMW, Ford and Toyota. Marques have used the platform to launch a wide range of technologies, with ground-breaking innovations such as driverless technology debuting at CES 2013.

This year's show, held on 7-10 January, featured a record nine manufacturers. AUTO took a look at some of their latest innovations aimed at safety and sustainability.



SAFETY: LASER LIGHTS

Compromised and poor visibility are acknowledged as being major factors in many automobile accidents. Audi is looking to rectify this issue with the unveiling of its new Laser Light technology.

Utilising a combination of matrix LEDs and lasers, the front headlights have been designed to provide sharper, better targeted and more powerful illumination. More accurate and potent beams mean better visibility and fewer accidents. Audi has even developed a solution for the potential issue of other road users being blinded by such strong light. To negate this effect, the headlight system automatically switches off the LEDs that may affect drivers of other vehicles, thus ensuring their safety on the road.

Audi has also made the new headlight more energy efficient than previous lights. The innovation will make its debut on the manufacturer's Le Mans 24 Hours challenger, the R18 e-tron Quattro (left), in June and is expected to feature on production cars in the near future.

AUTO REPORT: CES 2014, LAS VEGAS

SUSTAINABILITY: SOLAR HYBRIDS

Hybrid cars utilising solar energy are not a new concept but owing to efficiency concerns they have never made a serious impact. Ford believes it has a solution and debuted its new C-Max Solar Energi Concept at CES 2014.

Taking the base C-Max Hybrid model, the company has placed solar panels on the roof. But to maximise the effectiveness of these, Ford has developed a separate off-vehicle 'solar concentrator'. Made of plastic, the five-metre tall canopy focuses the sun's rays onto the roof-mounted solar panel allowing for speedier charging. The lens will follow the sun from east to west ensuring maximum effectiveness, and Ford's researchers believe the 'concentrator' will boost the impact of sunlight by a factor of eight.

The solar panels will not deliver enough battery life for the car to be powered solely by sunlight, so it will also feature a conventional electric charging socket. Testing will now begin to see if it is feasible for production, meaning we could see this technology on commercial vehicles in the next few years.

SAFETY: DRIVER FOCUS

A number of technologies launched at CES 2014 looked at cabin design innovation. Kia focused on advanced safety features involving the driver, unveiling its User-Centred Driver concept (UCD).

The system is designed to keep the driver's eyes on the road, eliminating key distractions such as radio or GPS use, which can be a major factor in traffic accidents. The intuitive interface features all vital information such as speed, navigation and traffic information on an 18-inch Head-Up Display (HUD) and is easily controlled through simple hand or finger movements.

SUSTAINABILITY: TRAFFIC MANAGEMENT

Intelligent traffic management systems are forecast to become an important method of reducing emissions. Audi held a display of its Traffic Light Assist system on the Las Vegas strip (above). Linking to a city's traffic light network, the system informs the driver, via the dashboard, what colour the next traffic light is and when it will change. It tells the driver the correct speed to choose to help with braking or acceleration, thereby reducing the work of the engine and cutting emissions.

AUTO/ FOCUS

AUTO REPORT: CES 2014, LAS VEGAS

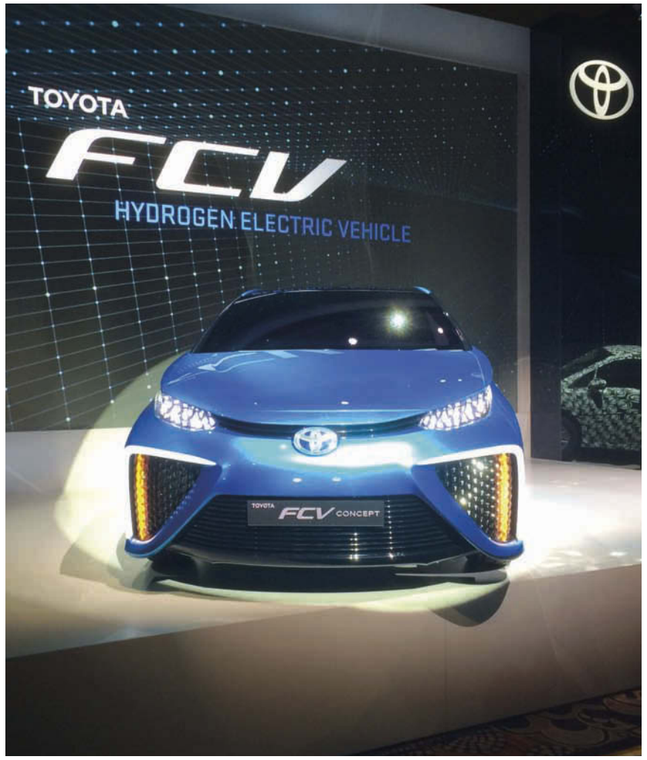
SUSTAINABILITY: HYDROGEN POWER

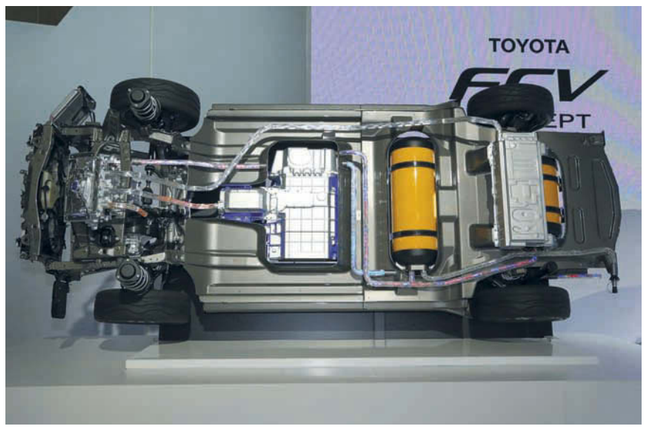
Hydrogen-powered vehicles have long been talked about as a possible replacement for gas-powered vehicles, but stumbling blocks over cost and infrastructure have proved divisive among car manufacturers. However, with the single emission being water vapour and refuelling times of three to five minutes, the technology has clear advantages over other sustainable or renewable fuels.

Toyota caused a major stir at the CES with its hydrogen-powered, Fuel Cell Vehicle (FCV). The car features two hydrogen tanks (below) that mix with oxygen to produce 100kW of electricity. Toyota believes the car will accelerate from 0-60mph in 10 seconds and have a range of 300 miles. It has also stated that there will be a 95 per cent reduction in production costs from 2012 levels, thus driving the technology towards a more affordable level for the average car user.

The Japanese manufacturer is planning to launch the car in 2015, focusing initially on California, due to the state's commitment to building at least 20 new hydrogen refuelling stations by 2015 and a further 80 by 2024. Bob Carter, senior vice-president for Toyota's automotive operations in the US, said: "The issue of infrastructure is not so much about how many, but rather location. If every vehicle in California ran on hydrogen, we could meet refuelling logistics with only 15 per cent of the nearly 10,000 gasoline stations currently operating in the state."

Indeed, if the cost and infrastructural difficulties that have plagued hydrogen technology can be overcome, then Toyota's FCV could become a major figure in the attempt to reduce fossil fuel emissions in road-going vehicles.





SAFETY AND SUSTAINABILITY: DRIVERLESS TECHNOLOGY

The predominant focus of car manufacturers at the CES show was undoubtedly driverless technology. The technology still has a long way to go to becoming fully autonomous but many of the advances presented in Las Vegas are slowly beginning to push humans out of the driver's seat.

Perhaps the greatest benefit of this rapid advancement is in the area of safety. Last year, a study by the Eno Centre for Transportation found that if only 10 per cent of cars on US roads were robotic there would be around 1,000 fewer deaths per year. Figures such as this highlight the importance of advances in driverless technology and why car manufacturers have put so much emphasis on their recent development.

Two manufacturers produced versions of pre-existing vehicles adapted to feature driverless technology. Audi launched an A7 concept car which ran on a Las Vegas freeway while being controlled by its computer system. The car is not fully driverless as it requires a driver when travelling over 40mph, but it has an intelligent autopilot system that can replace the driver under this speed. Using lasers and a radar to scan the road in front and mounted cameras to check blind spots, the vehicle is capable of staying in lane and slowing down for any obstruction in front, eliminating the possibility of an accident.

BMW took the autonomous 6 Series to a Las Vegas race track (above), demonstrating the technology's potential even at high speeds. Engineers from the German company pre-programmed a GPS route into the car but allowed its automated systems to handle throttle, brake and steering inputs. The vehicle even negotiated a low-grip wet corner, seamlessly drifting around it while remaining perfectly balanced on the edge of traction.

Non-road-going autonomous vehicles were also on show. French company Induct brought over the electric Navia shuttle, capable of carrying 10 passengers at a top speed of 12.5mph. With its low speed but ample space, the shuttle is designed to be an environmentally-friendly vehicle used at university campuses, airports and car parks.

Eliminating accidents or incidents when parking was also a key focus. BMW displayed a self-parking package that will not only park cars autonomously, but can locate a parking spot for its driver. Bosch, which sponsored the driverless car exhibition, demonstrated an app-controlled, self-parking technology. Stepping out of the car once a space is found, the driver selects the app on their smartphone and the car then parks itself with the help of ultrasonic sensors and video cameras. This represents a combination of autonomous technology and mobile integration most car makers are striving to perfect.

While many of these innovations are in their infancy, car makers are developing them at an impressive speed. Such concepts are set to become reality in production cars in the next few years, and the safety and sustainability of road use will be better for it. ■

Freeze frame

F1'S FIRST TASTE OF TURBOS

This season, for the first time in 26 years, Formula One will be turbocharged. Characterised by massively fast, powerful machines, the technology of the first turbo era got off to an explosive start...

It was an inauspicious debut. Midway through practice for the 1977 British Grand Prix, Jean-Pierre Jabouille steered Renault's new turbocharged RS01 into the pits, wreathed in smoke. "Ken Tyrrell just laughed," said Jabouille. "He called it a teapot!"

The smoke soon cleared. Despite qualifying 21st and exiting the race when the turbo blew after 16 laps, Renault persevered with the car that became known as the Yellow Teapot. The French company gave the RS01 four more outings in 1977, all of them unsuccessful, so much so that at the penultimate round in Canada, the RS01 failed to qualify. Tyrrell's guffaws were echoed by rival engineers and an increasingly sceptical media.

Renault and Jabouille would have the last laugh, though. A much-improved RS01 took its first points at Watkins Glen in 1978, where Jabouille came fourth, and by the start of '79 it was becoming a force to be reckoned with. Jabouille took pole at Kyalami, before engine failure struck again.

Renault also had an ace up its sleeve – a successor to the fragile RS01. The RS10 made its debut at the 1979 Monaco Grand Prix, and five weeks later Jabouille, joined by René Arnoux in a second Renault, scored the team's first victory. The writing was on the wall for normally-aspirated cars.

Ferrari introduced its first turbo car in 1981, and by '83 the technology ruled, Nelson Piquet winning the title in a BMW-Brabham. Turbocharged engines dominated the next five years of racing, with rumours of 'one-lap' specials developing 1400bhp for qualifying.

The party ended in 1989 when turbos were banned from F1. Now they're back in the latest engine formula to be introduced to the sport. These new turbos might be just one element in a highly complex, full hybrid 1.6-litre power unit, but you can still cast an eye back to that first decade of screaming, 1000bhp-plus monsters and smile at the memory of the Yellow Teapot.

PHOTOGRAPHY: DPPI

THE CAR: RENAULT RS01

Formula One's rules in the mid-1970s specified the use of normally-aspirated 3.0-litre engines, although a dusty clause also allowed teams to utilise a supercharged or turbocharged 1.5-litre powerplant. No company had chosen to explore the possibility until a group of Renault engineers convinced then-company chairman Bernard Hanon to bring a turbocharged car to F1.

Initial tests were frustrating, however. "Many times I did two laps, three laps, and the engine went bang," said Jean-Pierre Jabouille. "But then I tried it in Jarama just after the GP there, and the times were getting better and better. And we made the decision to race it."

THE DRIVER: JEAN-PIERRE JABOUILLE

Jabouille's contribution to Renault's programme cannot be overestimated. A qualified engineer, the Parisian came to Renault's F1 project having won the 1976 Formula 2 title in an Elf-sponsored Renault. Considered a good technician as well as a competitive driver, he was charged with giving Renault's fledgling F1 crew as much feedback as possible, something engine designer Bernard Dudot says he excelled at.

"At the time we had no telemetry and the only information we had came from the driver," he said. "The operation of a turbo engine depends on the interaction between the speed and temperature of the exhaust gases, themselves a function of the fuel dosage and ignition advance. Jean-Pierre's ability to analyse this complicated process was enormously helpful to our progress."

Jabouille made 47 starts for Renault before a serious crash at the 1980 Canadian Grand Prix led to his eventual retirement.

He managed Peugeot's sportscar programme in the early '90s and took over from Jean Todt as Peugeot Sport director in 1994, before starting his own sportscar team.

THE ENGINE: RENAULT EF1

Developed from a 2.0-litre unit used in sportscars and Formula 2, the EF1 engine suffered with a number of problems that Renault spent many years ironing out. Chief among them was turbo lag (the difference in time between the throttle being activated and the turbo spinning up).

While lag would remain a problem throughout F1's first turbo era, the issue was largely cured in Renault's cars via the installation of twin turbos. "With an aspirated engine you control everything with the throttle," said Jabouille. "With a turbo engine you controlled nothing. You touched it, nothing. You touched it some more, nothing. You touched it a little more, and vroom, everything! The solution was when we put two turbos in for 1979."

THE RACE: 1977 BRITISH GRAND PRIX

"I was realistic arriving at Silverstone," said Jabouille of the Renault RS01's debut. "I knew we would eventually be successful, but first of all I wanted to finish races. We made our debut, we weren't a disgrace, we were in the middle of the pack. At the end of a certain number of laps what we expected happened: the engine broke with a nice cloud of smoke, which made everyone laugh."

It wasn't just the engine and chassis that were unproven. The team, too, was vastly inexperienced as Dudot recalled: "We had a young team and we saw some extraordinary things: air lines to air bottles being snagged by wheels or wings coming off. At the start we had all that to learn, but we had something which was indispensable: youth, enthusiasm and a free spirit. You need that to succeed in such projects."

AUTO / GRAPH

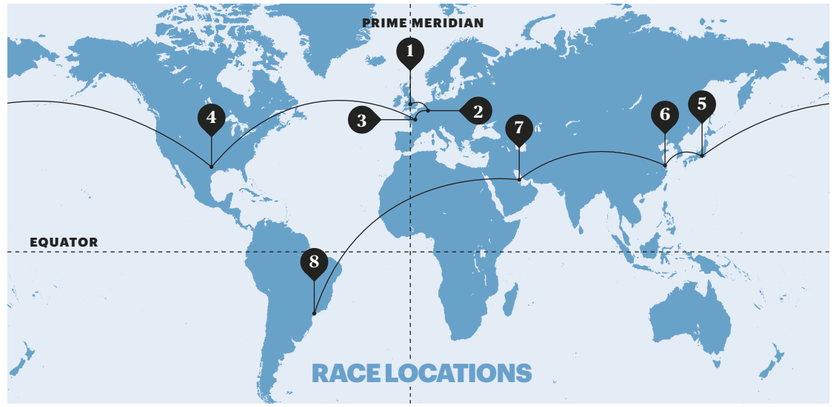
Now in its third year, the WEC maintains a global appeal while attracting exciting new technologies to the sport

FIA WORLD ENDURANCE CHAMPIONSHIP

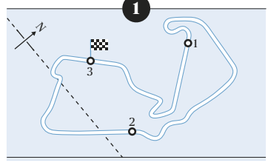
IN NUMBERS

8
RACES

The FIA has maintained continuity for the WEC's third season, with eight rounds in Europe, Asia, North and South America and the Middle East. With the series looking to expand into new territories, just two tracks and one race remain from the first year of the original World Sportscar Championship series in 1953, which featured 24-hour rounds at Le Mans and Spa that year.



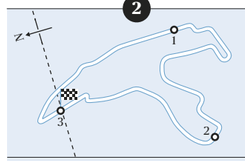
1 — 20/04/14 SILVERSTONE



UK | 6 hours

Track length: 0(km) — 15 — 5.9km

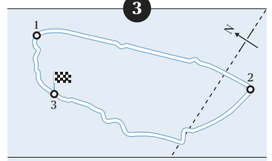
2 — 03/05/14 SPA-FRANCORCHAMPS



Belgium | 6 hours

Track length: 0 — 15 — 7km

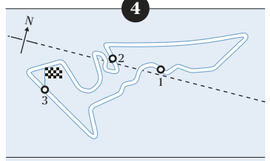
3 — 14/06/14 LE MANS



France | 24 hours

Track length: 0 — 15 — 13.6km

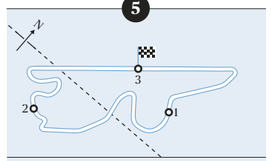
4 — 20/09/14 CIRCUIT OF THE AMERICAS



USA | 6 hours

Track length: 0 — 15 — 5.5km

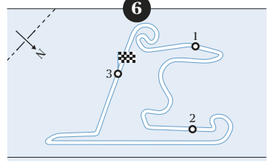
5 — 12/10/14 FUJI SPEEDWAY



Japan | 6 hours

Track length: 0 — 15 — 4.6km

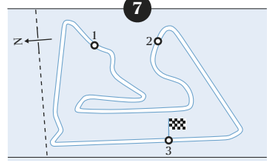
6 — 02/11/14 SHANGHAI INTERNATIONAL CIRCUIT



China | 6 hours

Track length: 0 — 15 — 5.5km

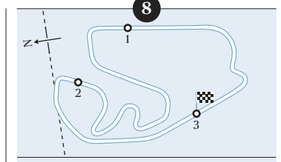
7 — 15/11/14 BAHRAIN INTERNATIONAL CIRCUIT



Bahrain | 6 hours

Track length: 0 — 15 — 5.4km

8 — 30/11/14 AUTODROMO JOSÉ CARLOS PACE

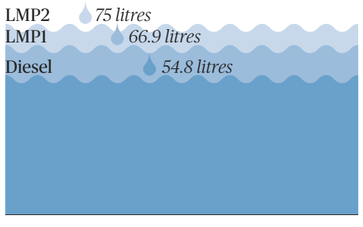


Brazil | 6 hours

Track length: 0 — 15 — 4.3km

1
ENGINE TYPE
For all seven LMP2 cars - the Zytek-developed 4.5-litre Nissan VK45DE

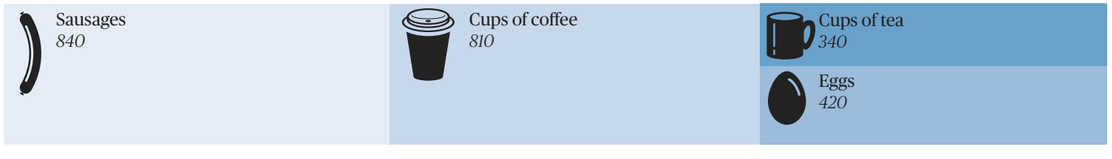
FUEL CAPACITY



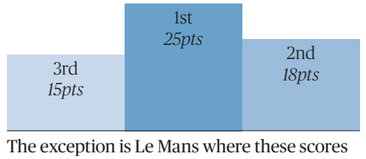
31
CARS

A healthy 31 cars are entered for the 2014 season, headed by nine LMP1s. Strakka Racing returns to LMP2 with a Dome-designed Zytek-Nissan. The GTs are again divided into Pro and Am classes fielded by Ferraris, Porsches and Aston Martins.

ON THE MENU
The food and drink consumed during Le Mans week by one privateer team



PODIUM POINTS



The exception is Le Mans where these scores are doubled for the 24-hour enduro. The other rounds consist of much shorter six-hour races.

GARAGE 56 LOOKS TO THE FUTURE
Traditionally, garage 56 is reserved for a technologically futuristic car at Le Mans that does not comply with existing regulations. This year the slot goes to the Ben Bowlby-designed three-cylinder hybrid Nissan ZEOD RC, the first Le Mans car capable of a lap of the circuit using nothing but electric power.

3
CLASSES

LMP1
A test bench for the latest prototypes

LMP2
The 'little prototype' class boasts diversity

LMGTE
A class dominated by top sports car brands

3 MANUFACTURERS ENTERED IN LMP1
There are now three marques capable of winning in the top class, with Porsche joining Audi and Toyota in the new LMP1-Hybrid category exclusive to manufacturers using energy recovery systems. Privateer LMP1 teams are also back. Rebellion Racing has teamed up with Oreca to build its own car, while the Kodewa team steps up from LMP2 with its Lotus-branded T129-AER.

LE MANS 2013
10,000
OVERTAKING MOVES

21–68
AGE RANGE

1 GRAND PRIX WINNER IN THE 2014 WEC
Last year, the number of former F1 drivers at Le Mans topped out at 16, with Alan McNish taking his third win. None, though, were grand prix victors. That changes this season with the arrival of nine-times GP winner Mark Webber, who will race a factory Porsche 919 Hybrid in the full WEC. ■

Edward Goossens of sustainable racefuel supplier GUTTS, which last year succeeded in reducing the carbon footprint of the FIA Junior WRC Championship by 24,455kg of CO2 with the help of its partners Abengoa, BioMCN, Eurol, Methanex and the Methanol Institute.

Sustainable Fuels

JEWEL OF A FUEL

Last year the Junior WRC's move to biofuels saw carbon emissions drop by 70 per cent. Now Edward Goosens of fuel supplier GUTTS wants to take things a stage further...

Q **What did you hope to show through your involvement in the Junior WRC?**
A Very simply we intended to demonstrate that rallying at world championship level can be as spectacular and as fast as everybody is used to while reducing CO2 footprints dramatically by using a smart multi-blend biofuel. We did that by reducing carbon emissions by 70 per cent.

Q **How is the fuel used for the Junior WRC formulated? What makes it sustainable?**
A The concept was dreamed up by Lotus engineering some years ago. They were researching alternatives for a fuel called E85, which is 85 per cent ethanol and 15 per cent gasoline, and they wanted to replace part of the ethanol with an even greener alternative, bio-methanol. We took that idea forward.

The bio-methanol used in our fuel in 2013 is made out of glycerine. All plant and animal fats contain glycerine, so if you have that in large enough quantities you can extract the glycerine and turn it into liquid methanol, bio-methanol. It is waste oil, frying oil and, for example, leftover waste from the meat industry. The ethanol we use is a wheat-based ethanol and the inedible parts of the wheat harvest are turned into fuel.

One hundred per cent of the fuel comes from waste materials, so you get a very low CO2 footprint.

Q **How was the performance of the cars compared with those using fossil fuels?**
A We worked together with (2013 Junior WRC vehicle supplier) M-Sport and we developed good mapping for the engine that showed a bit of horsepower increase and very good efficiency. The drivers were very happy, especially on the long, hard gravel rallies like Greece, where you have long uphill sections and fast corners. They stated that they could leave it in a higher gear and trust the engine on this fuel to get them through a bend. From a technical point of view people were happy with the fuel.

Q **Were there any logistical constraints?**
A The fuel volume is a little bit larger so we needed to think about some remote refuelling options and we had to alter the fire extinguishers in the cars. Alcohol-based fuel works a bit differently, so you need a special foam to put a fire out. All the fire extinguishers were refilled with AFFF foam, and homologated by the FIA.

Q **What is your hope for the fuel now?**
A My hope is that we continue in the World Rally Championships, supplying fuel to a junior series, because I really believe in the idea of pairing future fuel and future champions. We are working hard on that. Beyond that it's about running the biofuel to make a connection with good research – digging deep, getting results on the efficiency of the fuel in race car engines, and getting some good knowledge.

Q **And applying that to road car use?**
A That is a big part of it. An equally big part is the EU policy on fuels. There are maximum percentages of ethanol and methanol that you can blend into a fuel. The volumes of alcohol allowed are increasing but it is at a leisurely pace, so by demonstrating that you can use these fuels in motor sport, you can show that there is no technical limit. That's connecting the motor sport world to the policy world in showing the way forward.


FIA
SPORT
CONFERENCE
2014
MUNICH
24-26 JUNE
FIA SPORT CONFERENCE MUNICH 24-26 JUNE
PRESENTS
FIA
SPORT
MOTOREX
2014
COMPETITION
EXPERTISE
BUSINESS
NETWORK
The second edition of FIA Sport Conference will see the launch of a brand new exhibition for meeting and networking: the FIA Sport MotorEx. This is a unique opportunity to meet the authorities that are responsible for the purchasing, prescription, regulation, selection and certification of motorsport at the national and international level.
BE THE FIRST TO BE PART OF THIS UNIQUE EVENT IN THE MOTORSPORT CALENDAR
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