



ELECTRIC COMPANIES

Pushing the boundaries of electric car development with Formula E's new manufacturers P30

FUEL CELL FUTURE?

Once prohibitively expensive and unwieldy, new research is making hydrogen fuel cell cars a real world alternative P42

CROWD PLEASER

AUTO goes to France with the fans to chart the rise and rise of the FIA World Rallycross Championship P48

FINNISH LINES

One of motor sport's original Flying Finns, rally legend Timo Makinen looks back on a glorious career on the biggest stages P60

AUTO



P36

FROM RACE TO ROAD

HOW MOTOR SPORT'S SPIRIT OF
INNOVATION IS IMPROVING EFFICIENCY
AND SAFETY ON THE ROAD



THIS WATCH HAS SEEN MONTHS OF HARD-FOUGHT RACING. DAYS AND NIGHTS SPENT PERFECTING. AND THE SECONDS THAT CAN MAKE OR BREAK A SEASON. IN THE QUEST FOR MOTORSPORT'S ULTIMATE CHAMPIONSHIP.



OYSTER PERPETUAL SKY-DWELLER
IN 18 CT WHITE GOLD



THE F1 FORMULA 1 LOGO IS A TRADEMARK OF FORMULA ONE LICENSING BV, A FORMULA ONE GROUP COMPANY.

CHOOSE PIRELLI AND TAKE CONTROL.



P ZERO™ SOFT

**DIFFERENT TYRES,
CHOSEN BY FORMULA 1®
FOLLOW**

**SAME TECHNOLOGY.
AND THE BEST CAR MAKERS.
THEIR LEAD.**



P ZERO™ MO



POWER IS NOTHING WITHOUT CONTROL

ISSUE
#13

AUTO

INTERNATIONAL
JOURNAL OF THE FIA

Editorial Board:

JEAN TODT, OLIVIER FISCH
GERARD SAILLANT, TIM KEOWN,
SAUL BILLINGSLEY

Editor-in-chief: OLIVIER FISCH

Executive Editor: MARC CUTLER

Editor: JUSTIN HYNES

Copy Editor: GILLIAN RODGERS

Art Direction and Design: CARA FURMAN

Contributors: DAVID EVANS, RICHARD
KAVUMA, RORY MULHOLLAND,
ANTHONY PEACOCK, RICHARD RODGERS,
TONY THOMAS

Logistics: MARIE DUJET

Repro Manager: ADAM CARBAJAL

Printing: MANOR CREATIVE

We would like to thank the following
for their help with this issue of AUTO:

BEN DEACON, RACHEL CAVERS, QUENTIN
CROMBIE, DANIEL GOLDING, JOHN PAP,
AVI SILVERMAN

Advertising:

STEPHANE FILLASTRE

sfillastre@fia.com



Legal: © 2015 FIA. All rights reserved. Except to the extent permitted under applicable copyright laws, no part of the information found in this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the FIA.

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.

PANEL FOR PROGRESS

Much has been done to improve road safety but the fight to save lives has been held back by two issues - a lack of funding and of information.

To tackle these barriers and more, the FIA has launched a unique initiative - a High Level Panel of some of the world's leading decision-makers to help raise much-needed finance and to boost public awareness of the issue worldwide. You can find out more about this crucial project in this edition

Elsewhere, we focus on the development of road relevant technology in motor sport. We have seen great innovation but it comes at a cost. To address this the FIA has issued a tender for the supply of a lower-cost engine in Formula One, as maintaining the viability of our Championships is a key aim of the FIA.

Finally, I'd like to express my support to Paris following the terrorist attacks of 13 November. Paris has been the home of the FIA for 110 years and our bond with the City of Lights is strong. We are all very affected by this tragedy and my thoughts go out to all the victims of this heinous act.



Jean Todt,
FIA President

CONTENTS

From the transfer of race to road technology to World RX's formula for success, this is AUTO

10

UP FRONT

P10-15 GALLERY

Brasilia's Global High-Level Conference on Road Safety; WTCC Thailand; Mercedes' shape-shifting concept car

P16-23 NEWS

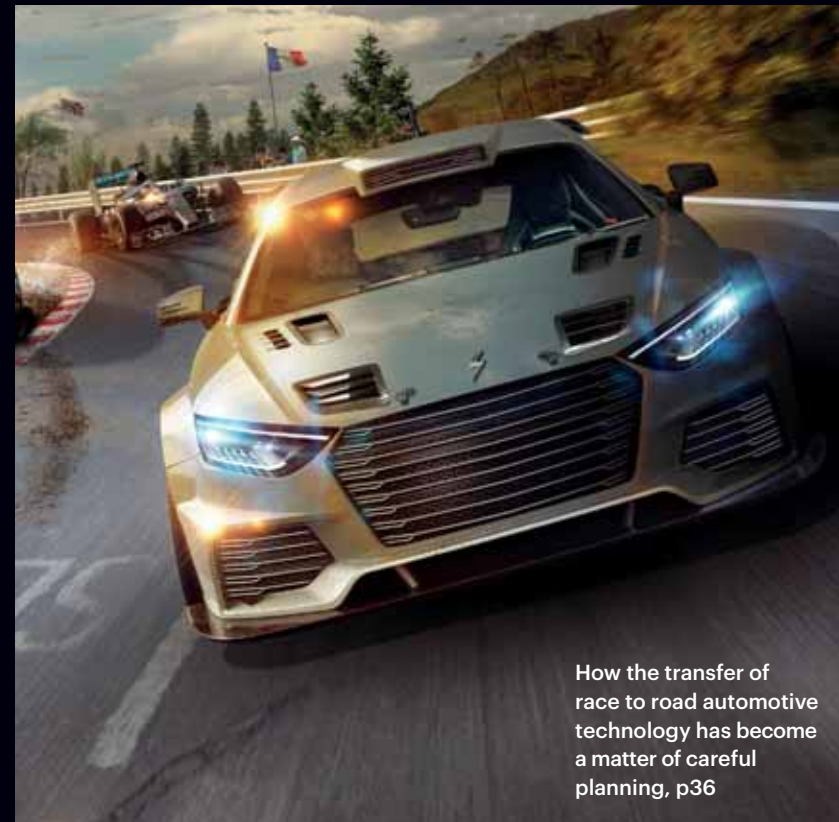
Luc Besson FIA road safety film gains global support; Britain and France top 2015 driver lists

24

AUTO ASKS

P22-23 THE BIG QUESTION

What is set to be the next major innovation in transportation? AUTO asked three expert speakers at the recent FIA Mobility Conference in London



How the transfer of race to road automotive technology has become a matter of careful planning, p36

26

TECH REPORT

P26-29 GLOBAL DRIVE FOR MOTOR SPORT SAFETY

From high-speed F1 cameras to virtual crash simulation tests, AUTO looks at the work of the Global Institute for Motor Sport Safety

36

COVER STORY

P36-41 THE JOURNEY FROM RACE TO ROAD

How racing teams are playing an integral role with car manufacturers as technology transfer shapes our automotive future

30

AUTO FOCUS

P30-35

FORMULA E POWER PLAYERS

The FIA's vision for its Formula E series as a fast-track for developing electric road car technologies took its first major step forward with the opening up of its powertrain rules. AUTO looks at how the sport's manufacturers are pushing the boundaries

P42-47

DRIVE TO HYDROGEN

How manufacturers such as BMW and Toyota are working towards a more promising future for hydrogen vehicles

P48-54

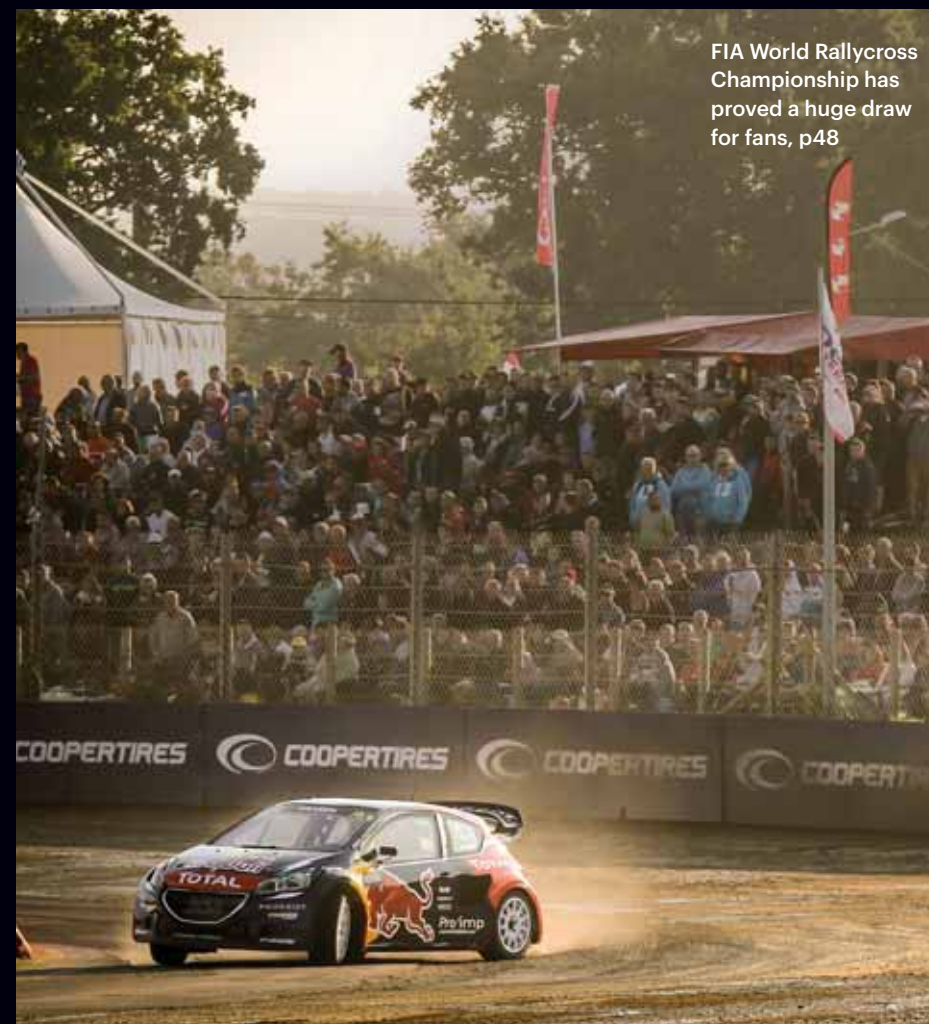
WORLD RX ON THE RISE

A look at the FIA World Rallycross Championship's winning formula – on show at its spiritual home of Loheac in France

P56-59

GOING GREEN WITH THE FIA

With help from the FIA Institute Sustainability Programme, motor sport's various bodies are becoming more environmentally efficient



FIA World Rallycross Championship has proved a huge draw for fans, p48

60

REAR VIEW

P60-65

LEGEND: TIMO MÄKINEN

One of the original Flying Finns, Mäkinen blazed a trail in world rallying in the 1960s and '70s

68

AUTO GRAPH

P68-69

COUNTRIES CUP

The five FIA World Championships in 2015 reveal just which countries are producing the most top-level drivers

66

FINAL LAP

P66-67

FREEZE FRAME

The 2016 WTCC Volvos have a lot to live up to – witness the successes of 'The Flying Brick' in '80s touring cars

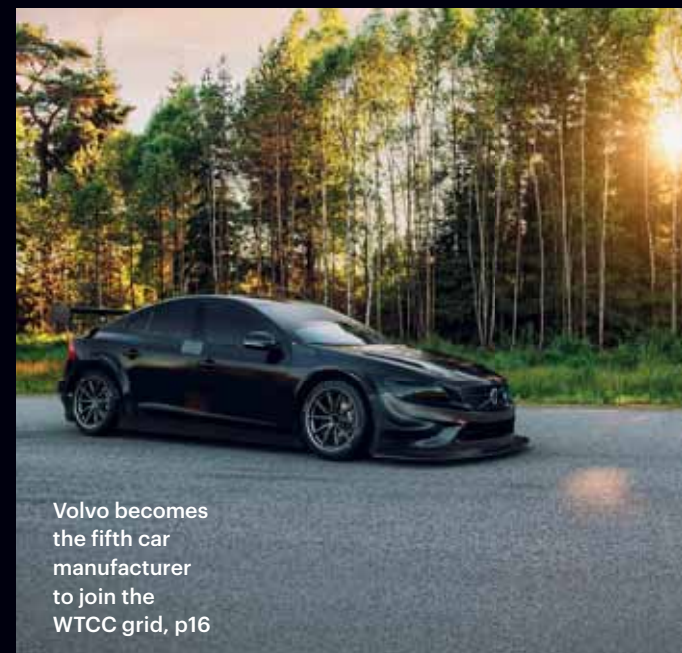


Nathaniel Beuse talks autonomous cars, p70

P70

SAFETY FOR THE MASSES

US car technology expert Nathaniel Beuse on the latest developments and their implementation



Volvo becomes the fifth car manufacturer to join the WTCC grid, p16

**UP
FRONT**

Road Safety

NATIONS UNITE

The second Global High Level Conference on Road Safety took place in Brasilia on 18-19 November. It set the agenda for renewed action to combat the global man-made epidemic of road traffic injury which is claiming the lives of over 1.2 million people each year.

At the United Nations, ahead of the conference, Governments had agreed an ambitious target to halve the number of road deaths worldwide by 2020. The 'Brasilia Declaration' agreed by Governments and the international community at the conference, outlined the measures needed to reach this objective, which is part of the UN's 'Global Goals' for sustainable development.

Governments agreed to intensify both national action and international cooperation to meet the 2020 target. The global #SaveKidsLives campaign which has been designed and supported by the FIA and FIA Foundation issued a strong call to action with one million people signing up ahead of the conference. The campaign's film by acclaimed director Luc Besson, which has received millions of views on social media worldwide, was shown at the conference.

FIA President and UN Special Envoy for Road Safety, Jean Todt joined leading global policy makers in opening the conference. Also speaking were Dilma Rousseff, President of Brazil, Michelle Yeoh, the spokesperson for the new FIA High Level Panel on Road Safety, and Zoleka Mandela, granddaughter of Nelson Mandela and global road safety campaigner. Over 70 delegates from FIA Clubs participated in the conference.

The FIA Foundation organised a series of events including an 'NGO Rally for Safer Roads', the Prince Michael of Kent International Road Safety Awards and a Forum on Child Health and Urban Mobility at which the Foundation's global partnership with UNICEF was announced. FIA Foundation Trustee, and former NATO Secretary General Lord Robertson of Port Ellen closed the conference.

It was the second global conference of its kind. The first Ministerial in Moscow had agreed the UN Decade of Action for Road Safety. The Brasilia conference marked the mid-point of the Decade of Action.



PRESIDENT'S ADDRESS

Brazilian President Dilma Rousseff tells the meeting that halfway through the UN Decade of Action for Road Safety (2011-2020) it is now time to take stock of the results achieved and to move forward in reducing the number of deaths over the next five years.

Environmental efficiency

SHAPE SHIFTER

With vehicle emissions tests becoming ever tougher, cars need to be more efficient, which has led to Mercedes-Benz unveiling a new concept that aims to improve aerodynamic and fuel efficiency through moving body parts.

The 'Concept IAA' (Intelligent Aerodynamic Automobile) made its debut at the Frankfurt International Motor Show in September. The German manufacturer has described it as two cars in one: a four-door coupé that switches automatically from design mode to aerodynamic mode when the vehicle reaches a speed of 80km/h.

The change can in part be seen below: eight segments extend at the rear of the car increasing its length by up to 390 millimetres, front flaps in the bumper extend by 25mm to the front and 20mm to the rear to improve air flow around the front end and the front wheel arches, Active Rims alter their cupping from 55mm to zero, and the louvre in the front bumper moves 60mm to the rear to improve underbody air flow. Inside, Mercedes says the IAA continues the design line of the S-Class and S-Class Coupé.

The car would be powered by a petrol/electric plug-in hybrid drive with a total output of 205kW or 279bhp, giving it a top speed of 250km/h. Mercedes says the car has an estimated all-electric range of 66km while emitting 28g CO₂, while in design mode the figures are 62km and 31g CO₂, although it expects real-life fuel savings to be greater.



DIGITAL DESIGN

The team behind Mercedes' Concept IAA used the latest algorithmic design methods to develop its complex geometrics, while aerodynamic experts calculated some 300 variants – the type of work normally reserved for production models.

Va: 80,0 km/h
 T: 23,0 °C
 cw: 0,19

UP FRONT

FIA World Touring Car Championship DOUBLE TOP

The FIA World Touring Car Championship's visit to Buriram, Thailand's so-called City of Happiness and one of five new venues on the 2015 calendar proved to be just that for Jose María Lopez, as the Argentinian clinched his second WTCC title in a row in a thrilling opening race of the series' weekend at the country's first FIA Grade 1 circuit.

Last year Lopez had become Argentina's first FIA world champion since Juan Manuel Fangio in the 1950s and at the Buriram Circuit he doubled up despite pressure from nine-time FIA World Rally champion Sébastien Loeb in the latter stages of the race.

Lopez led from pole position and his championship win was sealed when title rival Yvan Muller's race was compromised by an incident-packed opening lap.

Following collisions at Turn One involving Chevrolet's Tom Coronel and Lada's Nicky Catsburg and Nicolas Lapierre, Muller got caught up in a second incident at Turn Six when he tangled with fellow Frenchman Hugo Valente, and was forced to retire to the pits.

The incident sparked the introduction of the safety car and at the restart Lopez was forced to defend from the hard-charging Loeb. However, as the race wore on, Lopez gradually shook off the Frenchman, finishing 1.3 seconds clear to claim his ninth win of the season and the title.

"It's been an amazing year for me but really hard," said Lopez. "To win the championship three races before the end is a massive result looking at the competition. It's something I never expected but somehow life gave this to me so I really thank everything."



CITY OF HAPPINESS

Jose María Lopez celebrates winning the opening race of the WTCC's round at Thailand's Buriram circuit. The victory at the track, 410km north-east of Bangkok, sealed a second series title for the Argentinian with one round to go, at Qatar's Losail circuit.



UP FRONT



AUTO NEWS

In this issue, Volvo become the WTCC's fifth manufacturer, the FIA launches a major road safety initiative at the UN's New York headquarters and Toyota takes autonomy to the highways of Japan



VOLVO SIGNS UP FOR 2016 WTCC

Volvo will bring the total number of manufacturers represented in next season's FIA World Touring Car Championship to five after it announced a long-term entry through its recently acquired performance brand Polestar.

And its participation has been welcomed by WTCC makes Citroën and Honda. "We have no doubt they will be a solid competitor from the start," said Citroën Racing head Yves Matton.

William De Braekeleer, Honda Motor Europe's motorsport manager added: "This makes for an even more exciting,

competitive season for both the fans and manufacturers, while supporting the WTCC's growth and longevity."

Polestar Cyan Racing will field two Volvo S60 TC1s with plans in place to expand the line-up to three cars once build and capacity issues are overcome. Two Swedish drivers will be announced before the end of the year.

The car will carry on the legacy of the 240 Turbo, a winner of the FIA European Touring Car Championship in the mid-1980s by using the 400bhp four-cylinder turbo from Volvo's Drive-E engine family. See Freeze Frame, p74.



F1 DRIVERS PRAISE SAFETY BARRIERS

Following Toro Rosso Formula One driver Carlos Sainz's crash at October's Russian Grand Prix, where he walked away from a 153kph frontal impact, F1 drivers have praised the performance of the high-speed TecPro barriers employed at the Sochi Autodrom and other circuits around the world.

"The numbers are quite mind-blowing," said Alex Wurz, Chairman of the Grand Prix Drivers' Association. "[Stopping from] 153kph in four metres and the driver races the next day. The bottom line is this is really impressive and is thanks to all the intensive work that has been done."

Wurz was speaking after a presentation to F1 drivers by FIA Safety Director Laurent Mekies at the US Grand Prix. Mekies confirmed that Sainz's crash was the highest speed impact this year, with a 42G peak.

"It was quite an extreme stop, and it is quite an outstanding performance that both the car and barriers allowed the driver to walk away from the crash," said Mekies.

However, one area of concern is that after absorbing the impact, the barrier rebounded off the concrete Armco onto the top of the car. "This is a very important thing for us to solve because it gave quite a few concerns to the rescue team," added Mekies.

Mekies then joined Andy Mellor, research consultant for the Global Institute for Motor Sport Safety, the FIA Institute's research partner, in presenting F1 safety projects currently being researched, including greater driver cockpit protection.

For more on the Global Institute for Motor Sport Safety, turn to p24.



WILLIAMS' FORMULA E BATTERY RECEIVES TOP ENGINEERING AWARD

Williams Advanced Engineering has been awarded one of British engineering's most prestigious prizes, the Royal Automobile Club's Simms Medal, for its development of the batteries that power the FIA's Formula E all-electric racing series.

The prize, awarded by the RAC's Technical Committee, recognises a genuine contribution to motoring innovation by individuals or small companies that also exemplifies a spirit of adventure.

Announcing Williams as the recipient of the award, RAC Technical Committee chairman John Wood MBE said: "The Formula E battery is a design, technological and packaging marvel."

"Each of these batteries has enough energy to charge a smartphone every day for 13 years and holds the equivalent energy of 10,000 AA alkaline batteries. The batteries have powered a full grid of Formula E racing cars a total of some

60,000km in the first season - which is the equivalent of one and a half times around the Earth."

Accepting the honour, Williams Advanced Engineering director Craig Wilson said the company was proud of how its batteries had "stood up to the test in what was a very aggressive development and testing programme" for the inaugural 2014-'15 Formula E season.

The company's achievements were also lauded by Formula E CEO Alejandro Agag, who said: "Without the battery that Williams Advanced Engineering produced, Formula E would not exist. We are extremely proud that their work on this cutting-edge electric vehicle technology has been recognised by a body as prestigious as the Royal Automobile Club."

To get an insight into how Formula E's new powertrain rules are affecting the championship battle see page 28.

FUEL-SAVING CARBON CHASSIS DEBUTS AT TOKYO MOTOR SHOW

Lightweight, fuel-efficient carbon fibre chassis could be one step closer to everyday road car production following the launch of an innovative technology at last month's Tokyo Motor Show.

Developed by Gordon Murray Design, run by ex-Formula One designer Gordon Murray, iStream Carbon is a manufacturing system with a cycle time of just 100 seconds that allows for the production of a lightweight chassis without the high costs associated with current light weighting technologies. The system can reportedly cater for production volumes of 1,000-350,000 units per year

According to Murray, the low-cost investment and piece part cost of its

components will enable it to be used in sub-premium market segments.

"Light weighting is the final frontier in the automotive industry's fight for lower emissions," said Murray. "Light weighting is important for internal combustion engines, but even more so for hybrids and electrics."



FUEL INITIATIVE SETS SIGHTS ON UN SUMMIT

The Global Fuel Economy Initiative partnership of six global organisations, including the FIA Foundation, is set to make major progress in its campaign to secure efficiency commitments from 100 countries, when it attends the UN's summit on climate change in early December in Paris.

"Transport currently contributes almost a quarter of the carbon dioxide emissions that cause climate change, and road transport is a sizeable and growing proportion of that total," said Sheila Watson, Director of Environment for the FIA Foundation. "Improved vehicle fuel economy is vital for mitigating climate change."

In Paris at the beginning of December, governments will gather for the 21st session of the Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC). At the event they will try to realise a new agreement aimed at limiting the rise in global temperatures to 2-degrees Celsius above pre-industrial times and the GFEI will be present.

The GFEI has set a goal of 100 countries committing to improve fuel economy, and all indications are that major progress towards this goal will have been achieved by the time of the COP in Paris.



MSA ROAD SAFETY FILM WINNERS HONoured BY F1 CHAMPION

Two winning teams in the 2015 MSA Road Safety Film Competition have each received a £4,000 prize presented by Formula One World Champion Lewis Hamilton and FIA President Jean Todt.

Team Gell (pictured above, with Hamilton and President Todt) from Derbyshire and Team Kindsense from Harrow, both in the UK, travelled to September's Italian Grand Prix at Monza where they met Hamilton and enjoyed an exclusive tour of the Mercedes Formula One team garage.

As part of the FIA's Action for Road Safety campaign and in association with Allianz, the competition invited young people aged

16-24 to submit short films relating to one of the FIA's 10 Golden Rules for Safer Motoring.

Team Gell's film 'Worth It' and Team Kindsense's 'Pause' were both judged by Hamilton to be the best of a highly competitive entry, who along with President Todt and MSA Executive Rob Jones, presented the winners with their cheques for the purchase of filming equipment.

"It's a fantastic initiative to be involved with and a really good way to engage people with this issue," said Hamilton. "I'm genuinely shocked every time I see the stats about accidents and I hope projects like this will raise awareness and make a real difference."

FIA LAUNCHES TENDER FOR INDEPENDENT FORMULA ONE ENGINE

The FIA has launched a tender process to find a new supplier of an independent Formula One engine, which would be introduced for the 2017 season.

Companies that are interested in producing the standard power unit have been invited to submit expressions of interest via the FIA website. The independent engine is a response to the escalating costs associated with the current hybrid V6 turbo engines that were introduced in Formula One at the beginning of the 2014 season. After concerns were repeatedly raised that the price of the hybrid power units was causing financial difficulties for independent teams, the FIA decided to introduce an affordable standard unit.

The aim is for the cost of the new engine to be much lower than the price required to purchase a current power system from a manufacturer.

Although the exact specification for the new power unit has not been revealed, the FIA will provide those details to all interested parties. If a proposal is accepted, the company that builds the new engine would be required to do so for the duration of an exclusive contract, to run until the end of the 2019 season.



100 years young

TOYOTA TESTS AUTONOMOUS CAR ON TOKYO HIGHWAY, AIMS FOR 2020 LAUNCH

Toyota has successfully tested a new automated car called Highway Teammate, with the aim of launching related products by the year 2020.

The self-driving car, a modified Lexus GS, has been driven on Tokyo's Shuto Expressway during a series of manoeuvring trials that involved merging onto and exiting the highway and maintaining or changing lanes.

The Japanese manufacturer said Highway Teammate uses on-board technology to evaluate traffic conditions, make decisions and take action during the driving process.

The driver switches to automated driving mode after passing through a tollgate and entering a highway on-ramp. The car then uses external sensors to recognise nearby vehicles and hazards, selecting routes and lanes depending on the destination. Based on these inputs, the vehicle

then automatically operates the steering wheel, accelerator and brakes to achieve the appropriate speed and driving lines.

Toyota, which believes the car embodies the kind of safety technology expected to play a key role in future products, is increasing its research and development of automated driving technologies with the aim of launching products based on Highway Teammate in around five years' time.



FIA LAUNCHES HIGH LEVEL PANEL FOR ROAD SAFETY WITH SUPPORT OF BAN KI-MOON



The FIA, supported by UN Secretary General Ban Ki-moon, has launched a major new road safety project aimed at helping to tackle the issue worldwide.

The new High Level Panel for Road Safety brings together a coalition of senior decision makers in policy, business and public health to focus on raising funds and promoting awareness of road safety.

The panel will be chaired by FIA President Jean Todt, who is also the UN Secretary General's Special Envoy for Road Safety. Speaking at the announcement of the new initiative at the United Nations' headquarters in New York, President Todt said that the panel had been formed to help meet an "exceptional objective".

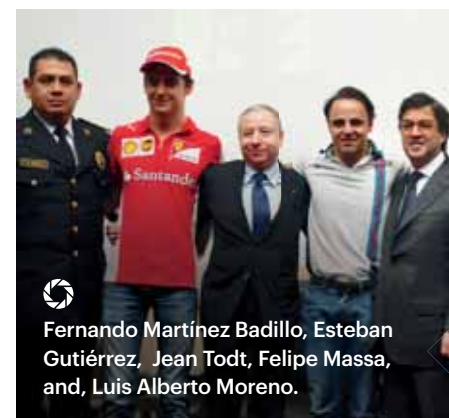
"The FIA High Level Panel for Road Safety is a unique initiative supporting an exceptional objective – a 50 per cent reduction of fatalities on the world's roads in the next five years, a target recognised under the recently ratified 2030 UN

Sustainable Development Goals," he said.

"The panel members, all of them leaders in their field, will work toward this goal through raising the necessary funds and awareness to stop and reverse the tragic loss of life on our roads," he added.

Set to meet two to four times a year, the panel aims to engage the private sector to raise funding and political awareness in response to the road safety crisis and to remobilise support for the goals of the UN Decade of Action for Road Safety and for the new Sustainable Development Goals, which were approved at the last UN General Assembly. The panel will explore the development of innovative financing measures, including pushing for the creation of a UN Road Safety Fund, which will finance road safety programmes.

More information on the High Level Panel for Road Safety can be found in the booklet accompanying this edition of AUTO.



Fernando Martínez Badillo, Esteban Gutiérrez, Jean Todt, Felipe Massa, and, Luis Alberto Moreno.

'KIDS FIRST' AT FIA-IDB SAFETY FORUM

Key road safety stakeholders gathered for the fourth edition of the FIA-IDB Road Safety Forum in Mexico City in October.

The session focused on the tools available to protect the lives of children and young people under the theme of 'Kids First'. Speakers included Jean Todt, FIA President and the UN Secretary General's Special Envoy for Road Safety, Luis Alberto Moreno, President of the Inter-American Development Bank and Carlos Slim Domit, President of Grupo Carso and President of Escudería Telmex-Telcel.

FIA HIGH LEVEL PANEL FOR ROAD SAFETY MEMBERS

Jean Todt, FIA President and UN Secretary General's Special Envoy for Road Safety (and Panel Chairman)

Thomas Bach, President, International Olympic Committee

Mary Barra, CEO, General Motors

David J. Bronczek, President and CEO FedEx Express

Rolando Gonzalez Bunster, Chairman and CEO, InterEnergy holdings

Carlos Ghosn, Chairman and CEO, Renault-Nissan Alliance

Muhtar Kent, CEO and President, The Coca-Cola Company

General Victor Kiryanov, Deputy Minister for Internal Affairs of the Russian Federation

Lord George Robertson, Former Secretary General of NATO

Jean-Dominique Sénard, CEO and President, Michelin

Li Shufu, Chairman Geely & Volvo

Carlos Slim Jr, Chairman of the Board, Grupo Carso

Sir Martin Sorrell, founder and CEO, WPP

Elhadj As Sy, Secretary General, CEO, International Federation of the Red Cross and Red Crescent Societies

Ratan Tata, Chairman, TATA Trusts

Jose Viegas, Secretary General, International Transport Forum

Michelle Yeoh, Actress and Global Road Safety Ambassador (Spokesperson for the High Level Panel for Road Safety)

During the forum, the winners of the 2015 'Project Yellow Light' film competition, organised by the IDB and supported by FIA, were revealed. The contest encouraged young people across Latin America and the Caribbean to produce their own road safety videos.

The winning videos, by Juan Felipe Chaverra, 25 from Colombia, Marisa Carinelli, 28 from Argentina, and Francisco Rojas, 25 from Mexico, focused on raising awareness on driver distraction, including the dangers of texting and driving.



IF YOU THOUGHT YOU KNEW OMP

THINK AGAIN

OMP

OMP RACING.COM

FIA OMP

OFFICIAL SUPPLIER RACEWEAR

We would like to amaze you! In fact, if you thought you knew OMP, the novelties collection just might surprise you. Along with our legendary quality, lightness and breathability that you've come to expect from OMP, we now offer a modern and timeless design for contemporary racers. Visit our website or the Authorized Dealer near you for details about our offerings.



WORLD-WORLD-WORLD-CHAMPION-CHAMPION-CHAMPION!



All good things come in threes. And apparently all the best things as well: For an outstanding third time in a row the Volkswagen Motorsport team and the Polo R WRC won the WRC Manufacturers' Championship 2015*. We congratulate the entire crew and applaud Sébastien Ogier and Julien Ingrassia for successfully defending their World Rally Champion titles once more.

RALLYTHEWORLD.COM
// EXCITEMENT WE SHARE



Das Auto.

*Subject to confirmation by the FIA.

BRITAIN, FRANCE PROVIDE THE MOST TOP-LEVEL TALENT IN 2015

This year, Britain and France have provided the most drivers competing in the FIA world championships - Formula One, World Rally Championship, World Endurance Championship (LMP1 category), World Touring Car Championship and World Rallycross Championship.

Of the 129 drivers representing 34 countries that have competed across these championships in 2015, Britain and France have supplied 17 drivers each, followed by Germany with 14. But France has had the most wins, with its drivers scoring 20 victories.

It is also the only country to have taken victories in four different world championships. It has won in the WRC with Sébastien Ogier, in WTCC with Sébastien Loeb and Yvan Muller, in WRX with Davy Jeanney, and in WEC with Benoît Tréluyer, who is part of the Audi crew. Britain is the next most successful country with 12 victories, with the majority of those wins coming via Lewis Hamilton in Formula One.

The data (see p72) also shows that a country hosting a top-level motor sport event does not necessarily succeed in developing top-level drivers. Canada and Malaysia both host long-standing F1 races but do not have a driver in any FIA world championship.



TENSION DEVICE SET TO EASE CHANGE

The Global Institute for Motor Sport Safety, the FIA Institute's research partner, has developed a seatbelt tension measurement system that informs a driver when his belts are sufficiently tightened. The system has been tested in Formula E this season and may enable the championship to shorten or remove the compulsory wait time while drivers change cars.

Currently, drivers have to wait for a minimum time period, determined at each ePrix, before they are allowed to leave their pit boxes. This is to ensure that safety standards are maintained and that harnesses are correctly adjusted.

Andy Mellor, consultant for the Global Institute, explained that the new device

informs the driver or mechanics when the belts are securely tightened via a system of lights. The load cell communicates with the race director so that he is informed when the driver leaves the pits without the correct adjustment and can send him back.

"We have put a load measurement device on the belt adjuster, so that when you are tightening the belts, it registers that you've got to achieve a peak force and that shows that you have gone through the correct tightening sequence," said Mellor.

The devices will be tested this season and may be introduced to Formula E in future. They could also be used in other championships that involved car or driver changes, such as in endurance racing.

STARS SUPPORT BESSON ROAD SAFETY FILM

The FIA's powerful road safety film *Save Kids Lives*, directed by renowned filmmaker Luce Besson and supported by the FIA Foundation, has won support from a host of stars in motor sport and beyond following its release.

The film, launched in October to coincide with International Walk to School Day as part of the FIA's #SaveKidsLives campaign, carries the message that children must have the basic right to walk to and from school each day free from road traffic danger.

At the time of writing the film had received over 2.6 million views on YouTube and gained backing from the United Nations, singer Pharrell Williams, tennis ace Rafael Nadal and

Jamaican 100-metre runner Yohan Blake.

Motor sport stars to have shown their support via Twitter included Formula One drivers Felipe Massa and Romain Grosjean as well as IndyCar star Juan Pablo Montoya and Formula E racer Sébastien Buemi.



**AUTO
ASKS**

QUESTION:

WHAT DO YOU THINK IS THE NEXT BIG INNOVATION IN TRANSPORTATION?

Transportation is undergoing huge change as new technologies revolutionise the way we get from A to B. Speaking at the recent FIA Mobility Conference in London, three experts shared their views on the upcoming developments in this sector



The businesswoman

ROBIN CHASE

TRANSPORT ENTREPRENEUR, FOUNDER, ZIPCAR

What is going to affect how we use vehicles will be the connected car. Not just in a way that your car sends data to a cell tower, but the connectivity between the vehicles, and the vehicles to infrastructure and buildings. I think of it as one part of a larger mesh of the internet and cars will be a very important part of that.

If we think about cars today they are the last frontier for our wireless connectivity revolution, so we are really ready for that transforming with this wireless access. There is a huge wealth of options for innovations.

Typically when we think about connected vehicles and the benefits of them it has to do with safety. But there are also more straightforward benefits such as when I get in my car it will know my appointment from my phone and will immediately load up the directions to that appointment, or if there is an accident ahead it will tell me about the accident.

With these vehicles connecting up to each other it will be interesting to see what the relationship is going to be between cars.

One idea is what I think of as the Cinderella car. This is where you have a young driver and they have been told by their parents they have to be home by midnight, so when they try to start the car after midnight it won't start unless you call home and the parent says 'OK, I'll enable the car for you'.

Another big innovation is going to be the apps that make it very easy to transfer between modes. We're starting to see them and they are still a little clunky, but the ability to book any kind of travel to know what is the fastest, cheapest, easiest way and pay for it in one sweep will be coming shortly. After that I actually think autonomous vehicles are going to become a game changer that is going to take out everything else.

The forward thinker

GREG LINDSAY

URBANIST, AUTHOR

Cities are not the sum of their roads or infrastructure. The most interesting thinking I've seen recently comes from some physicists, who are positing the idea that cities are essentially stars and instead of the sun, where you're compressing hydrogen into helium, you are taking social networks of people, compressing them in time and space and what comes out is ideas, productivity, everything we need to advance human civilisation. The question is what infrastructure do we need to compress those people in space and time?

That's the trouble we're having now with the automobile paradigm. We are reaching the limits of how dense we can make the cores. I think when it comes to cities we need to upgrade transit, make cities more walkable. We need to change the way we live and work and travel.

The great revolution comes with the smartphone. We now have the ability to not only summon mobility on-demand but the data that comes off the back of that allows us to coordinate private vehicles on scales we could never imagine. It will be interesting to see how people choose to enrol their cars in car-sharing programmes, how they choose to use mobility services such as Uber. I think we're going to start to see a revolution in the car not just being a private vehicle but a service you call when you need it.

The difficulty with autonomous vehicles comes from standardisation. The automobile is highly standardised by all sorts of international agencies. Computing operates on a different paradigm where you fight over standards, where companies clash until one can muscle the other into submission. Imagine your car doing that at 90km/h, where you car is trying negotiate with another car over a protocol. There is a lot of work that needs to be done on how cars are going to talk to each other.



The connectivity expert

MIKA RYTKÖNEN

HEAD OF BUSINESS DEVELOPMENT, HERE

Coming from the automotive development group at HERE, a leading mapping company, the obvious trend for me is connectivity, which will be a big game changer.

Seventy-two per cent of new vehicles will be connected by 2021 and we know that there will be quite a lot of devices in the coming years that will be creating data and they will be on the road. Often we believe this connectivity will be something brought in by smartphones or embedded in cars. But we are also talking about sensors on the road, which will not only be connected but which can be programmed and their behaviour changed as a result.

What if we could also get information from traffic lights – how long it takes before the lights change – and what if we could distribute that information to cars? What if cars could communicate that there are now a certain number of cars coming to an intersection and we could change the lights' behaviour because of the demands on the road.

You can see what the impact might be. Transportation is the second biggest sector for CO₂ emissions in Europe. With something like this we could have a very direct impact on CO₂ emissions and also on fuel consumption.

We are currently collaborating with the Finnish transport agency on how to integrate ITS use cases on top of standard 3G or 4G networks. The results from the first pilot are extremely encouraging. We can now move full-speed ahead on creating an environment in which we can connect cars without any additional investment from government on new infrastructure.

We can leverage existing networks and then we can bring the tools to citizens and governments in order to understand what is really happening on our streets. This will move forward next April with the start of a new one-year pilot scheme. We are starting this with 1,000 drivers in Finland and based on that experiment we will improve the service.





Motor sport safety

GLOBAL MISSION

The Global Institute for Motor Sport Safety is carrying out research at all levels of racing and rallying across the world

TEXT: MARC CUTLER

A high-speed camera for Formula One, a virtual crash simulation for sports cars and new load cell harnesses for Formula E – these are just a few of the recent research projects undertaken by the new Global Institute for Motor Sport Safety.

Launched earlier this year, the Global Institute’s overall aim is to investigate and implement motor sport safety techniques and technologies on behalf of its research partner, the FIA Institute. In the longer term, it will also focus on ways in which these technologies can be applied for road safety. For the time being, however, it is putting in place a three-tier plan to develop safety at all levels of motor sport.

The Geneva-based organisation is chaired by Luc Argand, a leading Swiss lawyer who has been heavily involved in motor racing for most of his career, working with the FIA since the 1980s and also as President of the Geneva Motor Show. He is responsible for chairing a board made up of business leaders and motor sport professionals (see list, p25) with Laurent Mekies, General Manager Research, and Quentin Crombie, General Manager Administration, also reporting to him. Together they choose the safety research projects to be carried out across three main areas: high-technology, cascading technology and grassroots research.

“The ultimate goal of the Global Institute is to develop safety in motor sport,” says Argand. “We want to increase the envelope of survivability in competition vehicles. A 30g accident was not survivable 20 years ago and now we see cases with 70g crashes being survived, so that’s big progress. At the Global Institute we have the duty and the responsibility to further this progress and to cascade down the research to all levels of the sport.”

The five-person board, which is responsible for the governance of the organisation, approves the work for its team of research engineers to conduct. ▶



The work of the Global Institute extends beyond Formula One right down to the grassroots level of motor sport, with the aim throughout of improving safety.



Leading Swiss lawyer and Global Institute chairman Luc Argand has been involved in motor sport for many years, working with the FIA since the 1980s.

“DANGER IS PART OF THE GAME, BUT THE PRICE F1 PAID FOR 40 YEARS WAS SO HUGE”

LUC ARGAND, CHAIRMAN GLOBAL INSTITUTE

TOP-LEVEL RESEARCH

The high-technology projects are driven by the categories at the pinnacle of motor sport, such as Formula One, the World Endurance Championship and the World Rally Championship. This research - a continuation of projects initiated by the FIA Institute - is focused on pushing the boundaries of what is survivable in a competition vehicle.

“The danger is part of the game, but the price that Formula One paid for 40 years was so huge,” says Argand. “We are not in a Roman arena any more where death was considered a normal part of events.

“If you look at the history of Ferrari, every year there was a fatal incident with one pilot dying, or even more, until the beginning of the 1980s. It was terrible and I want to make sure that the work the Global Institute does means avoiding a return to that. There is no longer any romanticism associated with death.”

Improved accident analysis will be central to this. This is why the Global Institute has developed a high-speed cockpit camera for Formula One, which records the movement of a driver’s head and torso during an accident. When played back in slow motion, this will show high-speed events in far greater detail than was previously possible. The technology will be implemented in Formula One next year with a view to filtering it down to other championships in following years.

“I think the Formula One programme is likely to be just the start. We’ll certainly be looking to use this technology to further help to develop safety across motor sport.”

Another project that will help to gather important data on drivers is one that is focusing on ear accelerometer biometrics. F1 drivers already have accelerometers built into their ear-pieces to measure the movement and forces on their head during an accident. Global

Institute researchers are now looking to incorporate other tools into this device that will provide biomechanical measurements such as heart-rate, pulse, temperature and even sweat analysis.

A further high-tech project has seen the development of a virtual simulation that has proven a theory to reduce spinal injuries for drivers. This has been conducted in partnership with Toyota, which has developed a computer model of the human body that it uses for virtual crash testing. Called the Total Human Model for Safety (THUMS), it is made up of almost two million elements that accurately reproduce the human form, from precise bone strength to the structure of organs.

This project has significant potential for application in road cars and will be one of the priority targets for road safety development by Global Institute researchers.

“Whatever we do in motor sport we have the chance to think about how we can bridge that to road safety,” says Argand. “Even for the way we select projects, we will prioritise those that could have road safety relevance.”

CASCADING RESEARCH

The core work of the Global Institute is not just aimed at the top levels of motor sport but at all levels. As Argand says: “We need a downwards cascade of product or results of research, which can help other levels of our sport.”

These second-tier research projects are designed to use the technologies developed in the top category and make them financially and technically accessible on a large scale.

“We have the duty and the responsibility to cascade down all the research towards a much larger audience,” explains Argand. This is a sentiment shared by FIA President Jean Todt, a key Global Institute stakeholder. “It’s very important that we filter down the benefits of the research so we can maximise the safety impact - this is something that I attach the upmost importance to.”

The projects that will benefit other championships include studies into preventing car launching in WEC, the WTCC-GT and WEC seat studies designed to minimise the risk of drivers in those categories suffering spinal cord injuries, and work on creating a new type of World Rally Championship ARMCO end barrier that can be used in different rally events.

Another important study is the development of a safety harness load cell that is being trialled in FIA Formula E and may be introduced fully in future seasons. It is a device that can attach to any safety belt and ensure it has been adjusted properly by the driver.

This is especially important in FIA Formula E where the driver changes car halfway through the event and has to adjust his belts quickly. When it is introduced, the load cell light will come on when the driver has safely done so.

This may help to facilitate a change in the format where the driver no longer has a mandatory wait in the pitlane. The car swap can be done as quickly as possible because the device ensures that the drivers are safely in the car and feeds back to the race director if they are not.

PHOTOGRAPHY: DANIEL LOPEZ-PAULLADA, DPPI

GLOBAL INSTITUTE FOR MOTOR SPORT SAFETY

CHAIRMAN:
Luc Argand

BOARD DIRECTORS:
Charles Firmenich
Pierre-François Unger
Colin Hilton
Garry Connelly

GENERAL MANAGER ADMINISTRATION:
Quentin Crombie

GENERAL MANAGER RESEARCH:
Laurent Mekies

This also has applications in any series involving driver changes, such as in endurance racing. “The belt is a problem because when there is a change of driver, if the belts are not properly tightened this can cause terrible injuries in the event of a crash,” says Argand.

GRASSROOTS LEVEL

The third tier of the Global Institute’s research studies, the grassroots projects, includes initiatives such as the World Accident Database and the Accident Data Recorders (ADRs), with ADRs now mandatory in all FIA Formula 4 championships around the world.

“There is also a new exciting project to develop a driver visual assessment tool,” says Argand. “That will hopefully have an application outside the sport.”

Looking to the future, Argand wants the Global Institute to build on its foundations and move towards becoming the world’s leading motor sport safety research centre: “First of all, I want the Global Institute to establish itself as the world leader in motor sport safety research, using innovation and excellence to help further reduce the incidences of fatal accidents and injuries. In the future, we will also be looking for ways to help take these ground-breaking developments and apply them to the motoring industry in general and for the betterment of society.”

This work is already having an impact on motor sport at every level of competition. Formula One, Formula E, Formula 4 and WEC are already benefiting from its research. But this is just the start. “There is no end because you cannot ever stop with safety research,” says Argand. “This is a long-term and ongoing commitment and I believe that the Global Institute is up to the challenge.” ■

GLOBAL INSTITUTE WORK

- HIGH-TECHNOLOGY PROJECTS:**
- Ear Accelerometer Biometrics
 - High-speed Camera
 - Accident Analysis Tolerance and Reconstruction
 - LMP1 Virtual Crash Model

- CASCADING-TECHNOLOGY PROJECTS:**
- LMP1 flying car study
 - WTCC/GT seat study
 - WRC ARMCO end barrier
 - LMP1/Formula E belt load cell

- GRASSROOTS PROJECTS:**
- World Accident Database
 - ADR Programme
 - Vision testing

FUTURE: ROAD SAFETY PROJECTS

AUTO
FOCUS

Electric competition

THE POWER PLAYERS

The FIA's vision for its Formula E series as a fast-track for developing electric road car technologies took its first major step forward with the opening up of its powertrain rules. AUTO looks at how the sport's manufacturers are pushing the boundaries

TEXT: JUSTIN HYNES

August at Donington Park and Formula E's teams are putting their season two cars through their first paces, machines trundling out of garages and coming to rest at the pit exit, drivers waiting for the signal to power them on track in anger for the first time.

At first glance there's nothing new here. The Spark chassis is the same as the one raced by all the series' teams in the inaugural 2014-15 season, the Williams battery packs are unchanged, the aero package is identical.

But as throttles are opened and the instantaneous power comes in, the great leap forward of season two of the FIA's all-electric series becomes abundantly clear.

Indian outfit Mahindra Racing's car pulls away with a slightly modulated version of the sweet whistle of last year's cars, as does the machine of reigning champion team Renault e.DAMS. A moment later and Virgin DS Racing's new challenger takes its place and this time the sound is like a police siren, spinning up from a low honk to a full-throated wail. Audi Sport ABT's car, meanwhile, launches with a sound that, without wishing to be unkind, doesn't sound unlike an amplified dentist's drill.

On the surface the differences appeared slight but the variation in sounds demonstrated the changes that have gone on under the skin of season two Formula E, a progression that has not only

increased competition but has also pushed the development of technologies that could transform the electric road vehicles of the future.

To get to the root of the changes, it's necessary to go back to the origins of the series, with the drafting of regulations predicated on a long-term technical development programme beginning with a 'spec' car that in year one would be raced by all teams, as FIA Technical Director Bernard Niclot explains.

"There were two main reasons [for the championship to launch as a one-make series]," he says. "The first was sportive. We wanted to have a championship that was interesting in terms of racing. We wanted drivers racing the same cars, fighting each other. We wanted close racing. And we achieved that. We saw many different winners [in season one] and Nelson Piquet Jr won the title by only one point over Sébastien Buemi, so it was exciting right up until the end. We wanted to create interest and momentum with the series and then in the future we would develop more on the technological side."

That future arrived as early as the midpoint of season one, when the FIA revealed the next stage of the electric series' evolution, the opening up of the regulations to allow teams to become manufacturers, with freedom in season two to develop a key element of the car – the powertrain. ▶



It is the next stage of a planned five-year cycle, which the FIA and the teams' major stakeholders believe will result in a technically rich yet still affordable championship that through competition will advance road car technology.

"We want to steer Formula E in the direction of being an accelerator of technology," asserts Niclot. "Since the beginning of the 20th century motor sport has been very useful in order to develop cars that [initially] were not very reliable, not very easy to drive, and now we want motor sport to play this role for the car and the automotive industry of the 21st century."

"We have created Formula E to show that electric drive and powertrain can be efficient and fun, and also to use motor sport to increase the development of electric powertrains. What we didn't want to do was see a car win because it has a better aerodynamic package."

TEAM BENEFITS

The invitation for teams to transition from simply being customers of the original Spark chassis and powertrain developed by F1 stalwart McLaren to manufacturer status required significant buy-in, however, and the federation was rewarded in February when eight of the 10 season one teams agreed to take the next step.

For Dilbagh Gill, Team Principal of Mahindra Racing, the advance was never in doubt. "One of the prime objectives of our presence in Formula E is what we call the 'race to road' programme," he says. "We are one of the oldest modern electric car manufacturers – we started building electric cars 19 years ago. We are increasingly going to be launching electric vehicles around the world and we wanted to start learning what's happening at the cutting edge of this technology – that's why we are in Formula E. As soon as it opened up for manufacturers and constructors we jumped at it. We didn't want to sign up as a proxy entry or anything like that. We came in as an OEM [Original Equipment Manufacturer] and we want to work on technology in this championship."

Virgin DS Team Principal Alex Tai concurs, adding that the series' technological aims chime with those of his parent company.

"What Virgin wants to do is develop technology that is going to have an impact on the societies we live in," he says. "We have a history of that through projects such as Virgin Galactic and even Virgin Oceanic, and then the Virgin Atlantic Global Flyer where we developed aircraft or pushed the boundaries of aircraft technology."

"What we are looking for in Formula E is to see if it can find improvements in technology that will improve the lives of people, including the environment that we live in. We sincerely believe that the planet is in trouble and we need to do what we can to reduce CO2 emissions and clean up the atmosphere. A large contributor to this is transportation. What we need to do is work with these OEMs to see if we can come up with better forms of powering the cars that you and I drive."

"We believe that Formula E does drive technology, it drives change and accelerates change in technology through competition, pitting different manufacturers against one another to produce more efficient and lighter, more powerful powertrains."

And to coin a phrase, therein lies the driving factor of the change – competitiveness – as Virgin DS Technical Chief Sylvain Filippi explains.

"What are we looking for with this move to bespoke powertrains? One word: efficiency," he says. "It's a bit different compared to normal internal combustion engine race car design. We don't have much downforce in Formula E, the chassis is the same and remember that the power is limited [to 200kw in qualifying and, this year, 170kw in race mode]. In other series you are given regulations that specify the size of engine, maybe some fuel flow restrictions and your job is to extract as much power from this as possible. ►



Virgin DS tech chief Sylvain Filippi has welcomed the competitive edge that development of Formula E's powertrains will provide.

Mahindra team boss Dilbagh Gill says Formula E's relevance to the road car market was a big motivator in its series participation.



Alex Tai, team boss at Virgin DS Racing, says the series' technological aims tie in nicely with those of his parent company.



With Formula E now established, FIA tech chief Bernard Niclot wants the series to become an accelerator of technology.

“For us, it’s a bit different. You obviously need to be able to design a powertrain that can deliver the maximum power allowed by the FIA. But you are not allowed to run that power anyway in the race, so what it’s all about is efficiency. Each time you go out for a given distance – a lap – and for a given speed – a lap time – the idea is to use as little energy as possible to achieve that distance and time. The more efficient it is the more you don’t have to save energy, because you can be flat out more of the time or go further in the race.”

“These new powertrains give you options and that can give you a competitive edge. It’s what I call improving the system efficiency – the efficiency of the energy store in the battery all the way to the wheel: from the battery, to the inverter, to the motors, to the transmission, to the wheel. If you can improve on the efficiency of this, you’ll win.”

EVOLUTION OVER REVOLUTION

Locating a competitive advantage through the development of bespoke technology comes with risks attached, however. Pursue the wrong development route and performance can be lost, edges are blunted and recovery becomes complex.

In the wake of a difficult first season, Mahindra has switched from 2014-15 partner Carlin, taken on more of the engineering load and found a new race partner in Adrian Campos’ team, which last year helped Team China’s Piquet to the drivers’ title.

The upshot for the team’s powertrain development is that it is pursuing a path of evolution over revolution – taking last year’s powertrain and tweaking its design in partnership with McLaren.

“We basically decided we would go for reliability initially and it’s an evolution rather than a revolution. There are a lot of unknowns still to come and we thought ‘let the series stabilise first’. While we have a limit on the battery output, which is very similar to season one, we felt that improving the efficiency of the powertrain

would give us the best results. It maintains reliability and keeps us on top of the evolution going forward.

“We approached McLaren with a list of requirements,” he adds. “Then they came back with some counter-proposals and worked around some small compromises. It’s a joint project but there are certain commercial rights to the product.”

Virgin, now backed by the might of Citroën and its FIA World Touring Car Championship-winning DS Performance arm, has chosen a different road – building a new powertrain from scratch, which according to tech boss Filippi has been no easy task.

“It was a big challenge, firstly because we have never done it and secondly we had very little time,” he says. “Normally in F1 or in other categories you are on a one-year rolling cycle, but in this case we literally had a few months. We got the final regulations in January and we had to homologate the car in June. In six months we had to design the powertrain, prototype it, test it on the bench, test it on the track, crash test it and homologate it, which is an awful lot of work. Even by F1 standards it was pretty tricky!”

The decision to build a bespoke powertrain was not, however, dependent on the team’s link to Citroën.

“We were always going to become a manufacturer regardless, but personally I was very interested in teaming up with a large car maker, simply because it makes more sense,” he says. “For Virgin Racing it’s good because it gives us more resources, talent and expertise. Also, I strongly believe that any technology we develop in Formula E can trickle down [to road cars] very quickly. I’m a firm believer in this because I have worked on both sides. I worked in the road car industry as a consultant on electric cars and I’ve worked on the motor sport side, so I’ve seen all sides of the electric car industry.”

“I believe that in as little as six months or a year’s time you can innovate and have some solutions that could be implemented on road cars. It is possible. There are not many components and you

“ANY TECHNOLOGY WE DEVELOP IN FORMULA E CAN TRICKLE DOWN TO ROAD CARS QUICKLY”

SYLVAIN FILIPPI, VIRGIN DS RACING

can swap them out fairly quickly. A lot of it is simply programming and software. You can develop more efficient software quickly.

“If we produce it all ourselves, well, we can do that, but we don’t make electric cars, so what is it for? But if we partner with a car manufacturer then we can develop better technology faster because they have more resources but also we have purpose, because whatever we develop the manufacturer can put on their road cars.”

“That’s why we were passionate about getting a manufacturer on board and why we talked to many,” he adds. “But Citroën was the best fit, because of proximity, because we know them and also because a) they are a large manufacturer, but b) because they have a competent racing arm. Partnering with an OEM is one thing, but the racing world is different because of the pace of development and a manufacturer needs to understand the imperatives.”

With the powertrain die now cast and the season underway, the series’ evolution will move on to a further opening up of the regulations, with coming seasons likely to see development of brake-by-wire systems, further increase in power output and, by

season five, a freeing up of battery development, aimed at moving away from the current format of drivers having to use two cars during a race due to energy constraints to driving a single car.

“I think that in season five if we can have a car completing the whole race it will be a big step forward,” says Niclot of the future road map. “If I could dream I would say that for me the ultimate achievement of this championship would be to introduce hydrogen into motor sport. But that is for the far future.”

It’s an ambitious programme but one that Gill is sure sends the right message about the series and which will result in tangible gains with road cars.

“In season one we wanted to say ‘this is racing, let’s talk about racing right now. It’s a new series, the racing is good, the cars are interesting, we’re bringing it to city centres,’” he says. “As we go forward the message will start to change towards relevance to people and that will intensify as the relevance to road cars increases.”

“There is already real crossover, it’s starting to happen,” he adds. “The work we have done over the last six to eight months, we will start to see some of that on the road within the next 12 to 18 months. At last year’s Delhi motor show Mahindra showed a concept car called the Reva and the powertrain of that is something that should be coming out in Formula E.”

In conclusion the Indian team boss insists that the technological advancement of Formula E could go even further.

“We should push hard,” he says. “This is a product category and our ambition for Formula E extends far ahead of racing. It has to push electric vehicle technology; it has to make it more exciting; it has to make it more relevant. I think we need to push boundaries.”

“We would like to see if we can accelerate the adoption of electric vehicles. We want people to understand that these vehicles are a genuine alternative and pushing the boundaries of the sport will help that.” ■



COVER STORY

Car makers in competition

FROM RACE TO ROAD

More than ever, new technology tested in motor sport has relevance to the road car market, with targeted development programmes replacing the chance breakthroughs of the past

TEXT: MATT YOUSON ILLUSTRATION: SEAN RODWELL

Technology migrates from the race track to the road, but the path of migration changes. In the first century of motor sport, that transfer was a haphazard affair, an exercise in blue sky research that occasionally led to great discovery. Innovations such as anti-lock brakes and paddle-shift gearboxes came from motor sport; the technology of direct injection, disc brakes and turbocharging all benefited from the helter-skelter rapidity for which racing development is famed and for which automotive development, pointedly, is not. Today, however, rather than technology transfer being a product of serendipity, it comes through targeted programmes of development. The game has changed.

Prof Dr Thomas Weber has a long title: Member of the Daimler Board of Management responsible for Group Research and Head of Mercedes-Benz Cars Development. An engineer with a long history of working in engine development for Mercedes, his current R&D portfolio includes responsibility for Mercedes AMG High Performance Powertrains (HPP). Located in Brixworth, England, HPP is best known as the home of Mercedes' Formula One engines and hybrid power units. It is the modern hybrid regulations in F1,

he argues, that make the sport a useful tool for road car research.

"The situation is now much better than in the past," he says. "In the past, very often the technologies we used [on track and road] were completely different. Now, with the change in regulations driven by the FIA, F1 is engaged with future-oriented technology: turbocharging, downsizing, hybridisation. That's exactly the global strategy of the road car side as well. The teams on the F1 side and the road car side have the same language. They can talk to each other."

There is, of course, a counter-argument. Would the automotive company not make bigger gains by spending that budget seeking automotive answers to automotive problems? Weber suggests not. Competition, he insists, improves the breed.

"Formula One guys are in a closer loop with their technology. Every two weeks, on the fastest test bench in the world, they have to demonstrate how good their technology is. And though the technology is now the same, the mentality is different in the car industry because the life cycles are so many years long. Engineers need to look for perfection. The speed is different; the approach to risk-taking is different. ▶

“When the FIA launched the current Formula One programme, this was the idea,” he adds. “These new power units are at the forefront of the development process. They’re speeding it up for the automotive industry.”

Andy Cowell, managing director of HPP, believes that, to explain what F1 can offer, it is first necessary to look at where evolution will take road cars in the next few years.

“In the automotive world the end game could be a very small internal combustion engine (ICE),” he explains. “In Formula One, we have a 1.6-litre engine with 850bhp-plus. How much horsepower does a road car need? 200bhp? That’s more than enough, so you’re looking at perhaps a 500cc ICE, heavily boosted, made driveable by an e-booster. When this car slows down, as much energy as possible is recovered by electric machines and stored in a battery that’s large enough to always recover all of the energy, and large enough so that initial town driving can be done in electric mode. It’s not an electrical vehicle, though: it’s the harmony between a highly efficient ICE, chasing greater than 40 per cent thermal efficiency, with electric hybrid systems to recover energy. I can envisage that in the road car world.”

JOINT COLLABORATION

Based on this vision of the future, Cowell argues that F1 is ideally placed to develop relevant technologies. “We – Renault, Ferrari, Honda, ourselves – are all trying to create great thermal efficiency in the combustion chamber. That expertise has got direct road relevance, even without requiring a car to be a hybrid.

“If we then add a turbocharger, the knowledge we’ve got of the electric turbocharger provides the opportunity to finish up with a heavily-boosted ICE and thus the next step in efficiency. Managing that and making it driveable is made possible by the electric machine on the turbocharger. In the road car world the e-booster is being developed and our expertise in this will help. Finally, there’s the MGU-K. For a car manufacturer, confidence that they can recover a lot of energy through an electric machine that’s connected to the road wheels is something that needs a lot of careful thought about control strategies, redundancies and fail-safes. We can help with the control systems approach to that – because in F1 we’re used to operating these systems safely with drivers who are right on the edge, while maximising the energy recovery.

“Then there are the batteries. The KERS [Kinetic Energy Recovery System] batteries were all about power, not so much about energy. The new F1 battery has both high power capability and also high energy density. The energy density is important to us because of the high energy levels we’re permitted. In a road car it will be what provides the range.”

Brixworth has a proven history in taking technology developed for the race track and passing along that knowledge to Mercedes’ road car operations. The learning curve for KERS was instrumental in the creation of Mercedes’ SLS AMG Electric Drive road car. The low-volume model, an electric derivative of the SLS AMG, utilised a powertrain comprising four synchronous electric motors and a lithium-ion battery pack. It was designed as a collaboration between Mercedes AMG and HPP. That project, in return, refined HPP’s

“THESE F1 POWER UNITS ARE SPEEDING UP DEVELOPMENT FOR THE AUTOMOTIVE INDUSTRY”

PROF DR THOMAS WEBER, MERCEDES

knowledge of working with large batteries, thus informing the creation of the world-beating Mercedes PU106 hybrid power units.

Developing new technology is only half the challenge, however. The other is disseminating the information through the organisation. Mercedes stresses the importance of having interaction between its engineers from racing and road divisions – which is why HPP is part of the mainstream R&D organisation – and frequently HPP will be asked to collaborate on projects such as the e-SLS. It is also party to Mercedes’ preferred method of development, which involves various design offices engaged in internal competition. The idea is to provide a second opinion – actually a range of second opinions – to that of Mercedes’ HQ engineering efforts in Sindelfingen, Germany.

“They have a common task, a kick-off meeting and then, however long later, we receive their ideas and compare drafts,” explains Weber. “The first ideas are never perfect, there is never one completely outstanding draft, and so we combine the best ideas and move forwards. More and more the Formula One side is involved in this process.”

Weber stresses that, at an operational level, Brixworth stays a separate organisation to the rest of Mercedes to protect both the IP of the business and also the racing culture. Interestingly, this is a very different approach to that taken by Porsche.

INTEGRATED EFFORT

While Porsche isn’t dominating the LMP1 category of the World Endurance Championship (WEC) to the same extent that Mercedes has dominated in F1, the return of the famous marque to top-level endurance racing has been a great success. In this, its second season back after a 15-year hiatus, Porsche has won the Le Mans 24 Hours and, at the time of writing, led both the manufacturers’ and drivers’ championships in LMP1. Rather than keep its racing division at arms length, Porsche places it at the heart of the operation.

Dr Frank-Steffen Walliser, Porsche Vice-President of Motor Sport, explains: “Our LMP1 race team is integrated into our R&D centres. We didn’t want to have an off-site racing team or anything like that. It was part of the technology transfer decision to have an on-site racing team. The LMP1 team uses the resources of the street car development [department], sharing test benches and so on; there’s an organic exchange of ideas.” Porsche pulled out from

The development of KERS in Formula One helped in the creation of Mercedes’ SLS AMG Electric Drive road car.



Andy Cowell and Prof Dr Thomas Weber (below) play an integral role in the transfer of race to road technology at Mercedes, as does Dr Frank-Steffen Walliser (right) at Porsche.





“IT WAS PART OF THE TECHNOLOGY TRANSFER DECISION TO HAVE AN ON-SITE RACING TEAM”

DR FRANK-STEFFEN WALLISER, PORSCHE

Porsche's latest 991-derived LM GTE race car is built on the same production line as the manufacturer's road-going models.

the elite endurance racing category in 1998, concentrating for the next decade on expanding the road car business beyond its traditional performance niche and into SUVs and mid-market sportscars. For 2005, the brand designed the LMP2 RS Spyder, racing in the American ALMS series, but it stayed away from LMP1 until WEC arrived and presented a view of the future based around hybrid technology.

“The RS Spyder could be considered a first step to coming back to Le Mans – but in those times, with a gasoline engine, you had no chance against the diesels,” says Walliser. “But when the new energy-efficient regulations arrived, with the equivalency between turbo, normally-aspirated and different classes for the energy recovery systems, it presented a really high level of freedom for the engineers and was the point at which the decision was made to come back to Le Mans.”

TECHNOLOGICAL GAINS

Porsche perhaps has an easier job transferring technology from racing to the road than many of its rivals, given that it has always maintained very close links between the two arms of its operation. Its 911 racing cars, including the latest 991-derived GT3 and LM GTE classes, are built on the same production line as road-going models and many technologies today found on road-going models begin life in racing. It could be assumed that the more exotic LMP1 programme is further removed from road-going applications, though Walliser, also responsible for the company's GT production sports car programmes, argues this is not necessarily the case.

“System-wise, it's not so far away with the hybridisation,” he says. “For instance, we are using an independent front axle in LMP1 that is very much like the concept in the [Porsche hybrid supercar] 918. The engine is more extreme, the design more lightweight and the regulations more specific, but the concept of these cars is not so far away from a street car. Obviously we don't expect to carry over parts because the race cars are low-volume prototypes, but for systems, for know-how, for development models, we can use the LMP1 programme.”

“There is a road map for hybridisation. Today, Porsche offers hybrid technology in the Cayenne and Panamera. The next generation will take this technology further and include input from Le Mans.”

The language used by both Porsche and Mercedes is subtly different to that heard in earlier eras of motor sport when ‘win on Sunday, sell on Monday’ had primacy and technical development was a useful bonus. Today, while both companies are enjoying considerable success, both argue their participation is driven by the technology rather than the marketing exercise. This is, perhaps, a healthy philosophy given the huge commitment obliged by a modern motor sport programme, involving, as it typically will, hundreds of personnel and hundreds of millions of dollars. Corporate boards can shoulder that obligation when there is a defined road map for development and a set of technical regulations shaped to target specific areas of research. It's a more trustworthy proposition than nebulous promises of silverware and glory. Those still rely on serendipity. ■

PHOTOGRAPHY: DPPI

HONDA'S F1 COMEBACK

Yasuhisa Arai, Honda R&D's chief officer of motorsport, talks to AUTO about the benefits of its return to F1 action with McLaren in 2015



Q Was technology development an important consideration in Honda's return to Formula One?

Technology development was definitely a big part of our decision to re-enter F1. The learning gained from developing hybrids will, we believe, make its way down into automotive in the future.

Q What technology do you expect to accrue from the F1 project?

Looking specifically from the engine perspective, we can gain knowledge of combustion and reduction of friction, high-pressure direct injection systems, efficiency in turbochargers, evolution in

oils and lubricants, and fuel efficiency. Hybrid technology will also be useful, for example, in the evolution of battery technology, power electronics and heat regeneration systems (MGU-H), etc.

Q Is it realistic to expect fully-formed technology to be transferable from F1 to road cars?

The fundamental concept, skills and technologies found within F1 are definitely transferable. What is already very similar now between F1 and road cars are the turbo combustion and direct injection technologies. The heat regeneration area still requires further

research before it can be used in road cars, but it being used in F1 is a revolution in itself – it was only mentioned as an idea or concept just a few years ago.

It is great to see these kinds of ideas come to life so quickly. However, all these F1 challenges are performed at the highest level of efficiency and therefore do not necessarily trickle down to road cars immediately, or even within a few years. Ultimately, it is very difficult to set precise goals in many areas of F1, but it is extremely helpful in our research to show in which direction the automotive industry can go.



A troubled return to F1 with McLaren hasn't dented Honda's hopes of making technological discoveries that can trickle down to its road car section.

AUTO
FOCUS

Fuel cell technology

THE DRIVE TO HYDROGEN

After years of unfulfilled promise in the hydrogen vehicle sector, BMW and Toyota look to be on the verge of a

breakthrough with a fuel cell car that takes efficiency to a whole new level TEXT: BEN BARRY



Six years ago, engineer Matthias Kliez was working alongside racing drivers Robert Kubica and Nick Heidfeld at the BMW Formula One team. Now the powertrain expert's skills are being applied to an entirely different field: the development of hydrogen-powered road cars, known as Fuel Cell Electric Vehicles (FCEVs). AUTO has met Kliez at BMW's sun-baked Miramas test facility in the south of France to sample what might just be an ultimate driving machine of the future: a 5-series GT hydrogen prototype.

There's a breathy exhalation as the prototype saloon leaps forward enthusiastically on full throttle, a futuristic if subdued soundtrack of high-pitched whirs and whines as the speed settles to a refined cruise, and an almost imperceptible transition as the second of two gears kicks in at 90km/h. We could be driving like this for up to 700km, estimates Kliez.

It's a tantalising prospect: a car fuelled by the world's most abundant resource and one that emits nothing but water from its exhaust. Critics, however, will argue that hydrogen as an alternative fuel source has been a prospect for a long time.

In 2006, hydrogen-powered vehicles looked to be on the cusp of a major breakthrough. BMW produced a small number of 7-series prototypes with V12 internal combustion engines converted to run on hydrogen, Mazda released bi-fuel, Wankel-engined RX-8 sports cars, Hyundai tested a fuel cell prototype in South Korea and Honda had public pilot trials of the FCX hydrogen fuel cell in both Japan and California. But the chicken-and-egg dilemma of who would fund the hydrogen refuelling infrastructure was never resolved and the electric car – its apparent demise chronicled by Sony Picture's *Who Killed The Electric Car?* in 2006 – subsequently made a comeback. Hydrogen seemed to be in its death throes.

Not so, says Kliez. "People often ask why BMW stopped developing hydrogen technology, but we never did; we have been working on it constantly for 30 years. Hydrogen offers zero emissions and very high levels of energy storage, so it's ideal for longer ranges and larger vehicles."

Hydrogen is not a silver bullet for the world's transportation needs – issues continue to dog the nascent refuelling infrastructure

and the manner in which hydrogen is extracted from the natural resources it comes bundled with – but a renewed push towards fuel cells could see them overtake battery-electric cars such as the Nissan Leaf, BMW i3 and Tesla Model S as the zero-emissions mobility choice of the future. "Eventually, fuel cells will be cheaper than battery-electric vehicles," predicts Kliez.

Now, a new cryogenic hydrogen storage system developed by BMW has enabled the 5-series GT's vast 700km driving range on a tankful and a technical partnership inked with Toyota in 2013 has injected fresh momentum.

BMW and Toyota intend their collaboration to speed up FCEV development, reduce costs and contribute to market standardisation, helping to avoid the confusion caused by the numerous chargers employed by battery-electric cars. In the 5-series GT prototype, the fuel cell stack is produced by Toyota and fuel cell auxiliaries by both companies, while BMW manufactures the hydrogen tank, electric motor, fuel cell housing and high-voltage battery.

BMW has 15 years' expertise in FCEVs, its earlier work focusing on internal combustion engines running hydrogen. In an FCEV, the chemical reaction that generates motive power is a twist on the school laboratory electrolysis experiment. Instead of splitting water into hydrogen and oxygen by introducing an electrical current, water and electrical energy are created as a by-product of hydrogen and oxygen reacting in the fuel cell stack.

It works like this: hydrogen is pumped into the 5-series GT at a refuelling station much like you fuel a car with petrol and is stored in a bulletproof 'tunnel tank' between the front and rear axles, where a conventional BMW's propshaft would reside. But the key is the fuel cell stack under the bonnet. When the driver accelerates, hydrogen is fed to the fuel cell stack where it reacts with oxygen, generating electricity for the 245bhp electric motor that powers the wheels and emitting water from the exhaust.

The fuel cell is also supported by a high-voltage battery at the rear of the vehicle, so energy can be captured during braking and deceleration – similar in concept to a Formula One car's KERS system – and fed back to the electric motor, reducing hydrogen consumption. But because it only serves as a power buffer, the high-voltage battery can be smaller and lighter than a normal electric car's battery. As a result, there is no reduction in the large saloon's luggage capacity. The 5-series GT FCEV *does* weigh around 100kg more than its internal-combustion siblings, but Kliez expects this penalty to diminish throughout development.

REFUELLING FOR THOUGHT

A sizeable advantage of hydrogen fuel cell vehicles compared with battery-electric cars is their short refuelling times. A home charge for a battery-electric car can take up to eight hours, while the fastest rapid-chargers give an 80 per cent charge in 30 minutes, enough for around 160km of driving depending on the car. A FCEV can be refuelled in less than five minutes and offer well over twice the range from 4.5kg of hydrogen stored at 700 bar in a typical pump. It's an easy fossil fuel substitute for the regular motorist.

However, BMW's cryogenic hydrogen storage system increases the range to up to 700km in the case of the 5-series GT though does, ironically, introduce a second fuelling method and therefore adds more complexity for the customer to understand. The hydrogen is stored at -220deg C, allowing the 5-series GT to hold 7.1kg of hydrogen in its fuel tank. At today's prices, that equates to a €70 tankful. The hose is fully insulated, so you can't feel the extreme cold, and there's no risk of a leak when removing the hose after refuelling, unlike with petrol or diesel.

The first cryogenic hydrogen filling station has already opened in Munich, a public station operated by Total where BMW engineers can fuel prototype test cars. Conventional 700-bar hydrogen storage is offered at the same site.

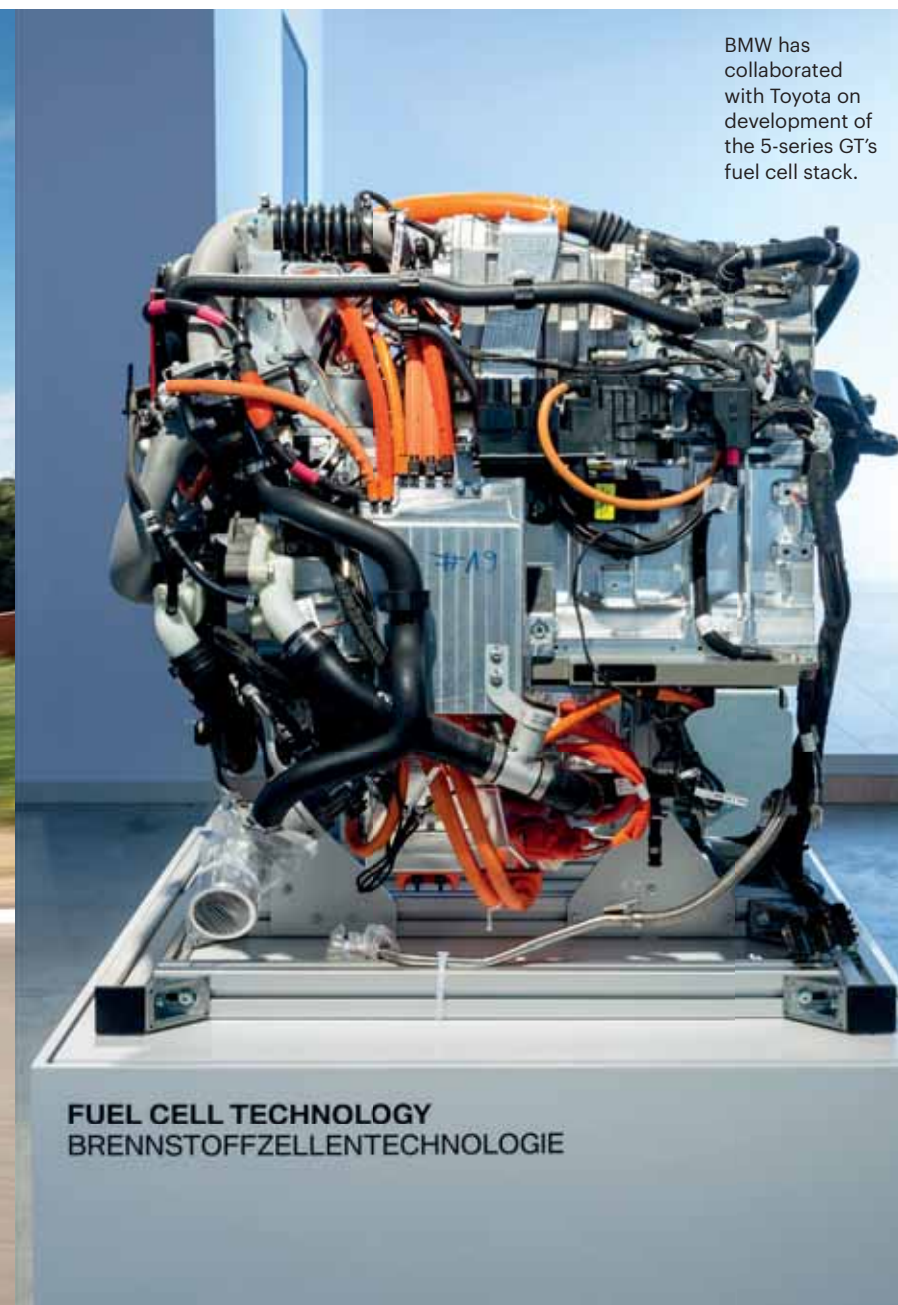
"One cryogenic hydrogen pump can provide energy for 100,000km of driving per day, compared with 50,000km per day based on a regular 700-bar pump," reveals Kliez. "We would offer the customer both systems, the cryogenic system carrying a premium when the car was first ordered. Both would be available at the pump, like leaded and super unleaded, and a different sized nozzle would be fitted to avoid misfuelling."

As BMW's own press materials point out, 'the successful introduction of FCEVs is dependent on the development of a hydrogen infrastructure in the markets concerned'. Of those, key European territories are Germany, Scandinavia and the UK.

Germany currently has 50 hydrogen refuelling stations with a target of 400 by 2023, and the Scandinavian Hydrogen Highway Partnership has pledged to have 45 stations in operation ▶

"PEOPLE OFTEN ASK WHY BMW STOPPED DEVELOPING HYDROGEN TECHNOLOGY, BUT WE NEVER DID"

MATTHIAS KLIEZ, BMW



BMW has collaborated with Toyota on development of the 5-series GT's fuel cell stack.

FUEL CELL TECHNOLOGY
BRENNSTOFFZELLENTechnologie

With a driving range of 700km, BMW's 5-series GT hydrogen prototype has been tested at the Miramas in France. Below: refuelling is fast and efficient, providing the infrastructure is in place.



this year. The UK government, meanwhile, has earmarked £11 million to develop a hydrogen infrastructure and fund 40 hydrogen-powered vehicles for public sector fleets. The sizeable investment will take the UK's tally of refuelling stations to around only 15.

"The infrastructure for hydrogen is cheaper than for battery-electric charging and it's already there with existing fuel stations," says Kliez. "But who pays for the hydrogen pumps – the fuel company, the OEM [Original Equipment Manufacturer], the government – is not clear. Europe should look at Asia; it's a good indicator that you can make into a business case. South Korea has 43 stations with a target of 500 for 2030; Japan has 100 with 800 planned for 2025. Asia will be a driving force for hydrogen storage."

For Kliez, a switch to hydrogen is a logical – and essential – extension of the on-going drive towards renewable energy. "The need for hydrogen is not only driven by zero-emissions vehicles, it's essential so we can store renewable energy," he explains. "After the Fukushima nuclear disaster in Japan, Germany decided to phase out nuclear power and has a renewable energy target of 50 per cent by 2030. This will result in fluctuating energy supply, but we can capture

this energy and store it as liquid hydrogen. It will act as an electricity buffer for Germany and ideal as a vehicle fuel. To reach the government target, we have to start storing energy now."

As this process would use power-to-gas electrolysis to produce hydrogen from electricity, the environmental issues of extracting hydrogen from fossil fuels – often the case for industrial-scale production – are neatly sidestepped, undoing the argument that while only water is emitted from the 5-series GT's exhaust, the well-to-wheel environmental impact is significantly higher when production is considered.

We pull up at the side of the test track, the BMW gliding silently to a stop. It's an impressive piece of engineering from the powertrain expert who once chased tenths of a second on track. The big question is, then, when will an FCEV like the 5-series GT roll off Munich's production lines? Kliez smiles broadly, refuses to commit to an on-sale date, but does reveal that BMW hopes its components will be production-ready by 2020.

Could the long-forecast hydrogen breakthrough be just around the corner? This time, it might just be. ■

HYDROGEN: PUTTING THE WHEELS IN MOTION

FCEVs GO ON SALE: While FCEVs have previously been leased to the public during limited trials, the latest cars can now be bought outright. Hyundai launched the ix35 in 2015, billing it as the world's first mass-produced hydrogen car. It costs around €72,330 in Europe and KRW\$150m in South Korea, but is available only to lease in the US.

BMW's technical partner Toyota introduced the Mirai FCEV from late 2014 after 20 years of development. The family saloon has a sale price of €66,000, \$57,500 in California and 6.7m Yen in Japan. Production was increased from 300 to 700 units for 2015 and Toyota is targeting 3000 sales by 2017.

HYDROGEN IN THE UK: The UK H2Mobility project aims to maximise the commercial deployment of FCEVs in Britain from 2015. It offers a forum for fuel cell developers, energy suppliers, fuel retailers and car manufacturers to meet with government departments and administrative bodies to develop a business case and strategic plan for the rollout of FCEVs.

UK H2Mobility cites that the UK has a legally binding carbon reduction target of 80 per cent by 2050, with transport likely to be required to decarbonise by up to 90 per cent. The project will look at the role FCEVs could play in decarbonisation, as well as evaluating the economic benefits of the UK as a key player in the development and manufacture of hydrogen-fuel technologies.

TOYOTA RELEASES FUEL CELL PATENTS: Following electric car maker Tesla's innovative lead, Toyota released 5680

patents relating to hydrogen fuel cell development on a royalty-free basis at the 2015 Consumer Electronics Show.

In sharing its normally closely guarded secrets, Toyota hopes to support the wider introduction of FCEVs. The more FCEVs that are made, the greater the demand for refuelling stations.

The patents relate only to those exclusively owned by Toyota, and Toyota asks interested parties to share their patents in exchange.

EUROPE'S HYFIVE PROJECT: BMW, Daimler, Honda, Hyundai and Toyota are collaborating on the HyFive project in Europe. HyFive is a joined up approach where the five manufacturers – all of whom have invested millions in fuel cell development – will introduce FCEVs in markets with an infrastructure mature enough to support them.

HyFive is also working closely with European governments to supply 110 vehicles to six cities – including London – and establish a network of hydrogen refuelling stations.

JOINT CO-OPERATION IN JAPAN: As a relatively isolated island with dense centres of population, Japan is ideally placed to develop a hydrogen-refuelling infrastructure. Toyota, Nissan and Honda have announced the Joint Hydrogen Infrastructure Support Project to fund and develop this. The three car makers will cover some of the operating costs of hydrogen stations and provide assistance for infrastructure companies.

The project complements the Japanese government's existing financial incentives for the introduction of hydrogen fuelling stations.



AUTO
FOCUS

World Rallycross

CROWD PLEASER

Every year thousands of fans descend on the sleepy French village of Loheac for the world's biggest rallycross event in a sport that is attracting headlines for all the right reasons

TEXT: HAL RIDGE PHOTOGRAPHY: TOM BANKS

For most of the year, the tranquil, idyllic French village of Loheac in Brittany, north-west France is home to around 600 people. For one weekend in early September, however, things get a littler busier as thousands of fanatic rallycross fans descend on it.

This year, the rallycross circuit that sits just half a kilometre from the restaurants and patisseries in the village's centre welcomed 75,000 spectators over two days of competition at round nine of the FIA World Rallycross Championship.

The French event is the most visited on the World RX calendar, with a mix of new and old fans packing the banking around the kilometre-long circuit to watch the series of heats, semi-finals and finals that form a World Rallycross weekend. While Lydden Hill in the UK is regarded as the 'home of rallycross' and Holjes in Sweden is the sport's festival weekend, Loheac - founded in 1976 - is regarded as the 'Mecca' of rallycross. This isn't just a race weekend; it's a motor racing pilgrimage.

Campsites around the circuit are a hive of activity in the evenings, while the village's restaurants produce bespoke menus for the occasion. Like the Le Mans 24 Hours that takes over another pocket of France each June, not far from Loheac, this is a fever-filled motor racing experience that starts before the Friday evening parade of World RX cars and drivers through the village's narrow streets.

It is even more significant this year as rallycross is on an upward curve in popularity with drivers, teams and fans since the sport's promotion was taken over in 2013 by marketing giant IMG. Together with the FIA it had turned the series into a world championship by 2014. As well as an increase in viewing figures, via both television and the internet, the sport is experiencing an upturn in on-event spectators at every round - and Loheac is no exception.

FOCUS ON THE FANS

Yet while rallycross is growing faster than many other four-wheeled disciplines, accessibility for the fans hasn't changed, which is just one of the sport's many endearing features. A general admission ticket allows access to almost the full perimeter of the Loheac track to view the quick-fire, action-packed races for four-wheel drive Supercars that harbour 600bph under their bonnets and can out-accelerate a Formula One car to 100kph, before rubbing panels while sliding sideways on sealed and unsealed surfaces. And the fever doesn't end there. Once the on-track action takes a breather (heats are run over four laps, with semi-finals and finals run over six), spectators have full access to the paddock, enabling anybody and everybody to get up close to the drivers and teams.

The current era of the sport accommodates young up-and-coming drivers who pitch themselves against established motor racing stars; those who have been there, done that and not only got the T-shirt but collected a whole host of racing suits and experiences too.

High-profile drivers like Petter Solberg, Yvan Muller and Mattias Ekström stand just feet away from the spectators' vantage point outside the team's awnings and such is the enthusiasm for the sport that even late in the evenings, long after the racing has finished, fans still wander the paddock watching the mechanics and engineers hard at work preparing for the next day's competition.

"This place is so special, it's an amazing atmosphere. In the camping zone I've met people who when I arrived I didn't know but now we are friends," says Belgian rallycross fanatic Jerome Larive, who has been attending European rallycross events for 30 years.

"People don't come only to see a car race, they come to see a real rallycross race. It's a passion for the people and it's about the whole thing, not just what's on the track. I think it's important that rallycross can keep the soul of the old ways, but for the TV show and progress it's important to evolve rallycross at a new level. It's a lot more accessible to the public now. ▶



Above and right: World RX stars including reigning champion Petter Solberg and Ford Olsbergs duo Andreas Bakkerud and Reinis Nitiss greet fans during the Loheac street parade. Right: the short, sharp race format helps keep fans glued to the action.



"THE SHORT HEATS, POWERFUL CARS AND CLOSE ACCESS FOR FANS IS WHAT ATTRACTS ME"

MATTIAS EKSTRÖM



Former European champion and World RX team owner Kenneth Hansen is pleased with how rallycross has progressed under the FIA and IMG's guidance.



Mattias Ekström (below) competes in both World RX and the DTM, but is a big supporter of rallycross's fan-friendly approach and down-to-earth nature.

AUTO FOCUS

“Before, this was the most secret motor sport. In the past it was a race for mechanics and farmers. Now it’s a very professional structure and it’s really good for the development of rallycross. I think a lot of the hard work has been done – you can tell by how many people come to Loheac now – and what they see in the paddock with all the trucks and big tents is amazing.”

Outside the Peugeot-Hansen awning on Saturday evening Timmy Hansen, who finished top after the first day’s heats and would go on to win the event, is signing autographs for the hordes of patriotic French fans. One excited spectator gleefully gets his T-shirt scribbled on in indelible ink and while having his photo taken with the Swedish driver exclaims: “I remember the battles between your father [Kenneth Hansen] and Jean-Luc Pailler here at Loheac. Now it’s amazing to watch you racing against Jean-Luc’s son [Fabien], Yvan Muller and François Duval. This is what rallycross should be,” he beams, as he heads through the throng in search of the next mark on his now-favourite top.

THE RIGHT MIX

The current blend of new and old, from fans to drivers, teams and circuits in the World Rallycross Championship, is providing a diverse range of experiences for the growth of the sport. The mix of circuits in World RX is that of traditional tracks such as Loheac, Lydden Hill and Holjes with new venues at the likes of Hockenheim in Germany, Istanbul in Turkey and Trois-Rivieres in Canada. While these new territories are all about attracting new fans to the circuits via social media, the internet and television, the more traditional venues mean the sport’s promoters are also required to maintain the support of traditional rallycross addicts.

Geatan Lepage attended World RX for the first time at Loheac to cheer on home hero Davy Jeanney. “There are a lot of people here and they come from all over the country,” he says. “This is my

first time and I love it. My friends have been for two or three years and always say it is so good, so I had to come. We come from the hometown of Davy [Jeanney] so we have come to support him but also for the ambience, which is amazing. The whole weekend is so much fun, in the camping site and by the track. The racing is amazing, the cars are so fast and very special.”

Local hotelier Pascal Le Coguic feels the sport’s progress is evident in Loheac, but also believes that rallycross is strong in itself and not just riding a wave of high-profile names. “Just by walking in the paddock you can sense the evolution and professionalism of the sport,” he says. “Everything is a lot better organised than before, from hotel reservations to the event as a whole. There’s a higher attendance than ever, which comes with obvious financial benefits to the region. People have always come to Loheac and will in the future, but there has been an increase, with people like Sébastien Loeb and Ken Block racing in recent years. But I’m sure most people come for the rallycross regardless of the headliners.”

That formula of new mixed with old is evidently working. The sport is aiming itself at a younger demographic than the average motor racing fan – the short, sharp race format of a rallycross event perfect for a generation more familiar with watching video clips on the likes of Twitter and Facebook than maintaining interest in a circuit race that develops over a longer period of time. For double DTM champion turned EKS rallycross team owner and driver Ekström, that aspect is a key attraction.

“The way the sport is operating, with short heats, powerful cars and allowing the fans to be very close to the teams is what really attracts me. The younger audience are impatient and you need something to balance out a two-hour Formula One race for kids who get bored after a 30-second Facebook clip. You need to entertain them on a level that will interest them more and is action-packed, and I think rallycross offers a lot of action. ▶

Bakkerud (right) does his bit for the fans. Below: Hansen and Ekström battle it out on the kilometre-long Loheac track.



FIA WORLD RALLY CROSS CHAMPIONSHIP

Team Peugeot-Hansen driver Timmy Hansen was a popular winner for the French marque in Loheac. Below: Rallycross fans benefit from close access to the drivers and teams.



I really believe in rallycross as a sport, a concept, for entertainment and because value for money is high for the fans,” explains the Swede, who continues to compete at the top in DTM alongside his World RX programme.

In May this year the two disciplines met at Hockenheim, giving Ekström’s touring car colleagues an opportunity to view rallycross first hand. “A lot of them think the cars are pretty fast, but they think the paddock life, like having a truck and a tent, is not DTM or F1 standard. For me, motor racing is not about the hospitality or how big your paddock facility is, it’s the racing, how much entertainment value there is and how great the cars are to drive. You can put any driver into a rallycross car and I promise you they will get out with a smile. Jenson Button said something I really like: ‘To make a sport great, first the drivers have to love what they’re doing.’ In this paddock, I promise you that every single one of us loves what we are doing.”

CHANGE FOR THE BETTER

Reigning World RX champion Petter Solberg, whose 2014 crown made him the first-ever FIA world champion in two different disciplines (having bagged the WRC title in 2003) thinks the level of competition in rallycross is especially high.

“The last few years have been a massive step in how the sport is promoted, the teams, the development of the cars and drivers,” he says. “You also see a lot of engineers coming from many other different motor sports. It’s been a huge step, but there is still a long way to go.

“It’s not that any rally or race driver can come in and just clean the floor with everyone, it’s not like that at all. There are a lot of drivers who have rallycross experience and then you have DTM, F1, WTCC, WRC drivers – it’s no walk in the park. In F1 you have Mercedes and Lewis Hamilton who are a little better than everyone else, in WTCC you have Citroën at the top, in WRC you have Volkswagen, but in rallycross you don’t see that because there are so many different factors involved.”

The Norwegian enjoys being at close quarters with the fans at World RX events like Loheac. “When I did rallying for many years in a big team, many of the teams tried to hide away and relax, but for me what I like about rallycross is that I get energy from the people, so I like to keep things more open and they love it. That is so different compared to many other motor sports, and a very good thing. It needs to keep this.”

While Ekström and Solberg and their respective teams are relative newcomers to the highest level in rallycross, fellow Scandinavian Kenneth Hansen has seen it all. The 14-time European champion and head of Team Peugeot-Hansen believes that it’s imperative the sport grows while maintaining its traditions. “Together with my wife Susann (also a European champion) we have seen a lot. I went into international rallycross in 1987 and over the years we saw around 10 organisers trying to cooperate for a European championship, to get the level good and to get

good television and collect money to do that. It doesn’t work. We always said that we need a promoter; we needed someone to take care of the sport.

“Peugeot-Hansen was the first team who officially supported IMG’s idea at the beginning, as not everyone wanted them to come. We have always had a very good sport, but to make the best fruit of it, we needed someone to make it into a package. We knew that not everything would always be as we wanted, but we want the sport to grow up and really be seen by the world. For us, it has been a big, big step,” adds Hansen, who is a member of the FIA Drivers’ Commission.

“The most important thing is that together we grow the sport as much as possible, but keep the rallycross spirit. We keep the fact that we are close to the people and the cost of running a team can be reasonable. If we can keep those things then we have a great future. We don’t want to be like Formula One where the fans are so far away, we want it to be that people can come and almost touch the cars, speak to the drivers and I think we are going in the right direction. Even if I’m not driving these days, I’m very happy to be involved in this incredible time for the sport, which has been such a big part of our lives.”

The final word on the Loheac weekend is left to Hansen, whose team and son Timmy – a graduate of the FIA Institute Young Driver Excellence Academy – won in front of Peugeot’s adoring home crowd, just down the road from the marque’s nearest factory in Rennes. “To win at Loheac, in France with Peugeot and for the French people in that atmosphere at a rallycross event, it’s absolutely magic! I won the European championship event here in 2001 in front of 40,000 people, but to make the victory for Peugeot with this kind of competition and 75,000 people watching, it gives me goosebumps just to think about it.” ■



AUTO
FOCUS

Environmental action

RACING GREEN

Motor sport's teams, promoters, circuits and organisations are increasingly embracing environmental efficiency, with the help of the FIA Institute Sustainability Programme

TEXT: ALEX KALINAUCKAS

More than ever before, motor sport's stakeholders are striving to improve their environmental performance. Racing teams, circuits, National Sporting Authorities and events have understood that sustainability is not just an area that can improve their efficiency but also have a positive effect on their income.

To facilitate this, the FIA Institute's Sustainability Programme offers motor sport's organisations the chance to measure, improve and be recognised for achieving the highest environmental standards. It offers an environmental accreditation scheme, the first to have been developed specifically for motor sport, which rates organisations on three levels of performance and offers benchmarks on which to improve.

A number of organisations are leading the way. The McLaren Formula One team was the first race team to be awarded the top-level Achievement of Excellence and earlier this year the Circuit de Barcelona-Catalunya became the first Grand Prix track to reach the same standard.

But the programme is also supporting organisations on their way up the ladder. Finland's ASN, AKK Finland, has achieved the second-level award, Progress Towards Excellence, and is striving to make it to the top.

One thing that all of these motor sport stakeholders have in common is their commitment to improvements in environmental efficiency, something that can only be good for the future of the industry.

THE RACE TEAM

When the Sustainability Programme was unveiled in June 2012, McLaren was the first organisation to apply for accreditation. The British team, which has been working on its environmental credentials since 2007, has taken the principles of sustainability into the core focus of the company and this can be seen throughout its products and ventures.

These include the P1 hybrid hypercar, the Formula E electric powertrain technology and even the company's work with the UK's National Air Traffic Service (NATS), which helps to increase efficiency at airports.

"McLaren Racing has developed strategic modelling software which looks at a multitude of variables in real time to predict race strategy," explains Ian Robertson, technical manager of the McLaren Technology Group. "These principles are being developed by McLaren Applied Technologies as predictive intelligence tools to reduce the holding times that aeroplanes spend in the sky above airports, thereby potentially reducing CO₂ emissions."

The most visible element of McLaren, the F1 team, also demonstrates the company's commitment to sustainability. The team's KERS systems are present in the P1 hybrid system and the drive systems of the Formula E Championship's power units.

Each department within McLaren has its own sustainability targets – even the race team's truck drivers have a competition to ▶

AKK Finland is working with Rally Finland organisers to raise awareness of environmental issues as the group aims for a top-level FIA Sustainability award.



see who can drive the most efficiently. “We use telemetry systems on the trucks to monitor and collate data on every aspect of the driving of that truck,” explains Robertson. “The drivers are quite a competitive bunch, as you can imagine.”

Despite expanding its business in recent years through its road car and technology operations, McLaren has managed to reduce its carbon footprint by 38 per cent in relative terms to its increased turnover.

McLaren’s accreditation at the top level in the FIA Institute Sustainability Programme has helped it to achieve this. Robertson believes that the award added a sense of legitimacy to the team’s work. “When we spoke to the FIA Institute about the Sustainability Programme, we weren’t as organised as we could have been with the different elements of sustainability and the programme helped pull everything together into a framework.”

It also helped to have an endorsement of its achievements from an external regulator. “If we had been singing our own praises then it might not have been taken as seriously as an external organisation endorsing what we’d been doing,” says Robertson. “That external verification is very useful.”

THE RACE TRACK

As the first Formula One track to be awarded the top level in the Sustainability Programme, the Circuit de Barcelona-Catalunya’s management uses a variety of means to improve the environmental impact of the facility, which had 88,700 people attend the 2015 Spanish Grand Prix race day and also hosts events in other major motor sport categories, such as Moto GP and the World Rallycross Championship.

“We have focused our efforts on the sustainable management of resources by means of selective trash collection for their valuation; the promotion of sustainable mobility when travelling to and from the circuit and the respect of our environment by means of a progressive extension of green areas,” says circuit president Vicenç Aguilera.

The track relays its commitment to the environment to the crowds attending events via its PA system and has set up an environmental surveillance committee that monitors and informs spectators and track employees about sustainability.

There is a system for managing the environmental impact of water and energy that involves continuous assessment to allow for improvements and corrections if deviations are detected. “To do that, we have drawn up detailed procedures, record external communications [that are] received and

The Circuit de Barcelona-Catalunya (above) became the first track to achieve a top-level FIA Sustainability award.



prepare regular reports in order to be able to act,” explains Aguilera.

During Grand Prix weekends, the track management collaborates with local public transport companies to offer all spectators the chance to travel via trains or buses, with increased frequencies on those services. The track also promotes a ‘Stop Food Waste’ campaign and has a ‘Green Meeting Point’, where environmental awareness is discussed with spectators during events.

The circuit has offset its CO₂ emissions by planting more than 7,000 trees in forests surrounding the track and by implementing a waste recovery system. “We have applied a selective collection system for all the generated waste, as well as a small-volume waste collection centre for recycling purposes,” explains Aguilera. The collection centre recycles around 50 per cent of the circuit’s total household waste and the unnecessary use of paper and batteries is discouraged.

Aguilera is pleased that his organisation has been accredited by the FIA Institute and recognises the benefits that environmental awareness has for all elements of society. “The fact that the FIA Institute is promoting this type of programme is excellent,” he says. “It is vital for the continuous improvement of motor sport, but also for society as a whole. Awards like the one from the FIA make us feel



The British-based McLaren F1 team has long pioneered strong environmental practices, recognised by the FIA and even employed in its work with the UK’s National Air Traffic Service (below left).

proud, as they are the consequence of a job well done and motivate us to continue working in this field.”

THE RACE CLUB

Currently at the second level of accreditation the Finnish National Sporting Authority, AKK Finland, is making progress towards excellence with the help of the programme.

“The process has changed our way of thinking generally,” says Jani Backman, AKK’s director general. “We will update our processes step-by-step and hopefully reach the highest level as soon as possible. Our target is to have an effect on motor sport throughout Finland at all levels, from a club evening to a world championship event.”

As the organisation works towards the top step, it has introduced a best practices manual based around environmental issues for the country’s local clubs and circuits to use. The document covers many of the key areas of sustainability, including conserving the natural environment, waste management and energy consumption.

This has been invaluable for its biggest motor sport event, the World Rally Championship’s Rally Finland. “We work together with Rally Finland to raise the national awareness,” says Backman. They have defined eight key priority areas to achieve a sustainable operation, including improvements to environmental processes, decreasing waste efficiently and emergency situation plans.

“These points assist the rally in the day-by-day planning and, together with the accreditation process from the FIA Institute here at AKK, we believe that we are in a position to improve our environmental performance in the future.”

But tackling noise pollution is the AKK’s biggest test: “Noise management at facilities and decreasing noise levels in our rules in the long term is our most important but continuing process.”

The AKK believes another way it can improve its environmental performance is by educating its officials so that they are thinking about the environment when planning events with local authorities. The organisation also introduced an electronic notice board and distributes results and official papers via mobile applications.

“Attitude is the key,” says Backman. “Sustainability is not rocket science, it’s more about a way of thinking.” ■

SUSTAINABILITY ACCREDITATION

ACHIEVEMENT OF EXCELLENCE

Apex Circuit Design
www.apexcircuitdesign.co.uk



Automobile & Touring Club of the United Arab Emirates
www.atcuae.ae



Circuit de Barcelona-Catalunya
www.circuitcat.com



Formula E
www.fiaformulae.com



Motor Sports Association (MSA)
www.msauk.org



Mugello Circuit S.p.A.
www.mugellocircuit.it



Norges Bilsportforbund (NBF)
www.bilsport.no



Rally Australia
www.rallyaustralia.com.au



Rally Sweden
www.rallysweden.com



McLaren Honda
www.mclaren.com/formula1



PROGRESS TOWARDS EXCELLENCE

AKK – Motorsport
www.autourheilu.fi



Goose Communications
www.goose.co.uk



Neste Oil Rally Finland
www.nesteoilrallyfinland.fi



COMMITMENT TO EXCELLENCE

Sasol Solar Challenge
www.solarchallenge.org.za



Trinidad and Tobago Automobile Sports Association
www.ttasa.org



AUTO FOCUS

REAR
VIEW

Legend

RALLYING'S FIRST HERO

The sublimely talented Timo Mäkinen led the way for a succession of Flying Finns competing at the very top in world rallying

TEXT: DAVID EVANS



Mäkinen's car control was legendary and helped him to the first of three successive victories for Ford on the 1973 RAC Rally (right).

T

To the uninitiated, the penny-farthing high-wheel bicycle of the late 1800s is a fairly peculiar way to get about. But a 20-year-old Timo Mäkinen was intrigued the first time he saw one parked outside his team boss Stuart Turner's house.

With the briefest of explanations of what it was and even briefer detail on how it worked, Turner headed inside. Realising he hadn't been followed, he returned to the door and found Mäkinen and the bike had gone.

"Timo was away off down the road before I could remind him how dangerous it was," says Turner, "not to mention how far he would have to fall."

Mäkinen remembers the moment well and smiles broadly at the recollection of his first and only trip aboard the highest of high-wheelers. "That was a lot of fun," he says.

And that's Mäkinen, always willing to jump in and give something a go. But it was the natural ability on four wheels that really drew then-British Motor Corporation team manager Turner to Timo.

Three years into his rallying career, Mäkinen borrowed a Mini Cooper from the Finnish importer to use on the Monte Carlo Rally – before taking it around the Monaco Grand Prix track faster than works driver Pat Moss.

Turner was impressed. And, keen to bring some Scandinavian speed to BMC's Abingdon headquarters, he invited Mäkinen, along with fellow Finn Rauno Aaltonen and Swedes Bengt Söderström and Tom Trana, to drive for him on the 1962 RAC Rally. ►



The Swedes retired, Aaltonen and Mäkinen were fifth and seventh – and employed.

“I thought this was possible,” says Mäkinen, “I thought I would be good enough from 1960, when I started winning.”

DELIVERING IN STYLE

Born in 1938, Mäkinen became a professional driver a long time before he sat in a rally car, delivering newspapers across central Finland for his family business. Spending much of their time on loose-surfaced gravel roads, car control comes naturally to Finns, but having to wheel a van from town to town through the deepest of winters helped further hone what would go on to become a legendary feel for grip.

At 21, the Helsinki-born Mäkinen brothers (Timo’s sibling Harri did the map reading) took to the rally stages in a Triumph TR3. The Mäkinens got to the finish of the 1959 1000 Lakes Rally third in class, just behind a couple of Saabs driven by Erik Carlsson and Aaltonen.

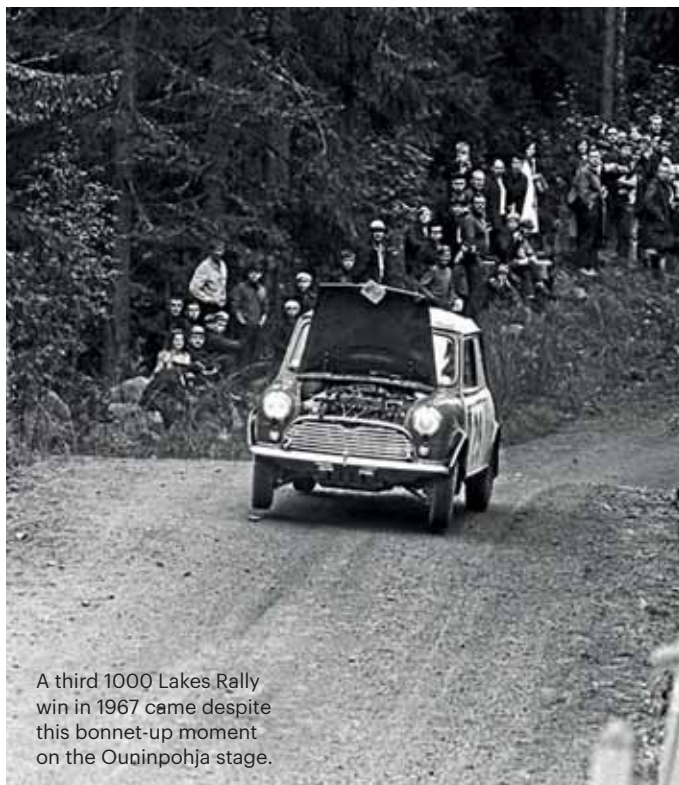
From then on, Timo would compete as often as possible and, in the winter of 1960, found himself tearing across frozen roads in a friend’s Jaguar D-Type.

“My friend was a bit frightened of the car,” recalls Mäkinen. “It was right-hand drive. I thought it handled well. The car had fantastic balance.”

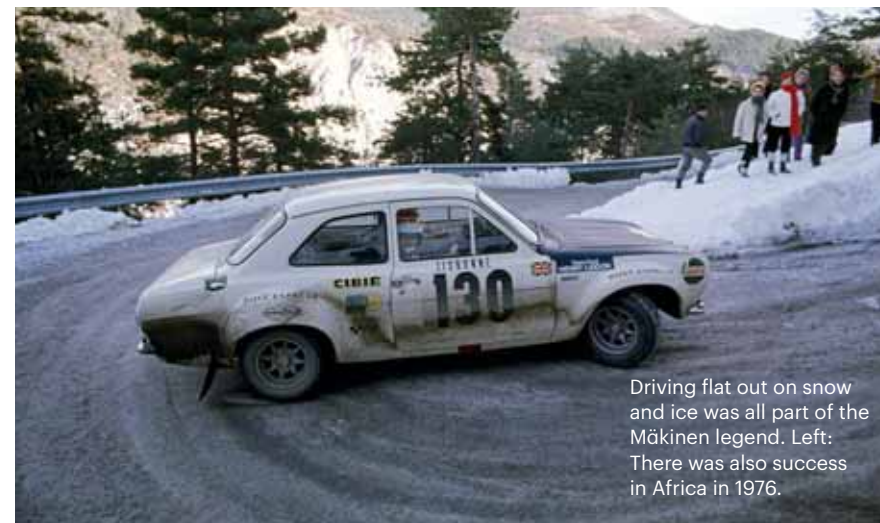
And so did Mäkinen. Following his big break on the RAC, Abingdon and Helsinki were in regular contact. A plan was made for the 1963 season. But it didn’t start quite as Mäkinen or Turner might have planned.

Turner says: “Timo joined the BMC team almost by chance. The Morris dealer in Helsinki called into my office in Abingdon and said he was supporting a young lad and it would help get publicity if I could find him a drive on the 1962 RAC Rally. He won his class and demonstrated the Flying Finn had arrived.

“At that time, entries for the Monte Carlo Rally had to be in before the RAC Rally had been run, but fortunately I’d entered Christabel Carlisle as a thank you for all her Mini racing successes.



A third 1000 Lakes Rally win in 1967 came despite this bonnet-up moment on the Ouainpohja stage.



Driving flat out on snow and ice was all part of the Mäkinen legend. Left: There was also success in Africa in 1976.



Mäkinen took his fourth and final win on the iconic 1000 Lakes rally aboard an Escort in 1973.

“WHEN I WON THE 1000 LAKES FOR THE FIRST TIME, THAT WAS A VERY SPECIAL MOMENT FOR A FINN”

TIMO MÄKINEN

The idea was that she’d drive her cousin in an Austin Healey Sprite. I persuaded her to sit alongside this new Finn in a 3000, instead.”

So, the world’s fastest piano teacher, native to South Kensington in London and knowing no Finnish, guided Mäkinen, a man who – by his own admission at the time – was familiar with only two words in English (one of them was whisky) on one of the toughest rallies of the season.

Turner remembers the outcome well and adds: “Their storming performance showed clearly how talented he was and how brave Christabel was; he swears she told him to go faster downhill, on snow and ice, at night in a Healey 3000!”

Thirteenth overall and a big win in the GT category demonstrated the Mäkinen magic had arrived.

In his first year with BMC, Timo was in and out of all sorts of cars, with a variety of folk navigating him. In 1964, his programme centred on Minis. Fourth on the Monte, he took his first big win on the Tulip Rally in the Netherlands, sharing a 1275S with Tony Ambrose. But when it came to the 1000 Lakes, Pekka Kesitalo would be co-driving as usual.

There was a need to find a regular voice from the navigator’s seat and, curiously for a man who hadn’t had much experience of the English language, Mäkinen saw the benefit of a British co-driver. “It definitely helped me as a driver,” he says, “but this was another idea from Stuart Turner – he was a very clever man and somebody who was very important in my career.”

A deal was done with Don Barrow, but when he fell ill shortly before the car version of the 1964 Tour de France, Paul Easter got a call. “Just before the Tour,” Easter says, “Diana Kirby [Turner’s secretary] called to ask if I could come to Abingdon to pick up some driveshafts, money and an air ticket. The next thing I knew I was in Lille as co-driver to Timo in a Cooper S.”

Everything was in place and Mäkinen began to exploit his immense natural talent and the professionalism of the team around him.

TRULY SPECIAL MOMENTS

Victory on the 1965 Monte Carlo Rally still ranks as one of the greatest drives in the history of the sport. Mäkinen eased a Cooper S across some of the most terrifying passes in some of the most extreme conditions and, on the way down the mountains, he tore into the opposition and left them trailing in his wake.

“That was my best ever result on a rally,” says Mäkinen. “That 1965 Monte win...”

If that was his best result. His best memory followed a few months down the line. ▶



Mäkinen spent much of 1975 running a Ford Escort RS1800. He was tough on machinery but had a sound mechanical knowledge to back it up.



A successful alliance with FIA President and then co-driver Jean Todt began in 1978 in a Peugeot 504 V6 Coupé.

“When I won the 1000 Lakes for the first time,” he says, “that was a very special moment for a Finn.”

Mäkinen’s success in host city Jyväskylä ended Simo Lampinen’s hopes of a home hat-trick. Winner on the previous two occasions, Lampinen’s Saab 96 was fourth in ’65. Straight after the finish, Mäkinen was ready to point out to Lampinen the error of his ways. It was his choice of car.

“It’s a wonder car,” Mäkinen smiled at his Cooper S. “It goes like stink and it doesn’t break.”

What happened next doesn’t happen very often these days. “Try it,” enthused the winner. Lampinen did just that. And got a couple of kilometres down the road when a driveshaft broke.

“Stuart Turner must have been impressed with that two kilometres,” says Lampinen. “He signed me for that year’s RAC – where I rolled the car properly!”

The hat-trick Lampinen wanted so badly instead came Mäkinen’s way two years later. Mäkinen’s 1967 1000 Lakes win will only be partly remembered as his third on the bounce; more readily, people recall his progress through the Ouninpohja stage with the bonnet up.

“We did about 12 of the 25 kilometres like that,” says Mäkinen. “I was third fastest, even though I could hardly see where I was going – the drag was terrible too. I kept trying to put my head out of the window, but the crash helmet was too big! I threw the car sideways this way and the other to try and get a view from the side windows.”

Mäkinen concedes that he had been the architect of his own Ouninpohja downfall. Concerned that the Mini was overheating, he’d put a bath sponge between the bonnet and the bodywork to allow more air to flow into the engine. The constant jumping and landing had stretched the leather straps and, on a particularly heavy landing, the straps let go, the bonnet shot up and history was made. Mäkinen took his hat-trick by eight seconds.

THE MONTE CONTROVERSY

In the middle of three years of home rule came Mäkinen’s lowest point in a rally car: his exclusion from the 1966 Monte Carlo Rally, an event he’d won fair and square on the stages, only to be robbed at post-event scrutineering. The Monte organisers found BMC guilty of running a headlight dipping system different from that used on the Mini’s road car equivalent.

Exclusion. And victory handed to French manufacturer Citroën. So incensed was ‘winning’ driver Pauli Toivonen, from Finland, he refused to attend prize-giving and declined the opportunity to drive for the Parisian firm again.

“That was my worst moment in rallying,” says Mäkinen. “When I first heard about that, I thought it couldn’t be true. But now people remember what happened and what actually happened in the rally.”

During the rally, the world had been treated to another display of Mäkinen magic. By now, Mäkinen was a dominant force in rallying. When he, Easter and the Mini were on song, they were, quite simply, unbeatable – regardless of where the rally was in the world.

Undoubtedly, Mäkinen was harder than some of his colleagues on cars, but as was also pointed out in his defence, he was always leading when the car broke. He was also firmly of the old school; more than proficient mechanically, Mäkinen was only too willing to get stuck into solving a problem his speed had helped create.

Aaltonen and Mäkinen are considered the original Flying Finns, with Rauno generally accepted to be the earliest proponent of left-foot braking. Four months younger than his countryman, Mäkinen took that style of driving and turned it into an art form.

Setting the car up with a stab of the left foot on the middle pedal, he would control the slide on the throttle; too much front-end push, more brake, while an overly wayward rear would be brought back into line with more power. The mid-corner speed he generated from this tap-dancing display was phenomenal and regularly carried the Cooper above and beyond competition which

Had the WRC started earlier, the present-day Mäkinen could be looking back on a career littered with titles.



should have cast it firmly into the shade.

He did, however, find his left-foot braking method utterly useless when he arrived in Britain in 1969. The event was the very first Round Britain Powerboat race, which he won. And he won it partly by persuading boat designer Don Shead that three V8 engines rather than just the two would work better.

As well as his exceptional speed, Mäkinen had the kind of personality that made people want to work with him and for him. With the win in the bag, Timo was, unfailingly, just as entertaining at the party afterwards.

END OF AN ERA

When BMC’s competition department shut in 1968, it was the end of an era. Could Mäkinen’s talents be showcased in anything other than a Mini?

Of course they could. Front-wheel drive God he might have been, but his innate ability made the switch to Ford’s rear-drive Escort as straightforward as turning a page.

There was barely a dip in the steady flow of success. Turner departed BMC bound for Ford’s factory squad – and wasted no time in calling Timo. Apart from steering the car on the throttle more than the brakes, the only other significant change was Henry Liddon stepping in to replace Easter in the co-driver’s seat.

The finest hour for the new partnership was repeated regularly at the end of the 1973, ’74 and ’75 seasons, when they won the RAC Rally – using an RS1600 twice then an RS1800 to conquer the British forests one last time in 1975.

Dousing the stunning black and white Allied Polymer Escort in champagne at the finish in York, few could have known that would be his last win in the world championship. A change in Ford’s team management for 1977 left Peter Ashcroft as the new broom. Mäkinen was swept out in favour of Björn Waldegård, the new face of Blue Oval.

Unwilling to turn his back on competition, Mäkinen signed to Peugeot and longer-distance events with another new co-driver, Jean Todt. The Finn remembers his time alongside the FIA President fondly.

“Jean was always very exact,” he says, “very precise. We never had any problems. He was so well-mannered and got along very well with everybody.”

By 1981, time had caught up with Mäkinen and the speed wasn’t quite the same. It’s a shame the drivers’ World Rally Championship title only arrived in 1979, at the twilight of Mäkinen’s career. Had it come 20 years earlier, Sébastien Loeb might not have been the first to celebrate nine titles.

Mäkinen really was that good. Home and away, he remains the original rallying legend and in a nation of stars, Timo’s still shines the brightest. ■

REAR VIEW

FINAL
LAP

Freeze frame

BRICK BUILT FOR VICTORY

Volvo's announcement that it will join the FIA World Touring Car Championship in 2016 came 30 years after perhaps its greatest season in motor sport with a car affectionately known as 'The Flying Brick'

When Polestar Racing, the performance division of Volvo, recently revealed that in partnership with Cyan Racing it will spearhead a 2016 FIA World Touring Car Championship campaign for the Swedish brand, the company couldn't resist tying the announcement to the anniversary of one of Volvo's greatest and in some ways most unlikely triumphs.

Indeed, with Volvo renowned for safe but somewhat unexciting cars – the kind Dudley Moore, in the movie *Crazy People*, would later refer to as 'boxy but good' – rather than high-performance sports models, the company's 1985 victories in the European Touring Car Championship (ETC) and the German Deutsche Touringwagen Meisterschaft (DTM) with the Volvo 240 Turbo, known as 'The Flying Brick', seem all the more incongruous.

However, when Volvo launched its 240 family car in 1981 with a turbo engine developing 155hp, it opened up a sporty new market for the company, far beyond its hallmarks of durable practicality. And when new international Group A regulations involving cars with limited modifications from stock were introduced the following year, the company was quick to get involved in racing its 240 Turbo Evolution

The Flying Brick began to compete in earnest in 1984, taking two wins in its first year. For '85, however, Volvo contracted two teams to run its cars, with the Swiss Eggenberger Motorsport team and Sweden's Magnum Racing competing in the ETC. It also ran an DTM campaign with IPS Motorsport.

Initially, competitors and audiences found it hard to take the Volvos seriously. But the Flying Bricks, equipped with bigger turbos and a revised engine control system that helped generate around 300bhp and a top speed of 260km/h, soon proved their competitive edge despite competing against cars with much bigger engines, such as the Rover 3500's V8.

On October 13 1985, following the race at Estoril in Portugal, it was all over. The Flying Brick had won six out of 14 races and Swede Thomas Lindström and Italian Gianfranco Brancatelli had claimed the ETC title. In DTM the 240 was equally potent and Per Stureson won the championship after one victory and five podium finishes.

If that wasn't enough, Volvo also won touring car titles in Finland, Portugal and New Zealand in '85 and took the Scottish rally championship crown in the same year.



Anders Olofsson drives the Magnum Racing Volvo 240 Turbo in the ETC round at the Nürburgring in 1985.

COUNTRY CUP: 2015 FIA WORLD CHAMPIONSHIPS

Looking across the five FIA World Championships - Formula One, World Rally Championship, World Endurance Championship (LMP1 category), World Touring Car Championship and World Rallycross Championship - it is clear that some countries have more success in producing top-level drivers than others. Of the 129 drivers representing 34 countries that have competed across these championships in 2015, Britain and France supplied the most drivers, with 17 each, followed by Germany with 14. But France has had the most wins with 20 victories among its drivers. These tables show which countries are having the most, and the least, success in producing top talent.

LIST OF CONTRIBUTING COUNTRIES

F1, WRC, WEC, WTCC, WRX

Argentina	🏆	🏁	🏎️
Australia	🏆	🏁	🏎️
Austria		🏁	🏎️
Bahrain		🏁	
Belgium		🏁	🏎️
Brazil		🏁	🏎️
Britain	🏆	🏁	🏎️
Canada		🏁	
China	🏆	🏁	🏎️
Czech Republic			🏎️
Estonia			🏎️
Finland	🏆	🏁	🏎️
France	🏆	🏁	🏎️
Germany	🏆	🏁	🏎️
Hungary	🏆	🏁	🏎️
Italy		🏁	🏎️
Japan		🏁	🏎️
Latvia			🏎️
Malaysia		🏁	
Mexico		🏁	🏎️
Monaco		🏁	
Morocco		🏁	🏎️

KEY:

- 🏎️ Competing drivers
- 🏆 Championships wins
- 🏁 Hosted races

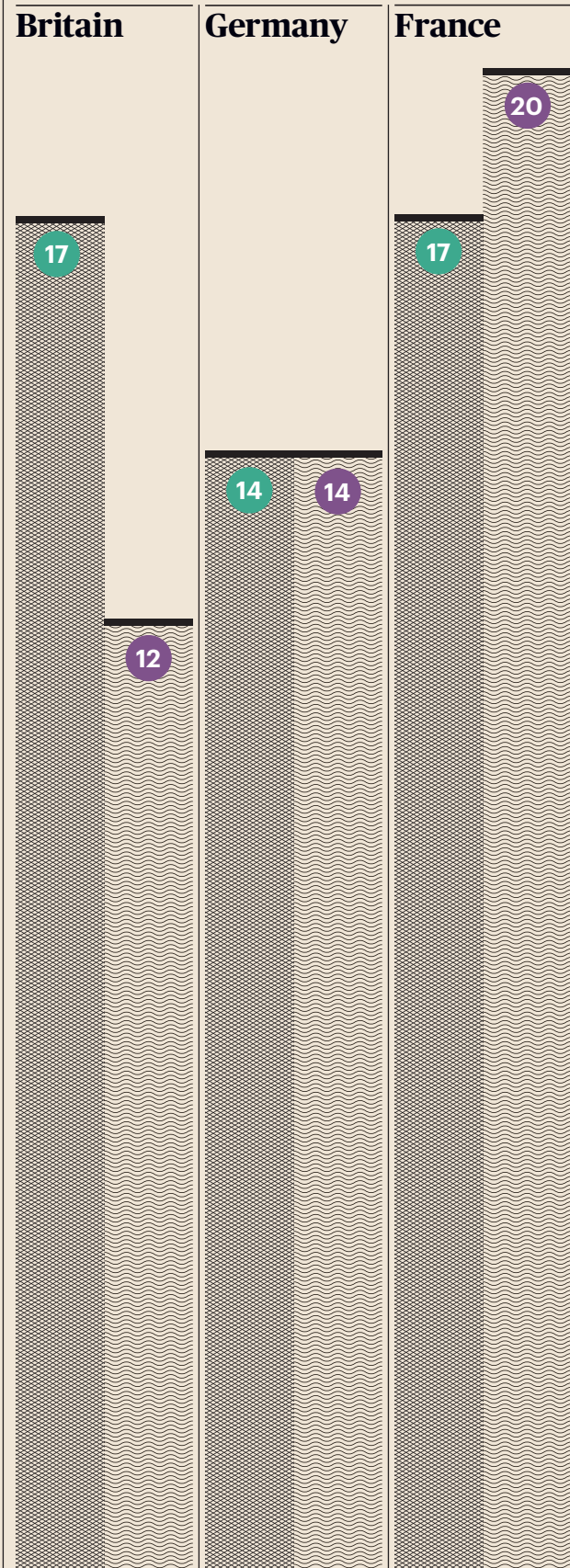
Netherlands			🏎️
New Zealand	🏆		🏎️
Norway	🏆	🏁	🏎️
Poland			🏎️
Portugal	🏆	🏁	🏎️
Qatar		🏁	
Russia		🏁	🏎️
Serbia			🏎️
Singapore		🏁	
Slovakia		🏁	🏎️
Spain		🏁	🏎️
Sweden	🏆	🏁	🏎️
Switzerland	🏆		🏎️
Thailand		🏁	🏎️
Turkey		🏁	
UAE		🏁	🏎️
Ukraine			🏎️
USA		🏁	🏎️
Venezuela			🏎️

34 countries with competing drivers
41 countries in total

MOST SUCCESSFUL COUNTRIES 2015

F1, WRC, WEC, WTCC, WRX

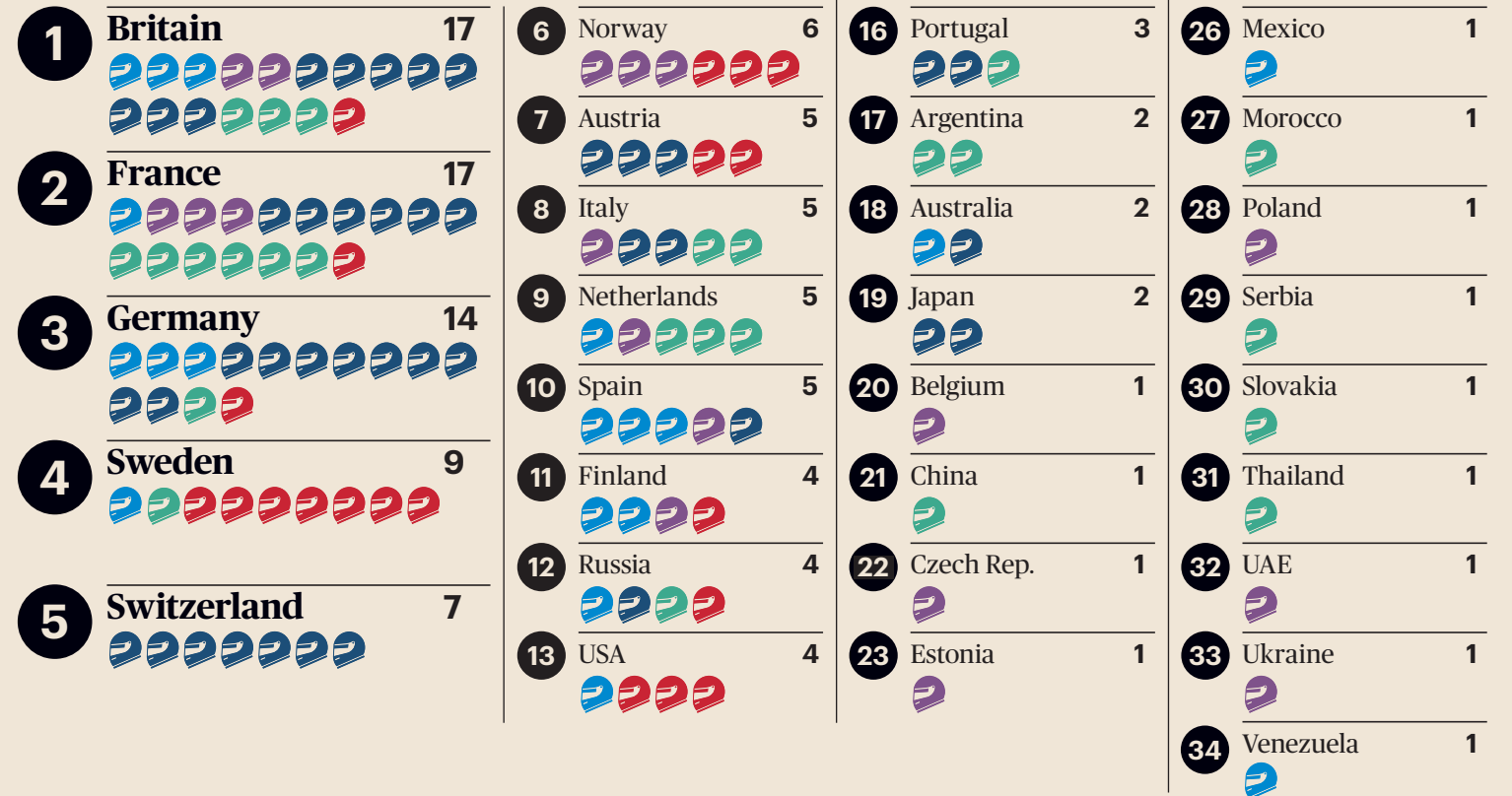
ALL TABLES:
• Data accurate up to 3.11.15
• Drivers counted once for each entry across all FIA championships



KEY: Drivers Total wins

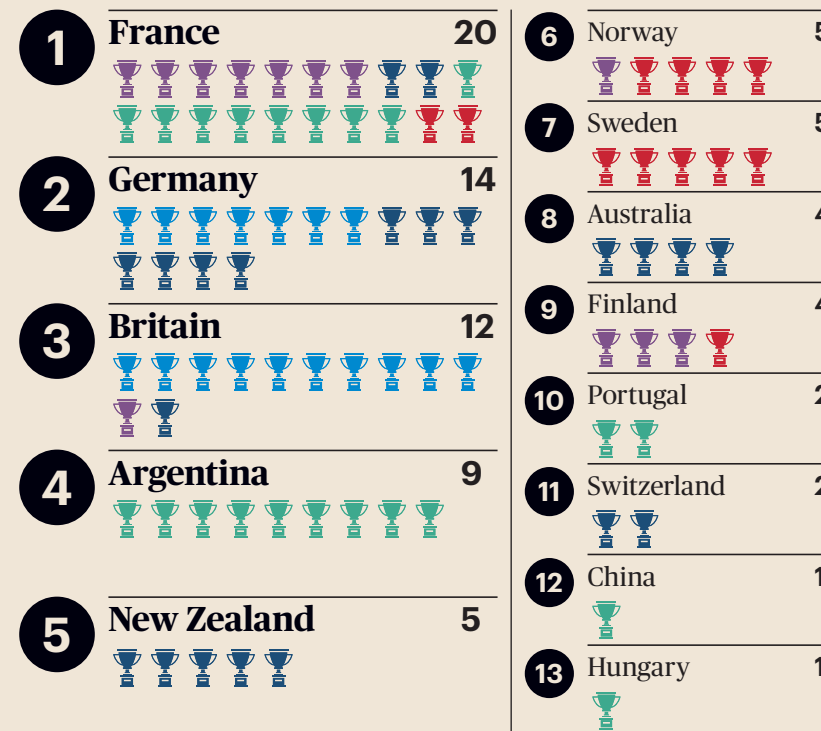
DRIVING NATIONS

Number of drivers from each country competing in the five FIA World Championships - F1, WRC, WEC, WTCC, WRX



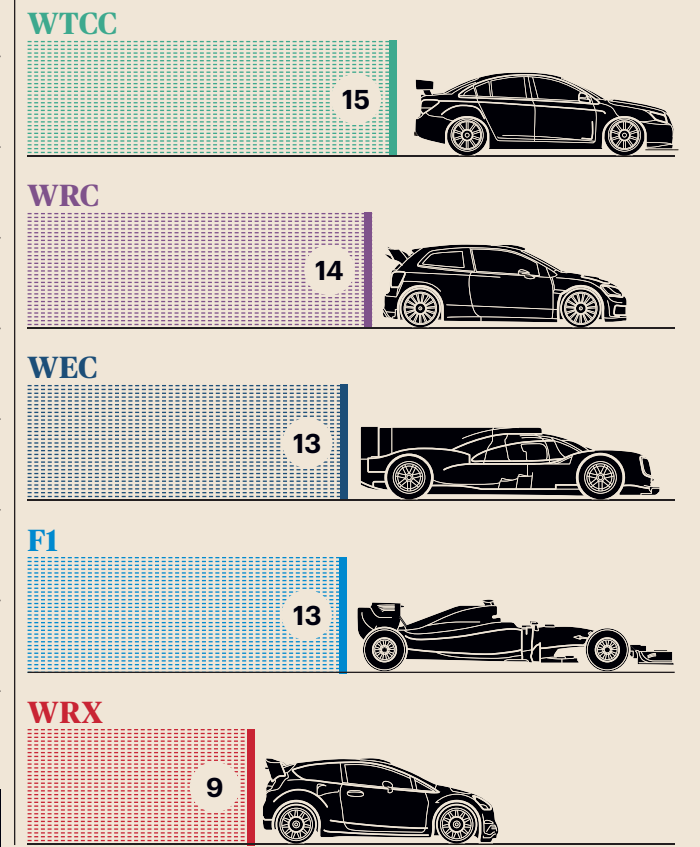
NATIONS' CUPS

Number of wins by drivers from each country across the five FIA World Championships - F1, WRC, WEC, WTCC, WRX



KEY: F1 WRC WEC WTCC WRX

MOST NATIONALITIES PER CHAMPIONSHIP



FINAL LAP

The last word

FORWARD THINKING

Nathaniel Beuse, Associate Administrator for Vehicle Safety Research at the US National Highway Traffic Safety Administration, is a leading expert in emerging car technologies. During FIA Mobility Conference Week he sat down with AUTO to discuss some of the latest automotive safety developments



Q What are some of the latest safety technologies that you've been testing?

A One that is hands-down proving itself across the world is automatic emergency braking. No matter what country I go to, no matter what manufacturer I talk with or what supplier, they agree that automatic emergency braking technology will prevent crashes and save lives.

One thing we've been working on is really collaborating across the globe to develop similar test procedures so that we're all using the same methods to evaluate these systems and make sure they deliver on their safety promise. Likewise, we've been trying to push very hard on how to get these technologies to the public in a faster way. Typically, they show up on top models, but we really want to see these most beneficial technologies migrate down to the lower price points.

Q You recently announced that 10 vehicle manufacturers in the US will make automatic braking a standard feature on all new models, so what impact is this going to have in terms of vehicle safety?

A We hope it will have a tremendous impact. It was a historic announcement [and] when you look at where that particular technology is in terms of its development, the ability to get 10 auto makers to commit to making it standard equipment is significant. It will help

to get that technology to all sorts of vehicles and into consumers' hands in a much faster way than regulation could have driven it.

Q That's great for developed markets like the US, but how can we also get this technology into more developing markets?

A Hopefully it will help there too because you start getting economies of scale and then you get the price points way down. So yes, it's true, in developed countries like Europe and the United States it's probably not as big of a leap as it is for a developing country, but that's not to say that they should have to wait a decade or so to get it. What it means is that the learning and knowledge that the developed countries will be able to bring to bear will actually help deploy it in a much faster way in those other countries than probably otherwise would have occurred.

Q There has been a lot of talk about autonomous cars – how much research are you doing in that area?

A Quite a bit. We're looking at several different aspects to automated vehicles. One is how do you test it? That's a big question, how do you test an automated vehicle? We're very used to developing tests when things go bad – when the driver makes a mistake you develop the scenario around that and then that's how you usually develop test procedures – here we're

going to try to model everyday driving and what does that really look like?

The other thing we're doing is looking at what is the potential, because as a safety regulatory agency we want to save lives and we want to reduce crashes, and so not every automated technology that will come out will likely have a safety benefit. It might have a mobility benefit, it might have some other kind of benefit, but we're looking at it from safety, so we're drawing a road map to try to figure out what are those technologies that we're going to go after first.

Q Realistically, how far are we from seeing autonomous cars on the public roads?

A I think it will be when the public trusts it, that's going to be a big part of it, something that none of us can control. The public has to be able to trust that the technology will work in a robust way, that they're going to feel comfortable putting their families in these vehicles when they might have less control than they otherwise would have.

But whether it's going to be next year or 10 years from now, who knows? I think it's one of the great and fascinating things about working in this space – we're sort of living the history right now and if you actually pause and think about it, it really is true given how fast everything is moving and the kind of discussions that are going on.

BACK 2 BACK CHAMPS



2015 FIA Formula One World Constructors Championship*. Won twice in a row. While the championship belongs to the MERCEDES AMG PETRONAS Formula One™ Team, the Winning Formula is shared by all. Award-winning efficiency and performance not for champions alone, but for everyday drivers too. Definitely a win-win for everyone.



*Subject to official confirmation by the FIA of the results of the 2015 FIA Formula One World Championship.

PETROLIAM NASIONAL BERHAD (PETRONAS) (20076-K)

RICHARD MILLE

A RACING MACHINE ON THE WRIST



RM 011 LOTUS F1 TEAM
ROMAIN GROSJEAN

