FACT SHEET XXL Round 6

WEC AUSTIN

September 16, 2017

SCHAEFFLER

Front runners

Following three victories in succession, Schaeffler and Porsche are leading the WEC standings by an impressive margin

High-tech wonder

Porsche is competing in the WEC with two 919 Hybrid cars

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Schaeffler and Porsche

Partners for 70 years both on and off the track

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Editorial

Jörg Walz
Vice President
Communications and
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Automotive

A gripping competition and electrifying technology – the races of the FIA World Endurance Championship (WEC) make the hearts of all fans as well as those of the engineers involved beat faster. Thanks to the regulations that are focused on the efficiency of the vehicles, the exchange between motorsport and production of the manufacturers with WEC commitments is an intensive one. Technology transfer is the key word – an ideal platform for Schaeffler. With its ideas and products, our company is actively involved in developing "mobility for tomorrow." Since 2014, we have been partnering with Porsche in the WEC and have celebrated important title wins and victories there – most recently the third consecutive victory in the prestigious 24-hour race at Le Mans. As the current WEC table leader, we hope to consolidate our good form at the event in Austin.

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Efficiency and *high tech*

The FIA World Endurance Championship (WEC) represents the ultimate of all world championships. The high-tech LMP1 race cars are fully focused on efficiency

Nine races per season in Europe, America and Asia, race durations of six to 24 hours and the participation of renowned manufacturers such as Alpine, Aston Martin, Ferrari, Ford, Toyota and Schaeffler's partner Porsche – the FIA World Endurance Championship (WEC) continues to thrill motorsport fans around the globe in its sixth season.

The absolute highlight on the calendar: the legendary 24-hour race at Le Mans. Schaeffler as manufacturer Porsche's partner is in the thick of the action. Together the two companies won both the drivers' and manufacturers' world championships in 2015 and 2016, plus the French race twice around the clock three times in succession.

Characteristic for the WEC are its revolutionary regulations. Since 2014, in the top category, LMP 1, in which Porsche competes with two 919 Hybrid cars, the output of the race cars has no longer been controlled by the regulations. Instead, their energy consumption (in megajoules) has been subject to control – in other words, not the amount that arrives at the wheels but that which flows into the fuel tank and batteries and is ultimately used. This rewards the most efficient contenders and no longer the most powerful ones.

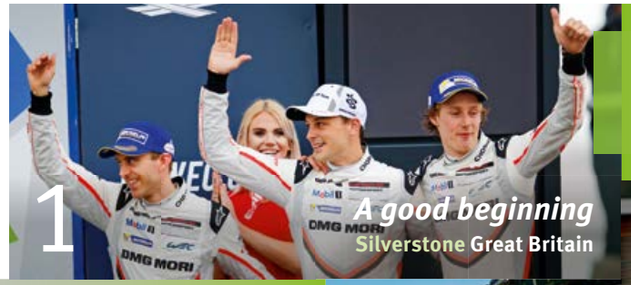
Technology transfer

As a result, a perfect parallel has been created, as the engineering designers for volume production keep inventing increasingly efficient automobiles, relying – just like in the WEC – on continually improving hybrid systems. Progress doesn't stop.

In 2017, the Porsche 919 Hybrid is again competing in the highest energy efficiency class established by the regulations. This means that on a 13.629-kilometer lap at Le Mans, the car is allowed to use eight megajoules of recuperated energy while being limited to a maximum fuel consumption of 4.31 liters. Both consumption levels are closely monitored and accounted for after each lap. For the recuperation technology used in the 919 Hybrid, Porsche in 2017 again relies on a combination of kinetic energy recuperation at the front axle and conversion of exhaust energy into electricity. The electrical energy is placed into interim storage in lithium-ion batteries and can be accessed to boost output by the driver pushing a button. ■

A trip around the world
with nine stops

Europe, North and Central America, the Far East and the Arab region – the FIA World Endurance Championship is fully living up to its ranking again in 2017. The iconic 24-hour race in France marks the pinnacle event of the season



1 A good beginning
Silverstone Great Britain

April 16, 2017
In the UK, both Porsche 919 Hybrid cars clinch podium places: Bamber/Bernhard/Hartley finish second and Jani/Lotterer/Tandy rank in third place.

Another podium 2
Spa-Francorchamps Belgium

May 6, 2017
On the "Ardennes roller coaster," Bamber/Bernhard/Hartley claim position three. Spa, however, remains the only WEC track Porsche has not yet won on.

Hat-trick perfected
Le Mans France

June 17/18, 2017
After 2015 and 2016, Porsche wins the legendary 24 Hours of Le Mans again this year and, as a result, extends its position as the record winner, now with 19 victories to its tally.

Home victory
Nürburgring Germany

July 16, 2017
Porsche remain unbeaten on home turf: Bamber/Bernhard/Hartley won in front of their teammates Jani/Lotterer/Tandy and celebrated their second victory in a row after Le Mans.

5 Another one-two
Mexico City Mexico

September 3, 2017
Schaeffler and Porsche continue to be in top shape: At the Autódromo Hermanos Rodríguez, their tally reflects another impressive one-two win after six hours of racing.

American way
Austin USA

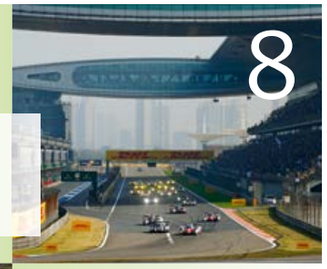
September 16, 2017
The Circuit of the Americas is the "youngest" race track on the calendar. In 2012, its inaugural year, the venue hosted Formula 1 and since 2013, the WEC has been racing on the U.S. circuit as well.

Tradition galore
Fuji Japan

October 15, 2017
As far back as in 1967, sports cars were battling for glory and honor in the 1000 Kilometers of Fuji. Since the WEC's inaugural season in 2012, the Speedway has been an integral component of the series.

Local color
Shanghai China

November 5, 2017
The track configuration of the Shanghai International Circuit, a Grand Prix circuit since 2004, has taken cues from the Chinese character shàng 上 (English: up, above, ascend).



Loyal companion
Sakhir Bahrain

November 18, 2017
The Bahrain International Circuit is one of six race tracks to have appeared on the calendar each year ever since the WEC's debut. Since 2015, the season finale has been held there.

Drivers' classification (Top 25)

P	Driver	Manufacturer	Pts
1	**Brendon Hartley (NZ)**	**Porsche**	**134**
1	**Earl Bamber (NZ)**	**Porsche**	**134**
1	**Timo Bernhard (D)**	**Porsche**	**134**
2	Anthony Davidson (GB)	Toyota	93
2	Kazuki Nakajima (J)	Toyota	93
2	Sébastien Buemi (CH)	Toyota	93
3	**André Lotterer (D)**	**Porsche**	**64**
3	**Neel Jani (CH)**	**Porsche**	**64**
3	**Nick Tandy (GB)**	**Porsche**	**64**
4	Ho-Pin Tung (CN)	Oreca	60.5
4	Oliver Jarvis (GB)	Oreca	60.5
4	Thomas Laurent (F)	Oreca	60.5
5	Kamui Kobayashi (J)	Toyota	48.5
5	Mike Conway (GB)	Toyota	48.5
6	Bruno Senna (BR)	Oreca	40
6	Julien Canal (F)	Oreca	40
7	Alex Bundle (GB)	Oreca	34
7	David Cheng (CN)	Oreca	34
7	Tristan Gommendy (F)	Oreca	34
8	André Negrão (BR)	Alpine	32.5
9	Gustavo Menezes (USA)	Alpine	32.5
10	Nicolas Prost (F)	Oreca	32
11	Matthew Rao (GB)	Alpine	30.5
12	Nicolas Lapierre (F)	Alpine/Toyota	30
13	José María López (RA)	Toyota	29.5
14	Jean-Eric Vergne (F)	Oreca	28.5
15	Nelson Panciatici (F)	Alpine	24.5
15	Pierre Ragues (F)	Alpine	24.5
16	Jonathan Hirschi (CH)	Oreca	23
16	Tor Graves (GB)	Oreca	23
17	Pierre Thiriet (F)	Oreca	15
17	Roman Rusinov (RUS)	Oreca	15
18	Alex Lynn (GB)	Oreca	14
19	Romain Dumas (F)	Alpine	12.5
20	Stéphane Sarrazin (F)	Toyota	11
21	Yuji Kunimoto (J)	Toyota	10
22	Emmanuel Collard (F)	Oreca	9.5
22	François Perrodo (F)	Oreca	9.5
23	Matthieu Vaxiviere (F)	Oreca	9
24	Dominik Kraihamer (A)	Enso	8.5
24	Oliver Webb (GB)	Enso	8.5
25	James Rossiter (GB)	Enso	8

Manufacturers' classification

P	Manufacturer	Pts
1	**Porsche**	**198**
2	Toyota	141.5

“Autos city” Austin

In Austin, the automobile – like in most North American regions – is an indispensable means of transportation. Alternatives are in scarce supply but urgently needed to relieve the burden on chronically congested streets

8

production sites and three research and development centers are operated by Schaeffler in the United States

201 million

U.S. dollars per year are spent by the state of Texas on transportation projects in Austin. Still, the traffic situation in the city has recently been rated as the tenth worst in all of the United States by Texas A&M University

Those who would like to catch a whiff of U.S. big city atmosphere off the Circuit of The Americas, the venue of race six of the FIA World Endurance Championship (WEC) season, should take a side trip to Austin which is about 30 kilometers away. However, it is advisable to rent a car for this purpose, not only to get from the race track to Austin, which has a population of 950,000, but also to get around the city itself. Like in most places in the United States, cars are the number one means of transportation here. 73 percent of all the people working in Austin use their privately owned vehicles to commute and ten percent use carpools.

Only five percent of the two million residents in the metropolitan area use locally available mass transit, which in Austin is essentially limited to a heavily frequented means of transportation: the bus. The Capital Metropolitan Transportation Authority operates 82 bus lines carrying some 2.2 million passengers per month between 2,700 stops. By contrast, the “Capital MetroRail” is a rather unusual form of mass transit in Austin. The above-ground streetcar has only one line hauling 60,000 people per month.

Leaving the car at home for a change

Don’t feel like struggling with traffic jams or taking a bus? If so, then Austin is a great place for using a bicycle to get from A to B. 130 kilometers of bicycle paths meander through Austin – which is pretty much for a big U.S. city. The internationally acclaimed “Bicycling” magazine has listed Austin as the seventh most bicycle-friendly city in the United States. “Forbes” magazine even ranks Austin in third place of this category behind Philadelphia and Tucson. ■

High-tech *wonder*

The hybrid powertrain in the Porsche 919 combines downsizing turbo technology with efficient gasoline direct injection in a two-liter V4 IC engine. A lithium-ion battery serves as an accumulator for the electrical energy from two different recuperation systems – braking energy from the front axle and exhaust energy

IC engine

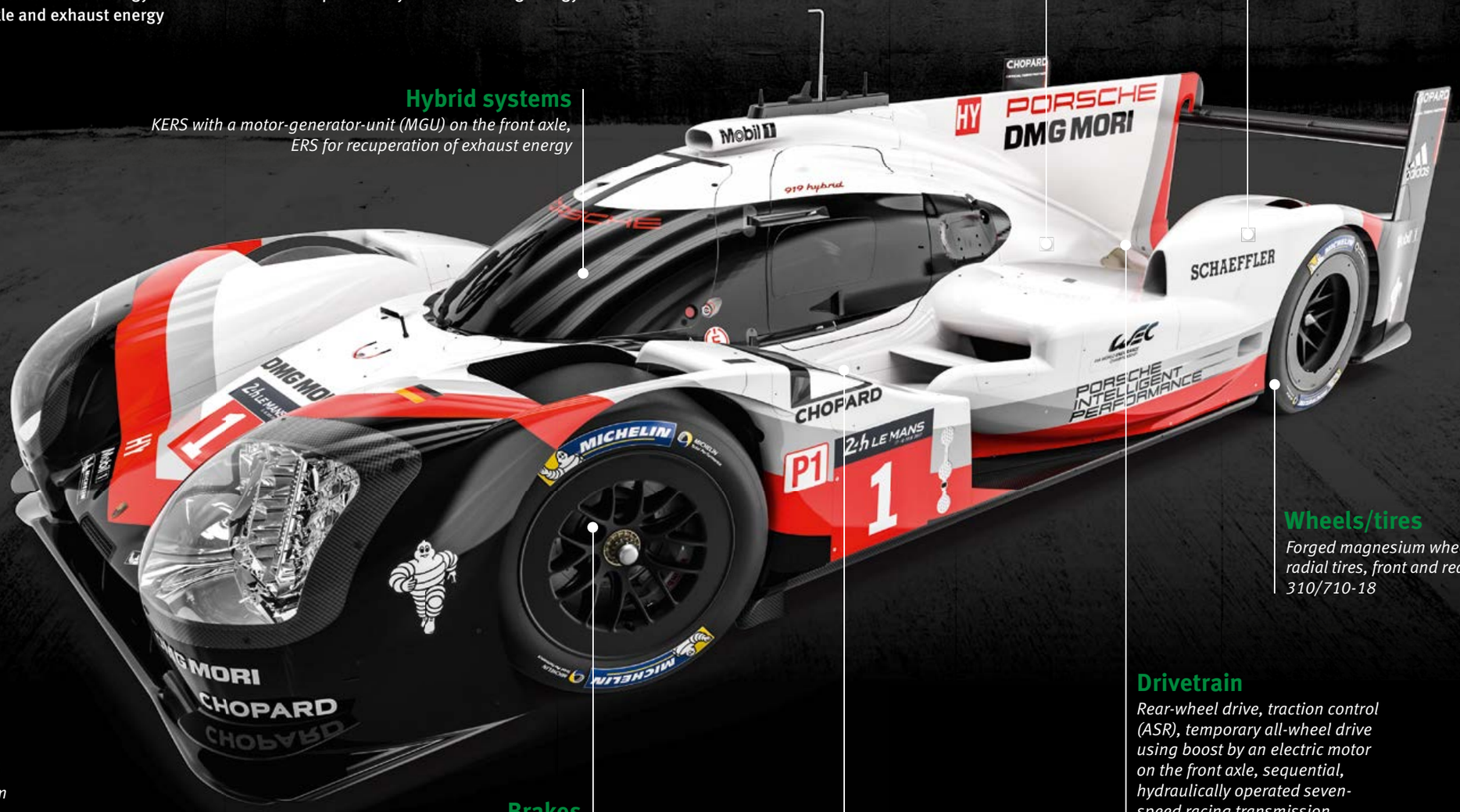
V four-cylinder engine (90-degree bank angle) with turbocharger, four valves per cylinder, 2,000 cc cubic capacity, DOHC, one Garrett turbocharger, gasoline direct injection

Suspension

Independent front and rear, pushrod system with adjustable dampers

Hybrid systems

KERS with a motor-generator-unit (MGU) on the front axle, ERS for recuperation of exhaust energy



Wheels/tires

Forged magnesium wheels, radial tires, front and rear: 310/710-18

Drivetrain

Rear-wheel drive, traction control (ASR), temporary all-wheel drive using boost by an electric motor on the front axle, sequential, hydraulically operated seven-speed racing transmission

Dimensions

***Length** 4,650 mm*
***Width** 1,900 mm*
***Height** 1,050 mm*
***Weight** 875 kg*

Output

***IC engine** ‹ 500 HP on the rear axle*
***MGU** › 400 HP on the front axle*

Brakes

Hydraulic dual-circuit braking system, mono block light metal brake calipers, ventilated carbon fiber brake discs front and rear, brake force distribution infinitely variable by the driver, the front brakes recuperate energy

Monocoque

Fiber-reinforced construction of carbon fibers with aluminum honeycomb core

Technology *elite*

“The 24 Hours of Le Mans pushes both man and machine to their absolute limits”

Fritz Enzinger
Head of LMP1 at Schaeffler’s partner Porsche

Schaeffler and Porsche @ Le Mans 2017

The video on the spirit of Le Mans. *You can only win the toughest race in the world with teamwork*

The FIA World Endurance Championship (WEC) with Le Mans as the pinnacle event of the season is regarded as one of the most challenging motorsport series in terms of technology. Thanks to a healthy mix of innovation and reliability of the vehicles, Schaeffler’s partner Porsche has been celebrating major successes – including this year

High speed and high tech – the WEC combines both to a special degree, efficiency being the magic word. Which team, which manufacturer makes the best use of the opportunities provided by the regulations and technology? At the moment, there’s hardly another more attractive, let alone more creative, stage to demonstrate the innovative prowess of high-end hybrid sports cars. The season’s pinnacle event, the 24 Hours of Le Mans, in which the drivers are on track four times as long as in the season’s other races, makes anything else pale in comparison. Thanks to a complex set of regulations for the top category, LMP, which has been in effect since 2014, the fastest contender at Le Mans is necessarily always the most efficient one as well. The one having covered the longest distance within 24 hours has extracted the maximum from a limited amount of fuel. Due to the major technological freedom in the areas of hybrid and powertrain technology, the manufacturers surprise with ever-new innovation impulses while delivering thrilling on-tarmac action in the process. This year, following a breathtaking comeback drive, Schaeffler’s partner Porsche has won the Le Mans race for the third time in succession.

Ideal platform for Schaeffler

Efficiency, high tech and reliability. In the WEC and at Le Mans, exactly the same topics matter which now are in absolute focus in automotive engineering, and thus at Schaeffler, and will continue to be in the coming decades. The analogy between motorsport and production very closely approaches its original meaning again. The things that prove viable and win out in the world’s toughest races demonstrate their fitness for use in production as well. The innovation-friendly regulations suit manufacturers and automotive suppliers like Schaeffler who aim to prove their technology expertise and the suitability of their visionary designs in front of large audiences around the globe.

The world’s toughest test laboratory

The fascination exuded by Le Mans. The iconic French endurance race demands maximum performance twice around the clock – of humans and hardware, as well as of the engineers in the development laboratories. Revolutionary technologies have frequently passed their baptism of fire at Le Mans and subsequently went on to become firmly established in volume production. A short summary of past achievements: streamlined body styles, lightweight design, disc brakes and hybrid drive.

24 Hours of Le Mans facts

815.6 kWh

was recuperated by the victorious Porsche 919 Hybrid in 2017. This energy would allow an electric car[1] to cover a distance of 6,473 kilometers

250 km/h

Average speed per lap, 220 km/h over the entire race duration

50 to 60 l

of racing fuel per 100 kilometers were consumed by a Porsche 956 in the 1980s – nearly twice the amount of the current, much faster 919 Hybrid whose "thirst" is limited to about 32 liters

19 victories

No brand has mounted the very top of the podium more often than Porsche

For manufacturers and suppliers, Le Mans is a paradise. For Schaeffler, the legendary 917, for example, was a development prototype for valve train components that were subsequently produced by the millions. The development of turbochargers profited from Le Mans as well. In 1976, Porsche achieved the first victory of a turbocharged engine there.

Teamwork, momentum, determination

Success in motorsport is closely tied to the abilities of every individual but, above all, to teamwork. Motorsport demands innovation prowess and momentum, determination and courage – the same applies to Schaeffler's employees in their daily pursuit of standing the company's ground and furthering its position as a globally leading automotive supplier.

High-end technology paired with emotions – the motorsport commitment has been a vital element of Schaeffler's brand strategy for decades, be it with high-tech hybrids in the WEC, touring car action in the DTM or in the electrifying Formula E. ■

"The *perfect* stage"

Why do you have a joint commitment with Porsche in the WEC?
The answer is simple. Hybrid is becoming an increasingly important automotive topic – both on the road and in motorsport. In the WEC regulations, energy efficiency and forward-thinking technology play the key role.

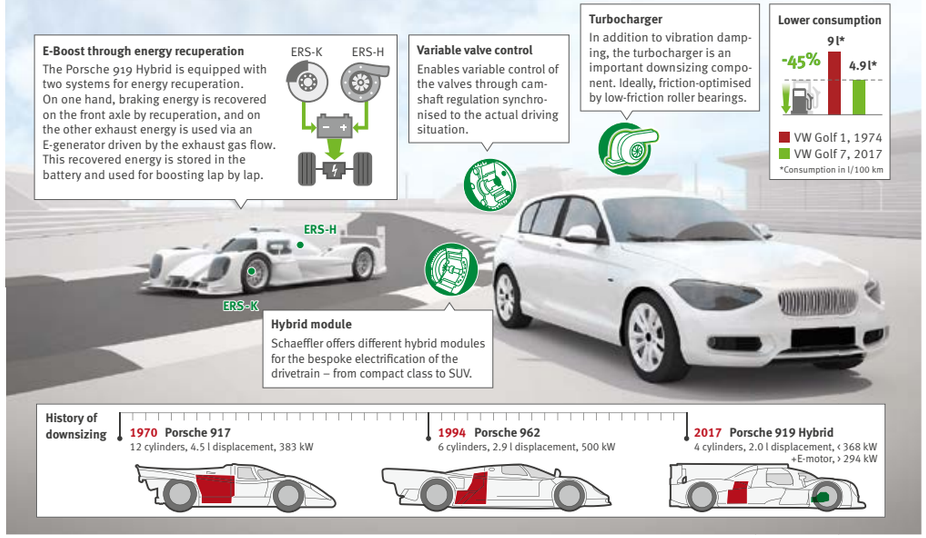
What are you aiming to prove?
Technological expertise. And the WEC, including Le Mans, provides the perfect stage for it. Especially in endurance racing with its extremely high demand for reliability we consistently learn new things.

But this is true as well for Formula E in which you've been on board ever since the inaugural season …
Exactly. This is where we explore extremes. After all, at Schaeffler, we have and continue to gather a lot of know-how relating to the combination and interaction of units and components. In Formula E, it is between the electric motor and the transmission, or in the WEC's hybrid, it's between the IC engine and the electric motor. In addition, motorsport is emotion – and that's what we need in electric mobility as well. That's why both series are ideal fields of activity for our company.

Prof. Peter Gutzmer Deputy CEO and Chief Technology Officer of Schaeffler AG

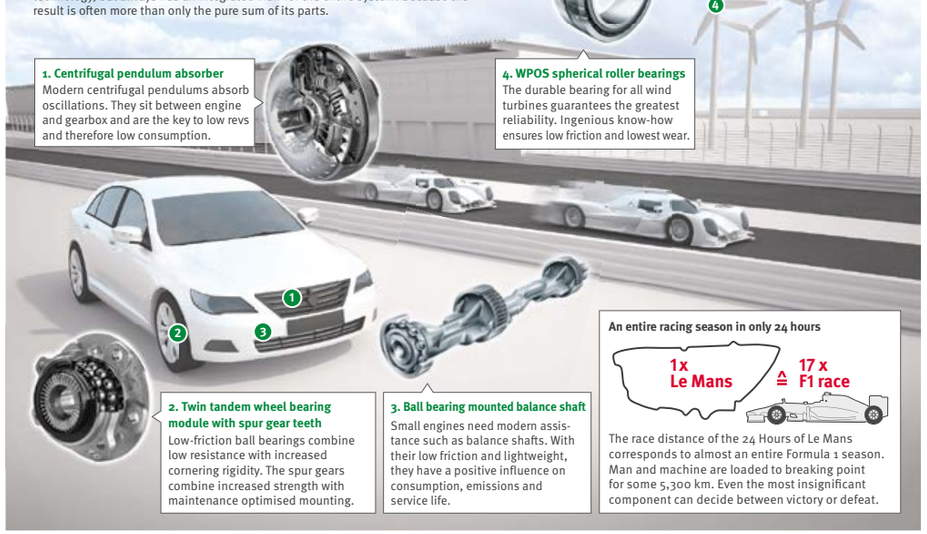
EFFICIENT MOTORING

Small engines save weight and with modern technology modern engines are genuine power plants despite having less cylinders – both on the race track and on public roads. Combined with systems to recuperate energy such as for example the recovery of brake energy (i.e. recuperation) the consumption level sinks significantly.



EXTREMELY RELIABLE

Extreme loads necessitate absolutely reliable components. This applies not just to motorsport, but also for everyday road traffic or energy generation by wind power. Schaeffler does not only offer comprehensive expertise in the field of bearing technology, but always has an integrated view for the entire system. Because the result is often more than only the pure sum of its parts.



Graphics www.josekdesign.de

[1] BMW i3 (94 Ah/battery 27.2 kWh; 12.6 kWh/100 km)

An electrifying *affair*

The powertrain concept of Porsche's Le Mans hybrid sports car is a forward-thinking one. A turbocharged downsized IC engine together with a powerful electric motor ensures dynamic and efficient propulsion. Schaeffler is developing diverse concepts to put hybrid powertrains on the fast track of everyday mobility as well

The first question to be clarified is the meaning of hybrid in the language of automotive developers. Put in a nutshell, a hybrid complements the conventional IC engine by a second source of propulsion and, today, this refers to electric motors.

One name, various concepts

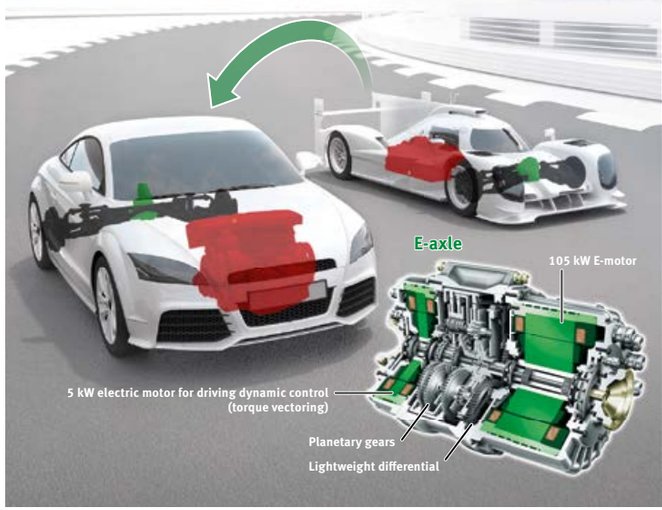
In the automotive OEM and supplier industries, various hybrid systems are being tested and offered for diverse demands. As a pioneer in this field, Schaeffler possesses a wealth of experience and wide range of systems – see right-hand page. Every one of these innovative and intelligent concepts has its justification in the marketplace. Not least due to the fact that "more electricity on board" makes it possible to replace other conventional mechanical or hydraulic components by electric ones.

Optimization in many areas

Obviously, within the Schaeffler Group, the optimization of the IC engine continues to be driven with the same intensity as hybrid technology. In spite of all the progress that has already been achieved, Schaeffler still sees further potential of optimizing the efficiency of IC engines, by 10 percent for diesel and by 20 percent for gasoline engines. ■

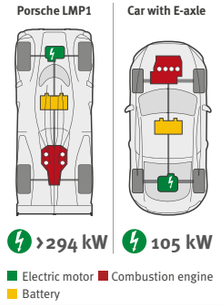
ELECTRIC FOUR-WHEEL DRIVE

The connection of the combustion engine with an electric drive provides new opportunities. In motor racing, hybrid cars with four-wheel drive concepts represent the pinnacle of the technically feasible. In conventional road cars, the electrification of the drivetrain with increasing hybridization plays an important role. With its E-axle, Schaeffler provides an innovation that combines the electric drive with the possibility of wheel selective controllable driving power. All-wheel drive in connection with combustion engines is available to the driver when required.



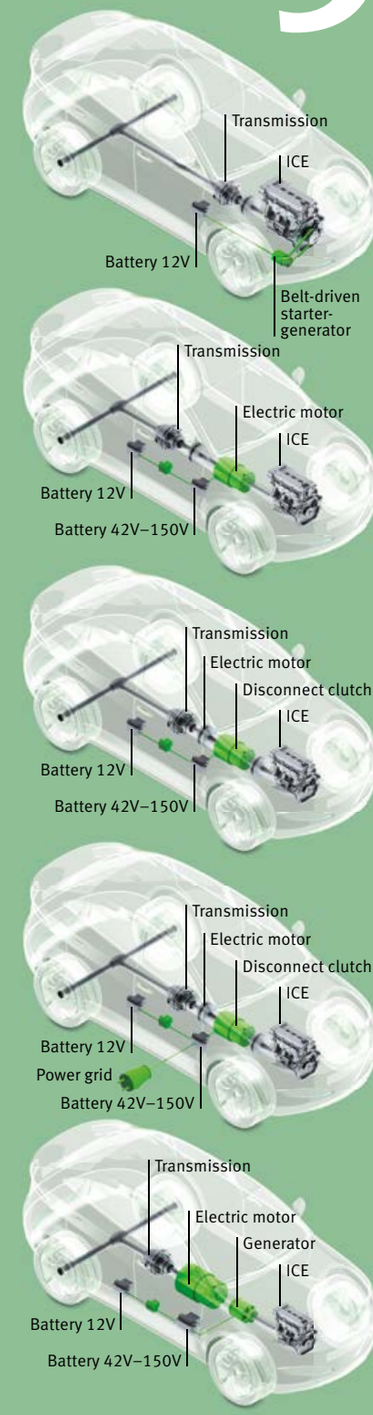
Vehicle concepts in comparison

The combination of modern combustion engines and a selectable electrical drive axle if required is not only a vision of the future from the WEC racing series. Even today with its E-axle, Schaeffler offers the advantages of a selectable all-wheel drive with a benefit in handling stability, safety and efficiency.



Graphics www.josekdesign.de

5 Comparison of *hybrid concepts*



Micro hybrid (12 volts)

The principle *Micro hybrid refers to vehicles that are equipped with a start-stop system and recuperate braking energy via a generator, in other words, continually charging the battery. The starter-generator – the electric machine – cannot be used for propulsion.*

In simple terms *The brakes and coasting of the vehicle charge the conventional battery, so the engine no longer has to perform this "job." This saves fuel, just like the automatically shutting off and turning the engine on again when the vehicle stops, for instance at a traffic light.*

Mild hybrid (48 volts)

The principle *The electric motor (which may be an electric axle, see info box, Page 14) in the 48-V hybrid assists the conventional IC engine (ICE) with a power boost. Braking energy can be recuperated. Using the 20-kW electric motor, even fully electric driving to a limited extent is an option when the IC engine is disengaged.*

In simple terms *Less consumption, fewer emissions, more momentum – the "mild" 48-V hybridization yields many advantages from a moderate technology investment.*

Full hybrid (› 200 volts)

The principle *Functions are similar to those of the 48-volt system. High-voltage technology, though, increases output as well as technology investment. Full hybrid vehicles can optionally be operated in all-electric mode, only using the IC engine or combined.*

In simple terms *A more powerful battery and a larger electric motor in this type of vehicle enable all-electric driving, albeit, as in the case of the 48-volt system, with shorter range and at lower speed.*

Plug-in hybrid (› 200 volts)

The principle *While the battery of a mild or full hybrid is charged exclusively via braking energy or the IC engine, the battery of a plug-in hybrid can additionally be charged externally using the power grid. Therefore, a larger battery is utilized which allows clearly longer ranges to be achieved in electric mode.*

In simple terms *The battery and electric motor are suitable for mid-range distances and the system can be charged by plugging into a power outlet/ charging station.*

Range extender (› 200 volts)

The principle *Electric vehicles with range extenders have a powerful electric motor and enable all-electric driving over a comparably long range. IC engines are most frequently used as range extenders. They drive a generator which in turn supplies power to the battery and the electric motor.*

In simple terms *The vehicle operates in fully electric mode. The "small" IC engine merely serves to charge the batteries for the "large" electric motor.*

Teamwork is crucial

In the WEC endurance races run for six hours – or even 24 as in the case of Le Mans – three drivers typically form a team, taking turns at the wheel after about two hours of racing. For the two 919 Hybrid cars in the field, Porsche can rely on an experienced sextet

Porsche 919 Hybrid #1

Neel Jani

Vita

Date of birth	December 8, 1983
Place of birth	Rorschach (CH)
Residence	Port (CH)
Height	1.72 m
Weight	62 kg

NeelJaniRacing
@neeljani
neel-jani.com
neeljani_official

André Lotterer

Vita

Date of birth	November 19, 1981
Place of birth	Duisburg (D)
Residence	Tokyo (J)
Height	1.84 m
Weight	74 kg

alotterer
@Andre_Lotterer
andre_lotterer

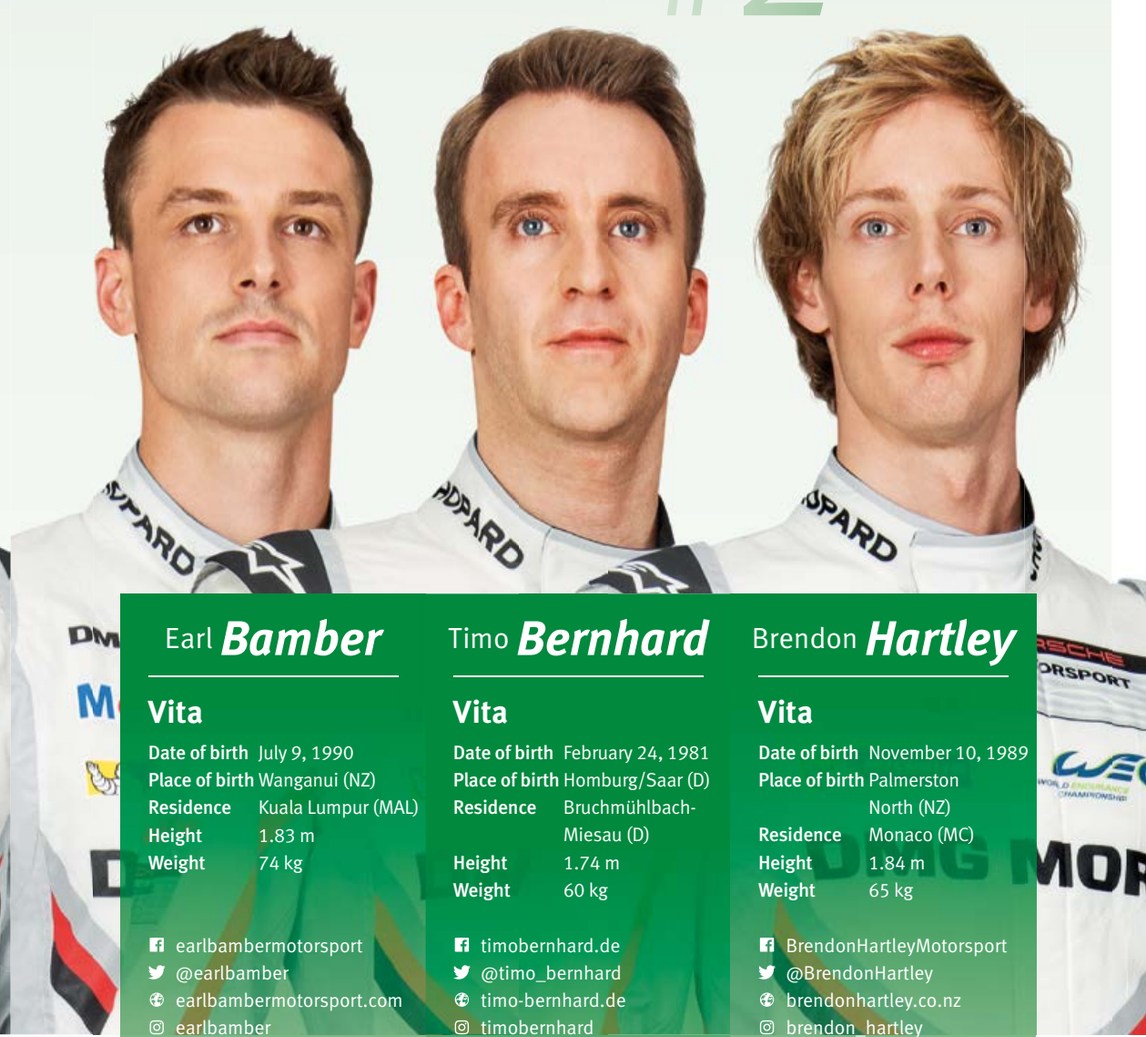
Nick Tandy

Vita

Date of birth	November 5, 1984
Place of birth	Bedford (GB)
Residence	Bedford (GB)
Height	1.78 m
Weight	71 kg

NickTandyRacing
@NickTandyR

Porsche 919 Hybrid #2



Earl Bamber

Vita

Date of birth	July 9, 1990
Place of birth	Wanganui (NZ)
Residence	Kuala Lumpur (MAL)
Height	1.83 m
Weight	74 kg

earlbambermotorsport
@earlbamber
earlbambermotorsport.com
earlbamber

Timo Bernhard

Vita

Date of birth	February 24, 1981
Place of birth	Homburg/Saar (D)
Residence	Bruchmühlbach-Miesau (D)
Height	1.74 m
Weight	60 kg

timobernhard.de
@timo_bernhard
timo-bernhard.de
timobernhard

Brendon Hartley

Vita

Date of birth	November 10, 1989
Place of birth	Palmerston North (NZ)
Residence	Monaco (MC)
Height	1.84 m
Weight	65 kg

BrendonHartleyMotorsport
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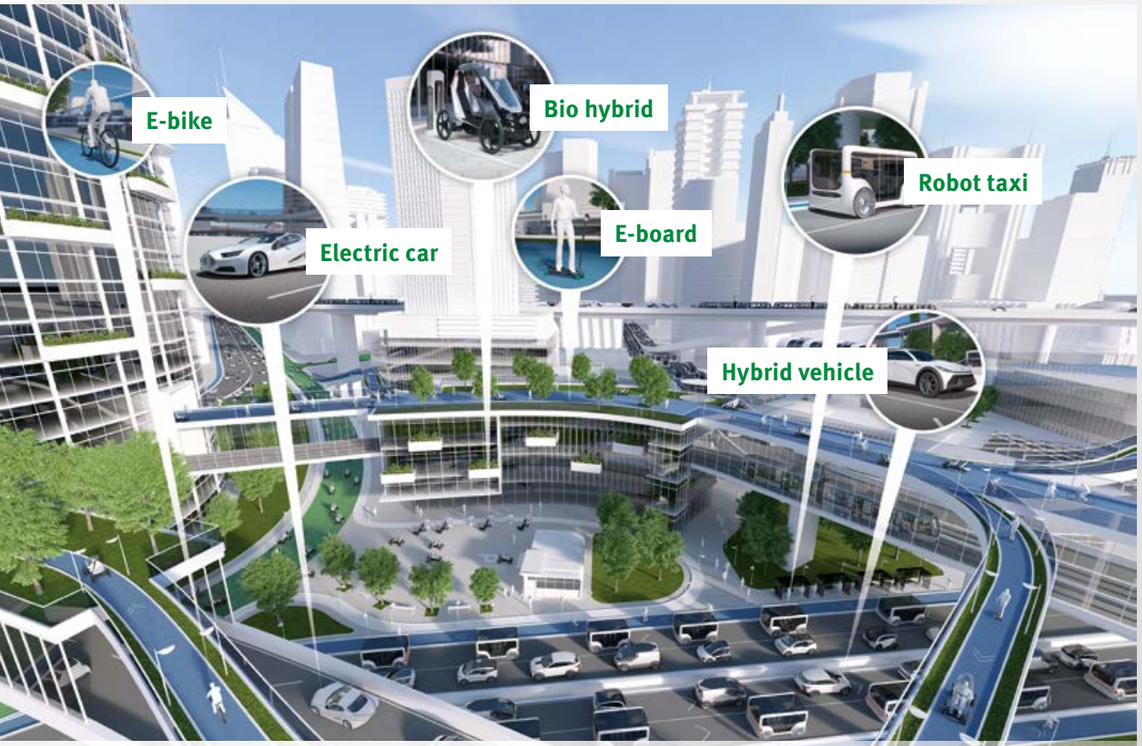
brendon_hartley



Race track ››› Road

An electric circuit

Motorsport has always been a driver of developments that subsequently make their way into production vehicles. This now applies to electrified powertrains as well. In the FIA World Endurance Championship (WEC) with Le Mans as its highlight, high-tech hybrid race cars are pitted against each other and in Formula E, all-electric single-seaters are. For Schaeffler, both racing series have become pioneering test beds for future technologies

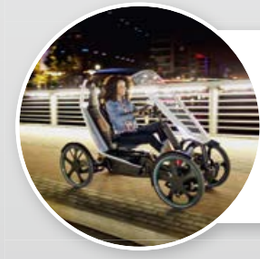
"The commitments in the WEC and in Formula E have been helping us gain a better understanding of the environment and systems of electric mobility," explains Prof. Peter Gutzmer, Schaeffler's Chief Technology Officer. Be it in terms of systems knowledge, the development of new materials, recuperation (recovery of braking energy) or thermal management – these are important findings which also advance the Schaeffler technology group aside from racing with respect to ideas, visions and technologies for networked mobility for tomorrow. Schaeffler has significantly increased the size of its development team for electric vehicle components and new mobility concepts within a short period of time and is working at full stretch on sustainable mobility solutions. Six examples ... ■

E-bike

On bicycle expressways, powerful pedelecs – with Schaeffler hardware and software on board – provide a particularly fast and eco-friendly means of transportation for shorter distances. Branded as SCHAEFFLER VELOSOLUTIONS, the company offers an extensive and innovative product range.
See also: ***www.schaeffler-velosolutions.com***

Electric car

Schaeffler's electric axles (pictured) help make traffic noise in inner cities a thing of the past, moving forward with a wide product range from Herzogenaurach. In this context, Schaeffler has developed an innovative modular system for electric axles in various configurations and build levels.



Bio hybrid

The innovative and compact mobility solution for urban areas not only provides weather protection but, featuring four wheels including an electric pedelec drive, high driving stability and ample stowage space. In spring of 2016, Schaeffler unveiled this design and development concept that met with positive response around the globe.

E-board

In addition to its handy dimensions, this ideal means of transportation for short distances in urban areas boasts hydraulic brakes and a range of 25 kilometers. At CES in Las Vegas in January 2017, Schaeffler showcased this prototype. Integrated in the board is a battery that drives the rear axle via an electric motor. The e-board is controlled using a stick with an ergonomically shaped handle.

Robot taxi

Self-driving buses with integrated wheel hub motors (pictured) from Schaeffler could provide a means of demand-based zero-emissions short-range public transportation in the future. All the drive components except for the battery are completely installed in the wheel. They include the electric motor, power electronics, the brake and the cooling system. eWheelDrive makes all-new drive concepts possible.

Hybrid vehicle

Hybrid components will continue to make conventional IC engine based powertrains more efficient. Schaeffler offers solutions across the entire range of electrification potential – from the 48-volt hybrid to the plug-in hybrid for various mounting positions to all-electric axles that assist the IC engine or serve as the sole short-term source of propulsion.

Partners *for 70 years*

The first model marked the beginning of the collaboration between Porsche and Schaeffler in 1948. A flashback to an intensive and innovative partnership between a manufacturer and a supplier with a shared vision of automotive progress

The partnership between Schaeffler and Porsche that started as far back as in the days of the legendary 356 has now been in existence for seven decades. Thanks to cooperation in a spirit of mutual trust, many highlights of automotive progress have been brought to market during this period of time – see page at right. In addition to hydraulic bucket tappets, they include complex components such as electromechanical camshaft adjusters and roll stabilizers. A prototype of the latter was presented by Schaeffler in the CO_2ncept-10% concept vehicle for the first time. In 2009, Schaeffler used this technology showcase based on a Porsche Cayenne to demonstrate the optimization potential of modern automobiles yet to be tapped. The wide range of coordinated Schaeffler products used, caused fuel consumption and CO_2 emissions to drop by ten percent.

Know-how and ingenuity

Not only Porsche but all automobile manufacturers around the globe rely on innovative and active support by suppliers that decisively influence progress in automotive engineering thanks to the ingenuity of their development engineers and concentrated production know-how. ■

Porsche 356 from 1948 on

The #cage-guided #INA needle bearing is a fundamental invention the Schaeffler brothers achieve in the late 40s. Its advantages: reduced friction and torque stability. Many transmissions only become fit for high-speed freeway driving due to these bearings. Obviously, Porsche is among Schaeffler's customers.

Porsche 911 from 1963 on

In 1965, Schaeffler founds clutch manufacturer LuK and launches the first #diaphragm spring clutch on the European market. This innovation marks the beginning of a successful career. Today, one in three cars around the globe is equipped with a clutch from Schaeffler's LuK brand.

Porsche 917 1970

In 1970, Porsche evolves from a class to an overall winner at Le Mans. Operating in the twelve-cylinder engine of the 917 are #bucket tappets of Schaeffler's INA brand. For Schaeffler, the racing commitment serves as a test laboratory. Today, Schaeffler has a long history as a specialist in valve train components and systems.

Porsche 928 1977

Schaeffler engineers introduce hydraulics in the valve train. #hydraulic #bucket tappets like those Porsche puts on the road in the 928 launched in 1977 put an end to time-intensive garage maintenance by the bucket tappets independently adjusting valve lash.

Porsche 959 1986

In the 959 that achieves a speed of over 300 km/h Porsche puts the optimum of what is technically feasible on four driven wheels at the end of the 80s. Among the components on board is the #hydraulic #chain tensioner, a Schaeffler invention Porsche drivers enjoyed in the 911 as well.

Porsche 911 (Typ 996) 1996

With #VarioCam Plus #variable #valve control Porsche sets new benchmarks in terms of efficiency and performance. This technology supplied by Schaeffler makes it possible to perfectly adjust engine characteristics to the respective driving mode.

Porsche Cayenne S Hybrid 2010

This Cayenne is the first hybrid vehicle from Porsche. The hybrid module with an integrated electric motor sits between the IC engine and the transmission. A #hybrid clutch from LuK harmoniously moderates the interaction between the individual components.

Porsche 918 Spyder 2013

The Porsche 918 as a hybrid sports car marks the pinnacle of what is technically feasible. Detailed work and sophistication are featured in abundance here, the wheel bearings from Schaeffler being a case in point. In these bearings, #ceramic balls replace the usual steel rolling elements, saving 640 grams of weight.

Schaeffler is a global competence partner

Sustainable mobility is the primary development goal at Schaeffler around the globe. The product portfolio encompasses technologies for the engine, transmission and suspension as well as hybrid elements and electric powertrains, ranging from single components to complex systems. Energy efficiency takes center stage in all of them.

Mobility *for tomorrow*

For Schaeffler, innovation has been part of its corporate DNA since the foundation of the company. It is based on lateral and interdisciplinary thinking

Schaeffler is known as an innovative leader delivering a wealth of technologies that make automobiles more fuel-efficient, environmentally friendly, and safer, as well as products for trains, aircraft, wind turbines, and many other industrial sectors. Schaeffler can be found wherever things are in motion – and motion also means mobility. The challenges facing mobility of the future are immense. That's why Schaeffler is committed to its holistic "mobility for tomorrow" concept, geared to finding sustainable solutions for the world of tomorrow. ■

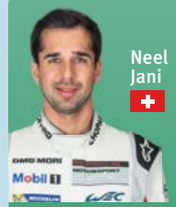
Mobility for tomorrow Under this concept, Schaeffler concentrates on four focus areas: environmentally friendly drive systems, urban mobility, interurban mobility and energy chain

Compact *info*

Porsche 919 Hybrid (LMP1)

- **Combustion engine** V4, turbocharger, 2,000 cc, ‹ 500 hp
- **Hybrid system** KERS at the front axle and exhaust gas energy recuperation, › 400 hp via motor-generator unit (MGU)
- **Hybrid class** 8 MJ
- **Energy storage system** Lithium-ion-battery cells
- **Drive system** rear-wheel drive via internal combustion engine, temporary front-wheel drive via hybrid system
- **Fuel tank capacity** 62.3 l
- **Minimum weight** 875 kg
- **Dimensions** Length 4,650 mm, Width 1,900 mm, Height 1,050 mm

#1



Neel Jani

✱ December 08, 1983
Rorschach (CH)
@neeljani

André Lotterer

✱ November 19, 1981
Duisburg (D)
@Andre_Lotterer

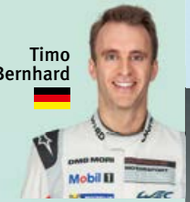
Nick Tandy

✱ November 05, 1984
Bedford (GB)
@NickTandyR

#2

Earl Bamber

✱ July 09, 1990
Wanganui (NZ)
@earlbamber



Timo Bernhard

✱ February 24, 1981
Homburg/Saar (D)
@Timo_Bernhard

Brendon Hartley

✱ November 10, 1989
Palmerston North (NZ)
@BrendonHartley

Facts about the new Porsche 919 Hybrid

60–70 % *new developments in comparison to the previous model*

900 hp *system performance*

A turbine turns **120,000** *times a minute in the exhaust tract for the purpose of exhaust gas recovery*

Success in the WEC (2014–2017)

30 *outings*

17 *pole positions*

16 *wins*

10 *fastest race laps*

Drivers' world championship titles

2

Manufacturers' world championship titles

Schaeffler facts

≈ 87,000	employees worldwide
13.3	billion Euro turnover in 2016
› 2,300	registered patents in 2016
25,000	active and pending patents
170	locations in 50 countries
75	factories worldwide
60	Schaeffler components in automobiles worldwide (average)
17	R&D centers worldwide

The race track

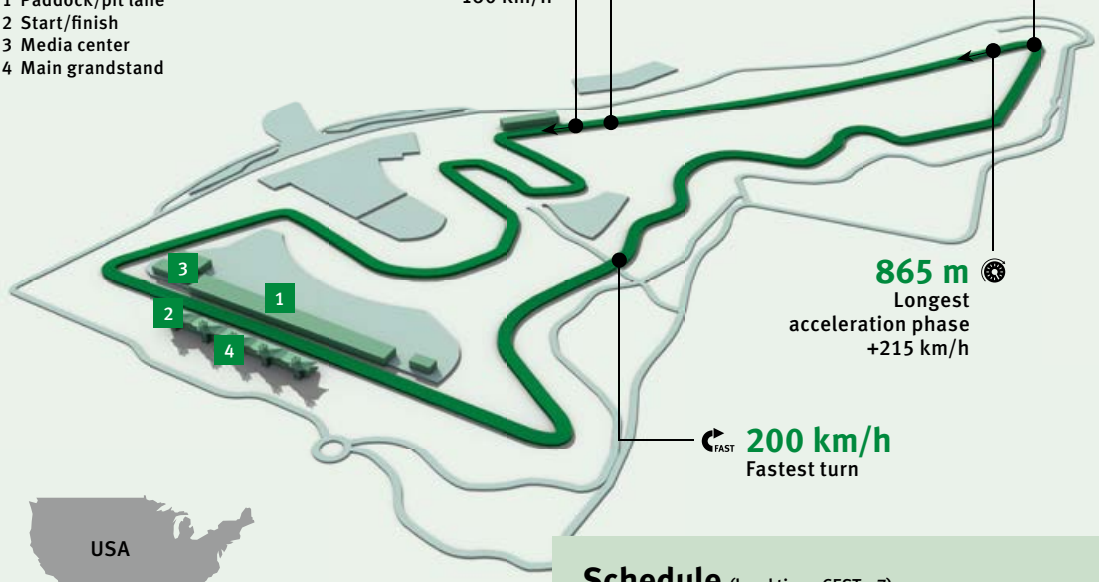
Circuit of The Americas

1 Paddock/pit lane
2 Start/finish
3 Media center
4 Main grandstand

130 m Heaviest breaking zone –160 km/h

277 km/h Top speed

66 km/h Slowest turn



865 m Longest acceleration phase +215 km/h

200 km/h Fastest turn

5,513 m Track length

6 hours Total distance

1st Pole position 2016 Fässler/Lotterer (Audi) 1m 45.842s

Schedule (local time, CEST –7)

Thursday, September 14

09:10 – 09:40	F4 USA Championship	Free practice 1
09:55 – 10:45	World Series Formel V8 3.5	Test 1
11:00 – 11:45	Ferrari Challenge NA	Free practice 1
12:00 – 13:30	WEC	Free practice 1
13:45 – 14:35	World Series Formel V8 3.5	Test 2
14:45 – 15:15	F4 USA Championship	Free practice 2
15:30 – 16:15	Ferrari Challenge NA	Free practice 2
16:30 – 18:00	WEC	Free practice 2
18:15 – 18:45	World Series Formel V8 3.5	Qualifying 1

Friday, September 15

08:30 – 09:00	Ferrari Challenge NA	Qualifying 1
09:15 – 09:45	F4 USA Championship	Qualifying
10:00 – 11:00	WEC	Free practice 3
11:15 – 11:45	World Series Formel V8 3.5	Qualifying 2
13:25 – 13:55	Ferrari Challenge NA	Qualifying 2
14:20 – 14:50	F4 USA Championship	Race 1
15:05 – 15:55	WEC	Qualifying
16:25 – 17:10	World Series Formel V8 3.5	Race 1
17:35 – 18:05	Ferrari Challenge NA	Race 1
18:30 – 19:00	F4 USA Championship	Race 2

Saturday, September 16

08:10 – 08:40	F4 USA Championship	Race 3
09:05 – 09:35	Ferrari Challenge NA	Race 2
10:00 – 10:45	World Series Formel V8 3.5	Race 2
12:00 – 18:00	WEC	Race