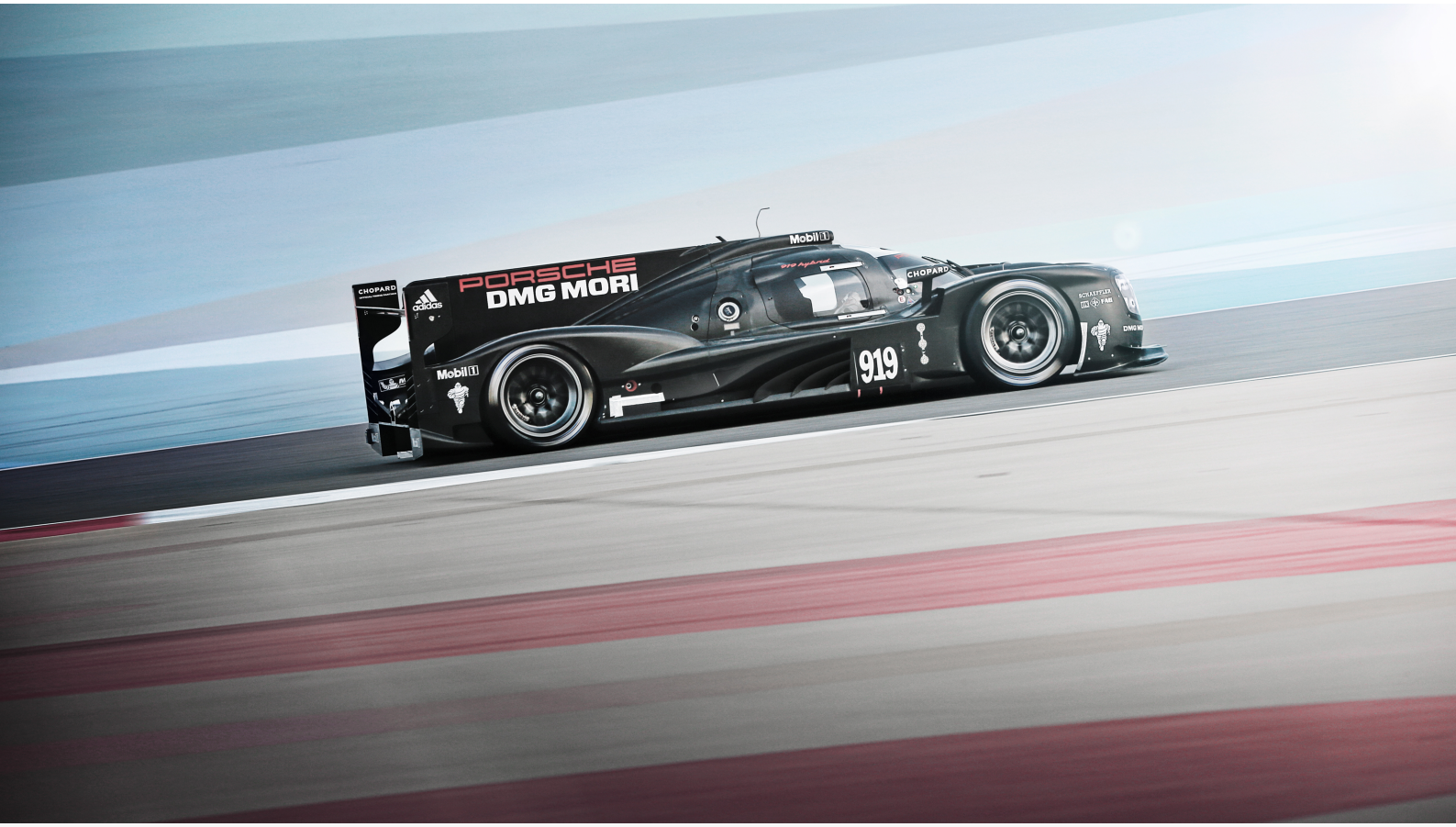


# The Road to Le Mans

01/06/2015 The Porsche 919 Hybrid is lighter, stronger, faster, and more reliable. All new materials were fine-tuned for competitiveness in the test-drives.

Porsche and Le Mans—it's a love story. Speaking of Le Mans, tough men wax misty-eyed about magic, goosebumps, tears, desperation, and ardor. Their recollections rise like an apparition, casting strange shadows on the presence of the listener. Without experiencing it, you can never understand this race.

"And then I go and spoil it all by saying something stupid like I love you"—grand sentiments can miss the mark, as Frank Sinatra and his daughter Nancy sang knowingly. And yet, while an entire self-help industry gamely tries to squeeze love into a guise of objectivity, things are decidedly easier when it comes to Le Mans. For beyond the feelings, it also has a goal-oriented technical angle to consider.

## LMP1 regulations call for hybridization

At Porsche, that aspect is the responsibility of Alexander Hitzinger. As the technical director of the LMP1 program, he's responsible for the prototypes with which Porsche is starting in the big leagues in

its second season since its comeback. LMP1 stands for Le Mans prototypes of Class 1—a closed race car for the FIA World Endurance Championship (WEC), with the 24 Hours of Le Mans taking place on June 13–14. The LMP1 regulations call for hybridization and directly link the performance of the prototypes to their energy efficiency.

It's going on midnight. The 2015 Porsche 919 Hybrid has been doings laps for hours and kicking up a massive cloud of dust. “The sandy desert winds make it difficult to record clear results,” laments Hitzinger, “but at night the conditions are somewhat more consistent, which is why we pushed the test times back.” Meanwhile, all nine drivers who will share three of the prototypes at Le Mans have taken the new car for a spin. The feedback is positive. “Somewhat better-tempered driving behavior was one of our development goals,” explains Hitzinger.

## “We want to field a winning package in 2015”

In endurance races, that is by no means a comfort issue. The aim is the lowest-possible tire wear, thus minimizing the risk of errors. The new rear end and suspension structure is lighter, less complex, and stiffer, doing away with the Porsche 919 Hybrid’s tendency to understeer. Indeed, being more efficient, stiffer, lighter, and yet more robust is the overall aim for the 919 in the 2015 season.

Wolfgang Hatz, executive board member and director of Research and Development, describes the LMP1 program’s marching orders: “We want to field a winning package in 2015. But developing forward-looking technologies for road sports cars is equally important.” Hatz continues, “In 2014, our bold drive concept proved its mettle. The second-generation 919 is therefore not a fundamentally new development, but a comprehensive evolution.”

Hitzinger and his team have put that evolutionary impulse into practice. While it may sound like adjusting a few screws here and there, in fact it meant that even as the basic concept was retained, every detail of it was re-examined. The 919 Hybrid still features a downsizing turbo gasoline engine with direct fuel injection and two energy recuperation systems. Total system output is now almost 735 kW (1,000 hp).

## The list of enhancements is long

The combustion efficiency of the now lighter and stiffer two-liter four-cylinder engine increased again. The load-bearing function of the 90-degree V-engine in the chassis also added to overall stiffness through geometry modifications. To improve performance and achieve more efficient aerodynamics, a twin exhaust system replaces the central exhaust tract in the previous version. The combustion engine powers the rear axle with well over 368 kW (500 hp).

With the critical sequential and hydraulically actuated seven-speed racing transmission as well, the team managed the balancing act of reducing the weight while simultaneously achieving greater

stiffness and robustness. “At the same time, we also reduced the shifting times yet again,” adds Hitzinger.

More power and less weight is the result of the comprehensive reworking of the hybrid system. On the front axle, kinetic energy is converted into electric energy during braking. The second recuperation system is in the exhaust tract. The exhaust flow drives—practically parallel to the turbocharger—a turbine.

The electricity generated this way, like that from the front brakes, is temporarily stored in lithium-ion battery cells. The driver can then call up the energy from there. When he needs full boost power, additional force to the tune of 294 kW (400 hp) presses him into his seat. This power is directed to the front axle via an electric motor and converts the 919 into an all-wheeler.

As with their selection of the drive concept, the engineers also enjoy freedom of choice with regard to the storage medium. “The key is to select the storage medium,” explains Hitzinger, “that is best suited to the respective hybrid system. There’s always a trade-off between power density and energy density.” The higher the power density of the medium, the quicker the energy can be added to and drawn from the battery.

The higher the energy density, the more energy can be stored. Achieving maximal values for both properties is physically impossible. Hitzinger says, “In terms of power density, our lithium-ion battery is nearly on the level of supercondensors, but with a much higher energy density. It can take up and put out a lot of power very quickly, and has a moderate weight and a relatively high storage capacity.”

## Drivers face a choice

When it comes to using electric energy, the drivers face a choice: if they largely drain the battery in a duel by boosting somewhere on the lap, they might be left behind on the straightaway if a competitor still has some reserves. The greater the amount of electric energy that a driver can apply per lap, the lower the amount of fuel he is allowed to use. The rules thus promote innovative hybrid technology while leveling the playing field between the different concepts.

The Porsche 919 Hybrid has been homologated in the highest megajoule class for the first time in 2015 and can add eight megajoules of boost per 13.6-kilometer lap, but can use only 4.76 liters of gasoline. For a 1,000-hp race car that drives at full throttle for 70 percent of the time and reaches speeds of 335 km/h on the straightaway, that’s revolutionary. The prototypes consume some 30 percent less fuel than in 2013—and yet are still faster than their predecessors.

## No compromise in terms of safety

The sandwich-design carbon-fiber monocoque, which is now manufactured in a single piece instead of

two, is notably lighter and yet stiffer. “That’s down to improved layer construction,” explains the technology expert. He would never compromise in terms of safety. And that approach has paid off: less than half an hour before the first victory of the previous car at the season finale in Brazil, Mark Webber emerged from a hair-raising crash almost entirely unscathed.

In terms of aerodynamics, efficiency objectives were joined by sensitivity concerns: lower susceptibility to wind, steering angle, float, and roll angle. These disruptions change the airflow around the car, compromise stability, and thus reduce speed. Aerodynamicists always have a twofold problem at Le Mans: the long straightaways require such low drag that downforce has to be kept to an absolute minimum. On the other sections, however, more downforce is needed.

## It's getting loud again

With its new twin tailpipe setup, the 919 sounds even more imposing. Nico Hülkenberg shifts into seventh gear, boosts, and kicks up a storm. Marc Lieb, the fastest symbiosis of passionate race-car driver and engineer, watches the sand eddies. What does it mean to start with this new Porsche at Le Mans? Lieb smiles in the darkness and shakes his head. “It's impossible to describe. You just have to feel it.”

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