

NEWS



2.13 SECONDS:
NEW RECORD
FOR AN ELECTRIC
CAR TO REACH
100 KM/H.



CHARGER: The Spark-Renault SRT_01E, an electric racer, will compete in 2014 after a demo race later this year.

ELECTRIFYING FORMULA ONE

Racing exposes the best
and worst about EVs

➤ **Formula One drivers have always needed physical stamina to endure** crushing turns and long races. Now they'll need to be good sprinters, too. That's because in lieu of a tire-change pit stop, drivers of the new all-electric Formula E series will sprint from one car to another midrace—twice.

The car swap will allow pit crews to recharge the batteries. The relay-race aspect of Formula E harks back to the Pony Express, but the car itself, unveiled in September at the Frankfurt Motor Show, in Germany, looks ahead to the possible future of electric cars.

During the inaugural 2014-2015 season, all 10 teams will use the same base car, called the Spark-Renault SRT_01E. The car is a Frankenstein's monster of sorts, with a brand-new chassis and tires, a battery based on the Formula One system that recovers energy from braking, and motors evolved from the McLaren P1 hybrid supercar.

The challenges of designing an everyday EV are a far cry from those of relaying a pair of 800-kilogram race cars at up to 225 kilometers per hour. But the series should generate spin-offs, says Kirsty Andrew, head of commercial operations for Williams Advanced Engineering, a Formula E supplier. "I »

200 kW

Amount of power Formula E cars
can use when passing other racers

think motor sport is always a good place to stress-test your innovation and your ideas because it is a harsh environment, and it's a very public environment, and it's repeated frequently," she says.

Like most people involved in the series, Andrew was coy when asked to put numbers on the car's specifications. Series rules limit the motor to 134 kilowatts (180 horsepower), but they will allow drivers to use a Push to Pass mode of 200 kW (270 hp) at certain points, much as Formula One drivers are allowed to alter their cars' aerodynamics for short stretches.

The relative importance of the power train versus the aerodynamics may be the most important difference between the Formula E series and Formula One racing, both of which are run by the Fédération Internationale de l'Automobile. The main innovations in Formula One for the past couple of decades have been aerodynamic: Engineers have tried everything from attaching dynamic spoilers to strategically releasing exhaust over car surfaces to reduce drag. Given its lower speeds and identical cars—at least in the first season—Formula E's competition will center on how the teams manage their electric resources.

SHOWING OFF: The Spark-Renault SRT_01E made its debut at the Frankfurt Auto Show in September.



"The problem is to have a very precise prediction of the state of charge and state of health of the battery," says electrical engineering researcher Peter Spies of the Fraunhofer Institute for Integrated Circuits, in Nuremberg, Germany, whose control system designs have attracted the attention of a leading Formula Student electric car team called EVE. (Formula Student is an international university-level engineering and motor sports competition run by the Institution of Mechanical Engineers.) His team is using new microcontrollers to build onboard monitoring instruments that in the past could be used only during pit stops. Similar fine-tuned control systems should enable Formula E teams to decide just when to pull over for a charging, he says. By season two of the series they may be able to charge using a wireless system from Qualcomm.

At least judging by what goes on in Formula Student racing, the year-to-year progress in Formula E may outpace that of Formula One. ETH Zurich engineering graduate student Julian Hügl, whose Formula Student

electric car beat the gasoline-powered competition this summer, says, "What we have seen in electric racing is that the development is much, much faster compared with combustion cars." He credits rapid advances in control systems.

Another driver of innovation will be necessity. The series is cost-capped, meaning that teams will have to invent rather than spend their way out of at least some of the technical bottlenecks. Indeed, McLaren Electronics has had to develop high-grade switching components to handle the high voltages and power densities of the Formula E electric motor, says its managing director, Peter van Manen. It has also invested in thermal design and avoided exotic materials for cooling its motors, to ensure that the lessons learned will apply to other EVs. "The same approaches you develop to deal with the [racing] challenges you can then reengineer into something which is a little bit smaller in terms of performance, a little bit more cost-effective," van Manen says.

Make that a lot smaller: The SRT_01E is even chunkier than its Formula One brethren: The fairings around its 200-kg battery and the electric motor bulge behind the driver. Organizers predict the car will take 3 seconds to reach 100 km/h, compared with the 2.13-seconds record achieved by a modified Formula Student car in September. The SRT_01E's peak speed of 225 km/h lags well behind that of Formula One cars, which can exceed 360 km/h. The lower speeds may be Formula E's "most problematic thing," says Hügl.

The real measure of success for racing cars, Hügl says, is the show they put on, beginning in late 2013 with demonstration runs: "If I'm interested in racing, I don't really care about the drivetrain of the car. I want to see wheel-to-wheel racing."

—LUCAS LAURSEN