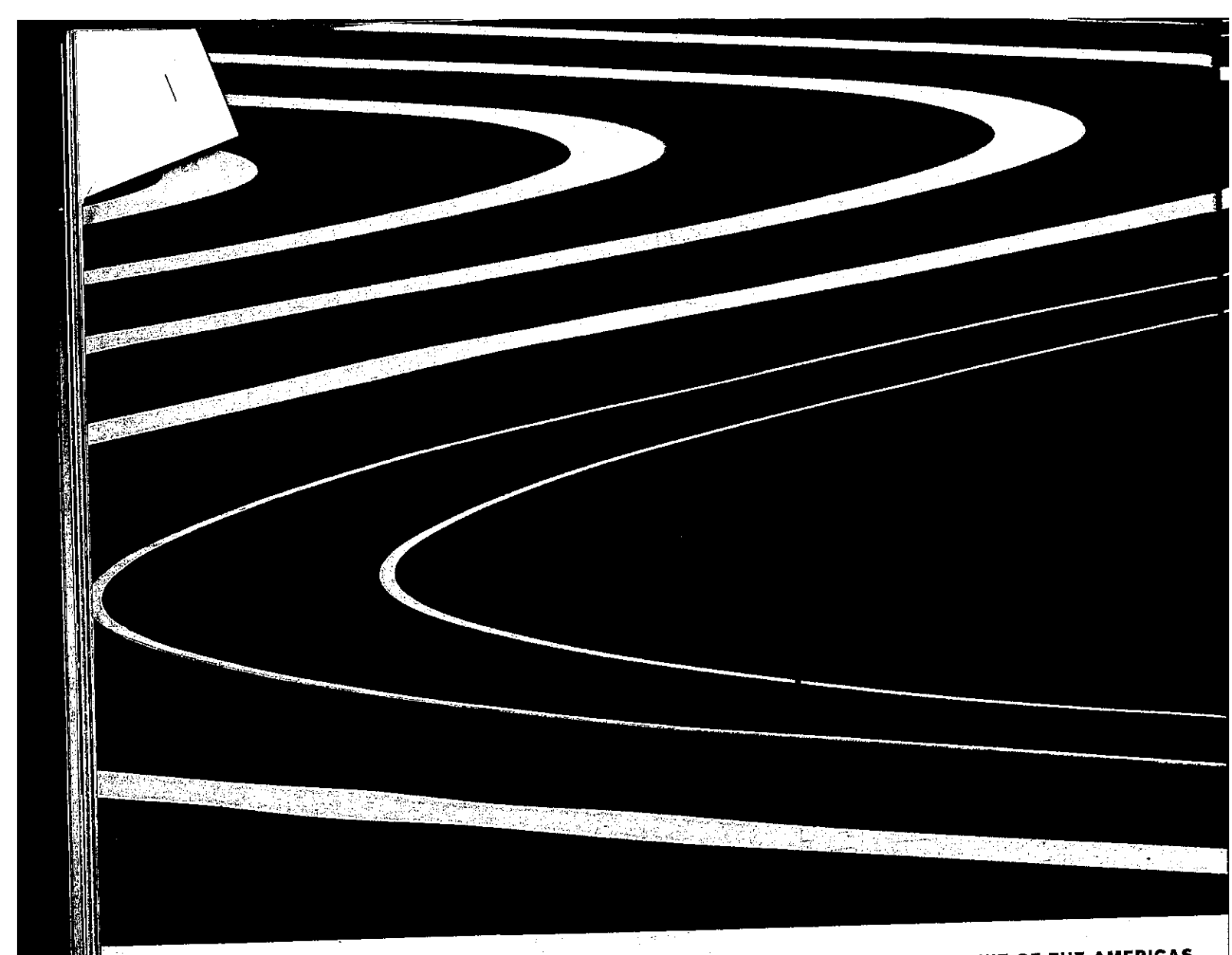

RIVERS TAKE TURN 11 AT CIRCUIT OF THE AMERICAS

pretty slowly. It's tight, and they'll only hit about 60 miles per hour, ending on the car. Then they'll charge down the main straight, a quarters-of-a-mile descent that lets the right machine clear 200. tand in the grandstands before turn 12, a black-and-gold racecar lls my field of view. It's Texas-hot in Austin today, close to 90 l, but the car brings a wind with it. The wind is made of noise. me to Formula One races for this kind of sensory experience. series spun up in 1946, following the exhaustive end of World ntastic machines replaced the terrifying cacophony of bombs oyful chorus of speed-linked sound. Over the years, millions ave swarmed the edges of racetracks to hear F1's roar.

ou don't just hear an F1 engine. You feel it. As the car flies by the tand, the concussive wave emanating from its eight pounding ers hits me in my chest, the back of my neck, and behind my eyes. air to call this a noise? It feels more like an emotion.

Too bad I'm not technically witnessing Formula One. I'm watching he Masters Historic series, an undercard to the next day's U.S. Grand Prix. This full-throated racer is an F1 car, yes, but it's one that hasn't competed for the championship in nearly 40 years.

The modern cars, whose complex hybrid powerplants are more than twice as powerful as the old-school V-8 that just streaked past me, don't sound as awesome. You can stand trackside at a present-day Formula

Steer clear
A Mercedes F1 racer takes turn 5 at Circuit of the Americas.

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One race without even wearing earplugs. This development has fans and teams making a ruckus of their own.

The decibel-depleting transition came four years ago with new league regulations that put hybrid gas-and-electric engines into F1 machines in an effort to appease the increasingly eco-conscious public. And while you might not equate a hybrid—you know, like a Prius—with the planet's pre-eminent racing series, the new cars are faster and more advanced than anything that's come before. This is important for competition, but also for the technological trickle-down that's so key to F1's place atop the motorsport pantheon. Many Formula One innovations find their way into our personal rides: Disc brakes, carbon fiber, and traction control are just a few examples that have made our own automobiles safer, more efficient, and, yeah, faster.

Formula One's hybrid engines definitely bring the innovation, but they're a bit short on sensory thrill.

"That's the slightly embarrassing thing," Ross Brawn, Formula One's managing director of motorsports, tells me later that day from a hermetically white hospitality room two buildings and a road removed from the circuit. "Everyone remembers how great the cars used to sound." Another V-8 screams down the track, its wail piercing our air-conditioned sanctum, and he fights a smile. Brawn, who has been working with F1 cars since the late 1970s, recalls a louder time. "We used to have engines that were ear-piercing," he says. Then hybrids arrived, and, "suddenly you could have a conversation next to a running car," he says.

This hints at an existential questions for Formula One: In our environmentally friendly future, will the most advanced racing series in the world still drive the innovations that power our road cars, or will it instead become pure sport, with entertainment as its singular goal? Or could an all-electric championship overtake F1 as the fastest R&D lab on planet Earth?

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FORMULA ONE IS AMONG THE MOST CASH-infused sports in the world. Race weekends take place on five continents from March through November and draw in excess of 100,000 paying spectators apiece. Team budgets stretch into the hundreds of millions of dollars. Much of that money goes toward developing parts, materials, and systems for their thoroughbred machines. Some of those innovations end up in our driveways.

But as the consumer world trends toward electric vehicles, Formula One shows no sign of putting the brakes on its gas-burning engines. To keep from losing fans and their yawning wallets, F1 heavies look to the petrol-fueled sensory assault of a modern Grand Prix to maintain interest. In parallel, to maintain the interest of eco-conscious race fans, the Federation Internationale de l'Automobile (FIA), which governs most of professional racing, recently bankrolled a new electric racing series called Formula E.

You'd think an all-amps competition would be the most sophisticated racing around, but Formula E is not as technologically cutthroat as F1. To attract smaller outfits, the FIA made entering Formula E, which is only three years old, relatively unintimidating: Many major parts are standard, so you don't need the kind of R&D operation required to develop, for example, a battery from scratch. And to keep the titans of motorsport from trampling newcomers, constructors (teams) can't spend more than $25 million per year on their rigs. That's a tenth of an F1 budget.

In both Formula One and Formula E, the FIA has a lot of say in how racing squads spend their money. Recently, the FIA has been directing teams to put their cash behind green tech, even in performance-obsessed F1.

Every year, the FIA and Formula One's management crew hand down technical regulations to F1 teams; every seven years or so, they create a thoroughly rethought set of these specs. The regulations direct every aspect of a car: engine configuration, angle of the driver's seat, number of joules the car's battery can discharge in a lap, and so on. The interpretation of these specs, even more than jockeying on the track, is F1's real field of play.

"The teams are fighting a technological war," says Brawn, a former tech boss with a reputation for ruthless

"The teams are fighting a technological war."
— ROSS BRAWN, FORMULA ONE MANAGING DIRECTOR OF MOTORSPORTS

competition. As soon as a squad receives the 100-plus-page document, engineers embark on an epic nerd-out, searching for technological edges and loopholes to exploit.

In 2014, the spec mandated new hybrid engines that thrust Formula One into the future—or at least the present day. The regs called for small gasoline-electric setups and resulted in a 35 percent reduction in fuel use. These power units, as they're called, are highly advanced. The gas-powered component displaes just 1.6 liters—that's smaller-than-a-Toyota-Corolla territory—but its diminutive six cylinders achieve phenomenal efficiency. In concert with an electric motor, they put more than 1,000 horsepower onto the track. These cars and their tiny engines are scary fast, breaking speed records at almost every race.

Fans, however, were not impressed by the hybrids' debut. "This yr F1 is kinda dull...I miss the...deafening sound of the V8," wrote one Twitter user. "#F1 in 2014 sucks. Hybrid v6 sound like my jetta," another tweeted. The media was brutal too. *F1's* "new sound gets thumbs down," read one Associated Press report.

The cars' noise level improved over the past three years, but not enough for some. Brawn, who now works for F1 leading the team that writes the all-controlling regulations, had a choice: Steer F1 toward electric power, or push it toward gas. Focusing on electric power would, without a doubt, hugely benefit electric-car R&D; gas would sound amazing.

Brawn's bringing back the roar.

"The show has to be the number-one priority," Brawn says, and then starts slapping the table to punctuate the list of factors that, to him, define Formula One: "The racing [*slap*], the drivers [*slap*], the history [*slap*], the noise [*slap*], the smell [*slap*], the atmosphere [*slap*]."

The FIA's next set of regulations, currently being drafted by Brawn and his crew, could pump up the atmosphere. They go into effect in 2021 and will likely allow higher fuel flow so the V-6 power units—still hybrids—can rev higher and scream louder. They also might do away with a device that makes the power units more efficient—and quieter—by harvesting energy from the engine.

The decision to not go greener is all business. F1 is expensive, and Brawn knows companies won't rush to drop a quarter-billion bucks to fund a team in a sport without fans. "You create the show because you've got substantial investment from manufacturers or technological partners who create this magic of Formula One," he says.

Toto Wolff, team principal of the magic-creating, four-time world-champion Mercedes-AMG Petronas F1 squad agrees. "Formula One is an audio-visual spectacle," he says. "We need to be shocked by the sheer speed of the cars, looking at them, and by the sound of the engines."

As a corporate officer at Mercedes-Benz (official title: Executive Director and Head of Mercedes-Benz Motorsport), Wolff answers to a publicly traded company that sells upwards of 2 million cars a year. His job is not just to win on the track; he also has to make sure the technological gains he achieves there have practical applications.

He can cross that off his to-do list. Sort of. Late in 2017, Mercedes introduced the Project One, which is essentially a street-legal F1 car. "The rear axle has got exactly the same power unit attached to it," says Andy Cowell, Mercedes'

CLOCKWISE FROM LEFT: CHARLES COATES/GETTY IMAGES; COURTESY MERCEDES-BENZ; MARK THOMPSON/GETTY IMAGES

TRICKLE DOWN TECH

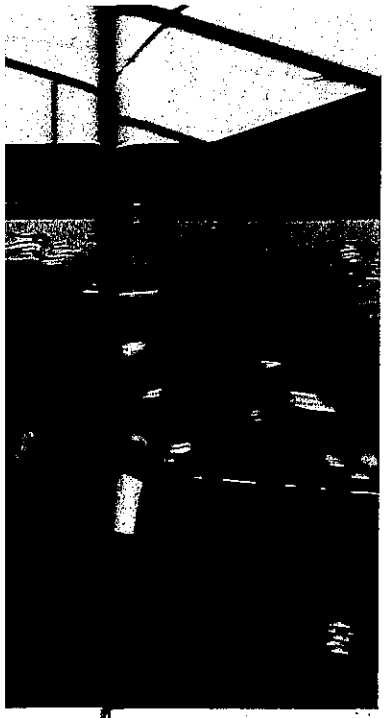
Innovations meant to make drivers faster on the Formula One track have made their way into our everyday wheels more than you might expect.

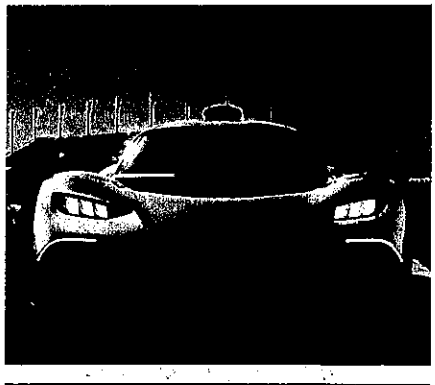
Carbon Fiber

This rigid weave of carbon and resin first made its way into F1 in a 1981 McLaren. During that year's Italian Grand Prix, driver John Watson crashed at high speed, and survived largely because of the aerospace material. Today you'll find the strong-yet-light stuff in nearly every performance car—from wheels to roofs.

Disc Brakes

Old-school drum brakes press metallic shoes into the sides of bowl-like housing. This builds up heat, which can reduce stopping power. The 1951 British Racing Motors Type 15 was the first F1 car with disc brakes, which pinch large plates between small calipers. Now most production cars use this setup.





CLOCKWISE FROM LEFT: CHARLES COATES/GETTY IMAGES; COURTESY MERCEDES-BENZ; MARK THOMPSON/GETTY IMAGES

managing director of high performance powertrains, who oversaw development of that power unit. "The only differences are that it's got an aftertreatment on the exhaust system to meet emissions regulations, and the tuning is adjusted so it can cope with regular gasoline." That's some direct tech transfer! Too bad most of us won't see a Project One at our local dealers. They run $2.8 million, and Mercedes sold all 275 of them the day they went on sale.

▲ Clockwise from left: Formula E driver Nelson Piquet Jr. hops into a new ride. Mercedes-Benz Project One supercar. Mercedes driver Lewis Hamilton and team boss Toto Wolff.

The high-performance hybrid is, at least, the near future of go-fast cars. But hybrids burn gas, and they've been on public roads for 20 years. It's hard to look at something with a tank full of hydrocarbons and see our motive destiny. By most accounts, Formula E and the wave of electric vehicles rushing toward dealerships will dominate our driveways in the years to come.

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"EVERYBODY JUMPS ON THE HYPE OF ELECTRIC cars because Tesla is doing it, but no auto manufacturer who is going pure electric has ever earned one dollar of profit," says Wolff, his German-accented English just *ein bisschen* louder than normal.

Maybe he's just nervous. The next day, his lead driver, Lewis Hamilton, will climb into his 1,000-horsepower hybrid and try to win the U.S. Grand Prix, the race that brought Wolff to Austin this weekend. There's more than just high-fives at stake: A win could secure the World Championship—and its roughly $150 million purse—for Mercedes. Kind of a high-pressure day.

Still, Wolff continues musing about EVs. "My personal view—and I'm not a road-car expert—is that hybrid is the future," he says. "I can see full electrification in cities as a first step, and hybrid everywhere else. But I doubt that we will have more than 25 percent electric by 2030."

Even so, Mercedes has committed to entering Formula E in 2019. "The reason for us joining is that our road cars are gonna go electric—that's a fact," says Wolff. This sounds like a contradiction, but it's not. Mercedes recently announced plans to produce a line of urban-aimed electric vehicles called EQ, and the racing series is a way for the company to promote it. "The marketing aspect interests us," he confirms. When I ask him if Formula E tech will have a meaningful impact on Mercedes' innovation in electric vehicles, Wolff is clear: "Not yet."

That's because Formula E's regulations are pretty locked-down. Engineers can play with the powertrain, the stuff that physically turns the wheels. And that would seem like a big deal, but every team uses the same chassis—the parts that determine how a car handles—and the same battery. Unlike in internal combustion engines, the battery is the most important component of an electric car. It's what lured Mercedes to the starting line.

Current Formula E battery packs can't last a 50-minute race, and, at about 440 pounds, it's impractical to swap one out midcompetition. That's why, about halfway through an ePrix, this happens: The car dips into the pit. The driver unbuckles his five-point harness, removes his steering wheel, climbs out of his car, hops a few steps over to a fully charged car, climbs in, lets the team buckle his safety harness and attach his steering wheel, and zooms off, motor whirring like an angry vacuum cleaner.

Tire Tech

Racing punishes tires. Pirelli currently makes all F1 rubber, and its latest P Zero road skids wear features pulled straight from the track. Hardened material where the tire meets the rim increases stability in turns, while extra silica reduces rolling resistance to boost fuel efficiency.

Fuel Injection

Mercedes-Benz needed to get more fuel into its 1954 F1 engine. It found its flow by ditching the carburetor for a fuel-injection system adapted from WWII fighter planes. The next year, the first fuel-injected production car, the 300SL, rolled off the lot. You'll find this setup in most modern cars, even base models.

Sequential Manual Transmission

F1 cars haven't used stick shifts since the '90s. The now-standard, semiautomatic system shifts gears via a paddle—no clutch-stomp required. The scheme first showed up in 1989's Ferrari 640 racer, and hit roads thanks to street racers like the early 2000s' Toyota MR2.

illustrations by John Kuehn

A pit stop spans about 40 seconds—40 seconds of seat belts and skipping between cars. It's boring and kind of embarrassing. What company wants racecars that can't finish a race? "It doesn't appeal to us to change cars because the batteries don't make it," says Wolff.

He's not alone in that sentiment. "The current configuration encourages people to have range anxiety," says Dick Glover, CTO of McLaren Applied Technologies (MAT). McLaren, a key player in F1 since the 1960s, doesn't just race: The company's Applied Technologies division supplies parts to every team in F1.

MAT is developing a battery that will treat Formula E's anxiety problem. Guess when that new battery will be ready. Yup—2019, which is when Mercedes plans to join Formula E. Porsche recently announced plans to race that year too. And Nissan, which makes the electric Leaf, will start running in 2018. These new teams could change Formula E into the kind of technological warfare that today makes F1 so compelling. And maybe even unseat it as the premiere R&D venue for a new generation.

Maybe.

Formula E's big challenge, if you ask Brawn, is that of a very fast chicken and its expensive egg: Without the public awareness and ticket sales, teams won't pour serious money into the sport, even if you let them. But absent those big spenders' crazy tech, the all-electric series won't draw the crowds... that attract the serious money. And on and on.

One solution would seem glaringly obvious: Formula One could go electric. Generations of history make it unthinkable for constructors like Ferrari to step away. And legions of fans will buy tickets and TV packages that support the multiple billions of dollars required to create the spectacular machines. Just as those same fans gave up their DVDs for Netflix and landlines for cellphones, they'll come to appreciate aspects of racing other than the noise. Right?

"I don't see it in the next five to 10 years," says Brawn. "I can't see that." And he's just referring to the tech required to run 186 miles at F1's hammering pace. "We have some tough questions to ask ourselves," he says.

Here's one: What if F1 were just a sport, with no real-world analog. Armies don't fight with spears anymore, and yet Olympians still win medals for throwing javelins. Why couldn't 24 petrol-powered cars racing around a track be part of our all-electric (or nuclear or hydrogen or whatever) future? "Transportation can become a commodity; it doesn't need to trigger any emotions within you," says Wolff. "Motor racing—the danger and the technology—that triggers emotions. I can definitely see the two not being aligned all the time."

Or maybe it depends on where you live. "We're used to a fairly homogeneous world," says McLaren's Glover. "In the future, it will be anything but that. Some countries will be very heavy on electrification. In others, it won't be much different from what you have now." So the tech on an F1 track might have applications in areas that won't be suited to electrification until decades after cities and infrastructure-heavy markets adopt it. For a sport that prides itself on its global reach, this makes a lot of sense.

That Sunday in Austin, at the race weekend's main event, Mercedes' Lewis Hamilton doesn't make a great start and finds himself in second place behind his Ferrari rival. Five laps later, though, Hamilton charges down that three-quarters-of-a-mile main straight at more than 200 miles per hour, and, right in front of the turn 12 grandstands, passes the Ferrari. He takes the lead. He clinches the championship. The roar of the crowd is all you can hear.

And they're off Drivers race toward the first turn at the U.S. Grand Prix.