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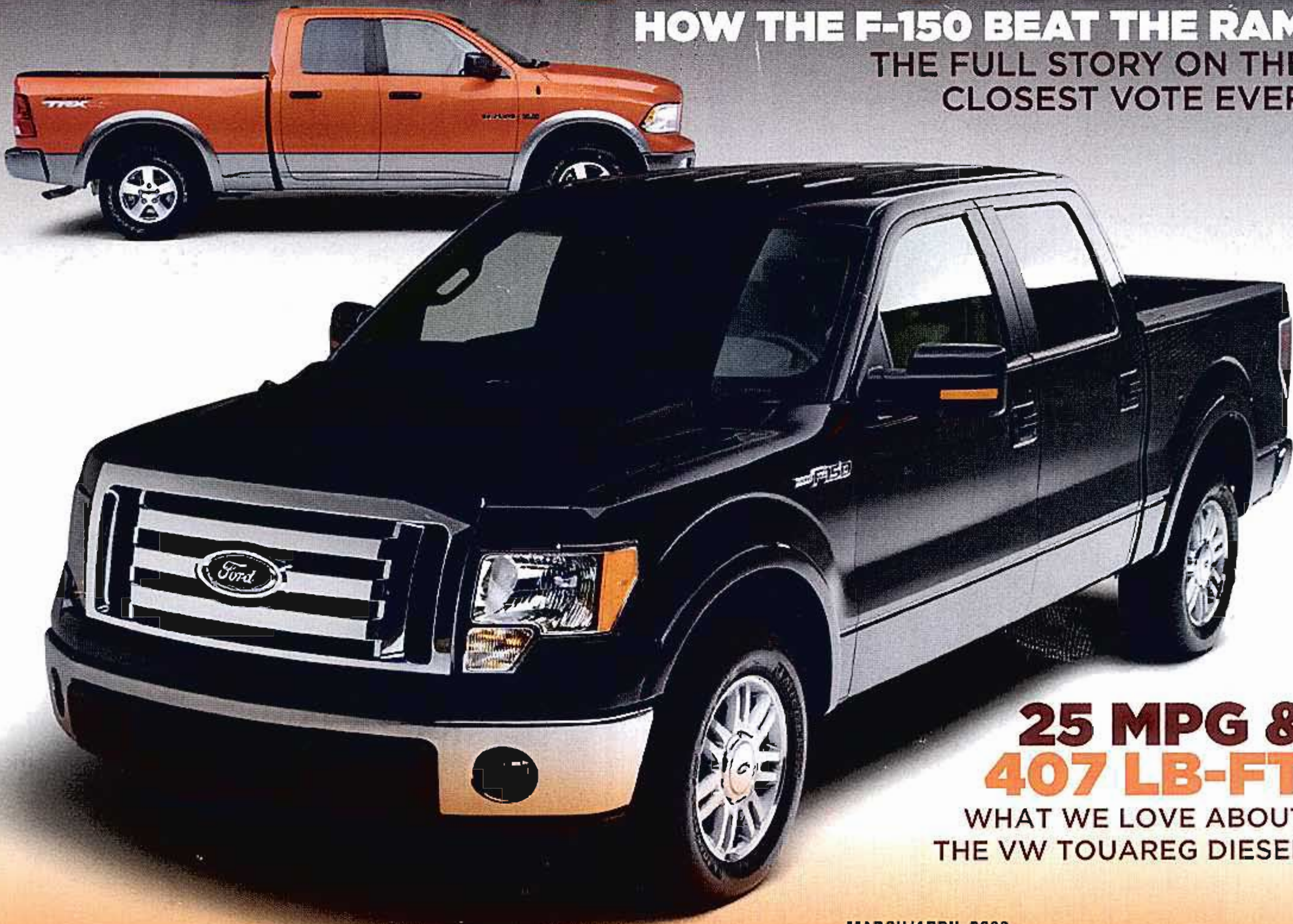

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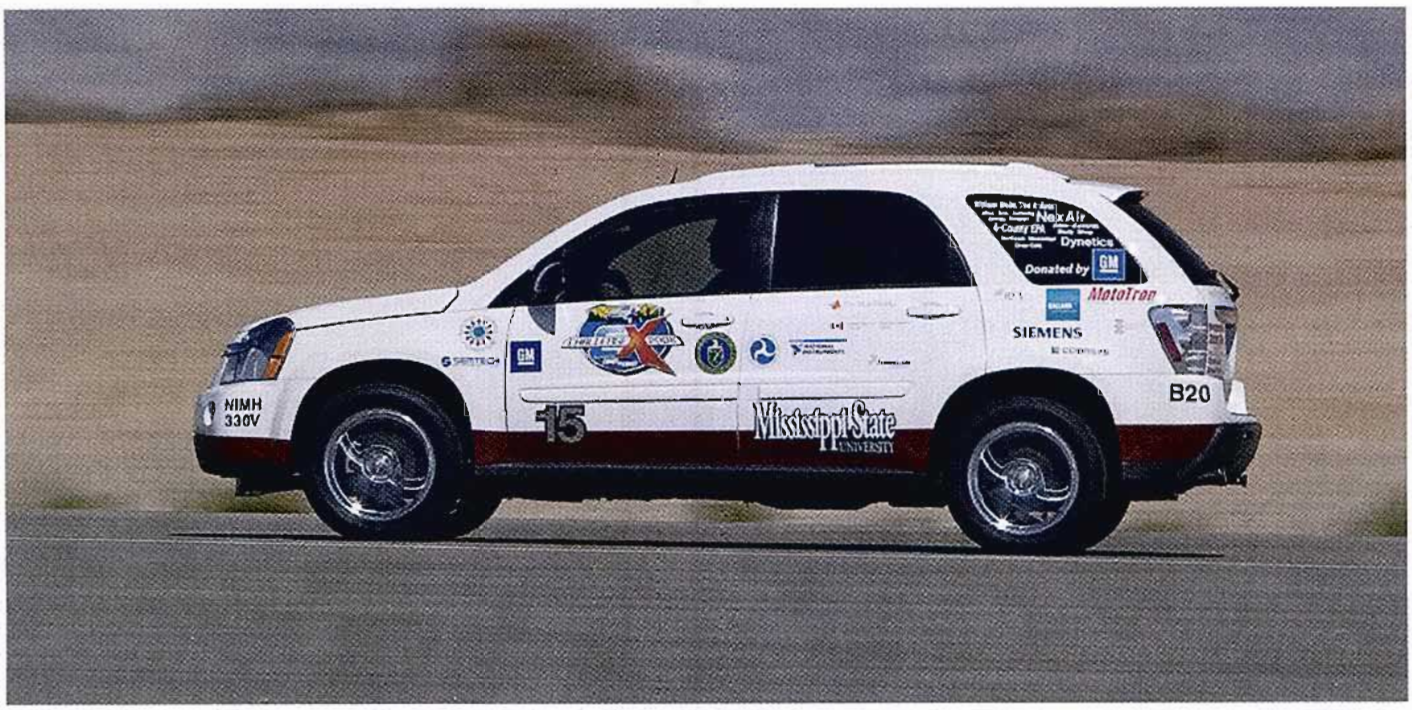
MSU's Diesel/Electric Hybrid Equinox

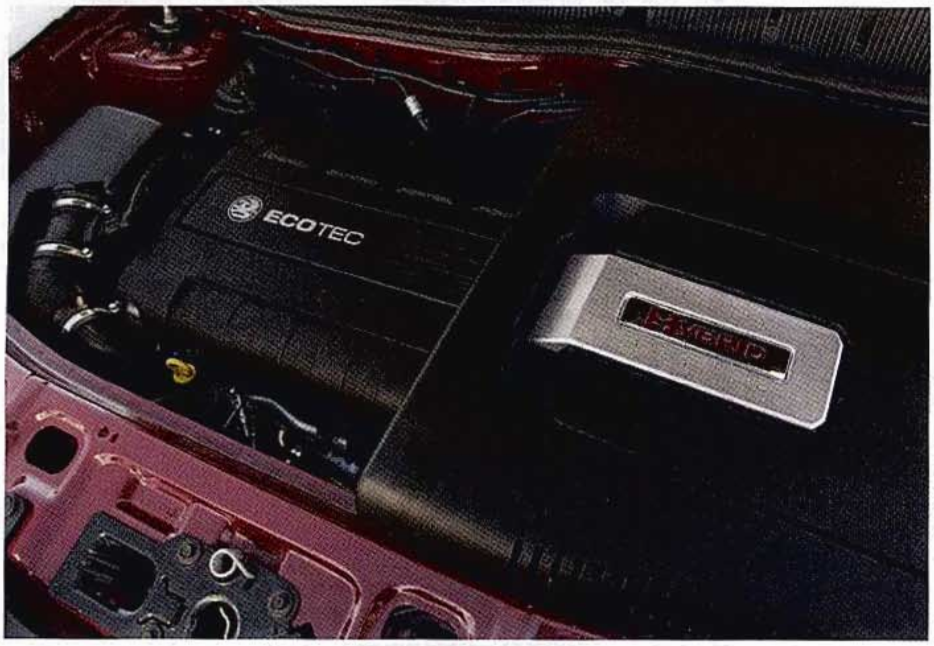


A Sign of Things To Come?

by **allyson harwood**
photography by **brian vance**

Those of us who have been following the enthusiasm surrounding hybrids and alternative fuels have wondered how this move away from typical gas-powered engines is going to affect trucks and SUVs. After all, it's often the case that when a vehicle gains fuel economy, it loses power and capability, and for people who tow, that's an absolute deal-breaker. So how can trucks take advantage of hybrid technology without losing the ability to tug a trailer?

The current answer is to use a stouter gas/electric hybrid system. When done right, it improves fuel economy in the city without sacrificing capability. However, there's another way to use this technology, which could improve towing capacity and would do it with better highway fuel-economy numbers than a regular hybrid: a diesel/electric system. With this combination, the electric motors could power a vehicle at low speed and assist in power around town, using regenerative braking to recharge the batteries. Then on freeways and at higher speeds, the diesel engine would take over, providing the torque truck guys need and the excellent fuel economy



diesel fans have come to expect. Clearly, if it were that easy, this system would already exist on every full-size truck and SUV. But there are some hurdles that have to be overcome, the biggest one being cost. Diesel engines are already pricey to produce, as are hybrid systems. Having both in the same vehicle could prove prohibitively expensive.

Believe it or not, research and development of diesel/electric hybrids is already taking place, but it isn't in the automakers' R&D centers; it's happening on school campuses. For several years, General Motors and the U.S. Department of Energy sponsored a competition known as Challenge X. The third such event included student teams from 17 universities who were given the task of designing and building a new-at-the-time hybrid 2005 Chevrolet Equinox, the goals being reduced emissions and, hopefully, improved fuel economy. Entries included hydrogen power, plug-ins, ethanol, ethanol/hydrogen, reformulated gasoline, B20, and regular diesel. After coming up with proposals, the schools that were accepted into the event spent a year working on computer simulations, then each school received its project SUV. Keys in hand, the students had two years to make the theoretical a reality.

We had the opportunity to drive the contest-winning entry from Mississippi State University, which uses a combination of an electric motor and diesel power. What made this vehicle stand out for the judges was its 48-percent increase in fuel economy over stock, how close it is to being production-ready, and that it's stout enough to handle cross-country jaunts (the guys put more than 15,000 miles on their vehicle, which is more than the next four teams did combined).

Testing the Chevrolet Fuel-Cell Equinox

It's about 11 p.m., and I'm parked along a dark freeway off-ramp. I'm sitting here because it just hit me that I really, truly, might not have enough of this compressed hydrogen to make it to the 24-hour U.C. Irvine refueling station I'm heading for. Sure, I know this is exactly why GM's Project Driveway sent these 100 fuel-cell Equinoxes into the real world—to get gritty feedback like this. I've suddenly realized there's a difference between "real-world experience" printed on a press release and sitting here in the dark, ahead of an idling semi wondering what the hell to do next. The difference is called anxiety.

The good news is that the Equinox is managing 43 miles per kilogram of hydrogen, comparable to 43 mpg on gas. Astounding when you consider that it's 46 percent heavier than the slippery Prius that does about the same numbers. All the same, what kind of mileage are you actually getting if you have to drive 20 or 30 percent farther to actually make it home?

I finally reach Riverside, pulling into the desolate facility. I find the lone H_2 pump amid a loopy, Alice-in-Wonderland forest of alternative-fuel dispensers. Following the instructions, I type in the code—er, hey, the keypad doesn't seem to work right. Some numbers you have to bang with your thumb, others fill the screen with the slightest graze. Eventually, I get the code in, but when I attach the electronic communication cable to the Equinox's stern, a communication error appears on the dispenser screen. I try it again. Error. And again. Error. What the hell, I plug the H_2 hose in anyway and, *hsssssss*, hydrogen starts entering the Equinox's spent lungs.

Until you've stared at a map of Southern California's sparse grid of hydrogen oases and gone to them, found some nonoperable, some demanding individual training sessions before use, learn that some stations take about seven minutes for a refill and others 25 minutes, only then will you appreciate how unbelievably far hydrogen has to go to be even remotely practical.

But as stunningly underdeveloped and uncoordinated as the hydrogen infrastructure is, GM gets a loud shout-out from us for building a hydrogen-fuel-cell SUV that runs like a Rolex. We drove it for two weeks and the whole time were simply amazed at how well it operated. After five miles or so, its oddball George Jetson drivetrain simply melts away into irrelevance—who cares what it is? It works. From a stop, the FCV simply hair-triggers away as its electric motor's 236 pound-feet of torque deliciously yanks you forward from zero rpm. To be sure, at freeway speed you pay the electric-motor piper, as its 98 horses dissolve the Equinox into econocar feebleness. But even here, the near-instant response of what little power you've got results in a useable gain until the stampede of internal-combustion buffalos manage to swallow a breath and start retaliating. Our only gripe was with the brakes, which in the last few mph tended to go all regen weird-feeling.

Compared with a gas Equinox we tested a while back, the FCV is 0.3 second slower to 60 and stops two feet shorter from 60. That's respectable given it's being saddled with a trio of 10,000psi H_2 tanks in the back (holding the equivalent of 4.2 gallons of gasoline for a 160-mile range) and enough radiators to cool Three Mile Island (needed to rid its lower-temp heat). It's a technical tour de force that should rightly make GM proud.

For decades, the story on hydrogen-fuel-cell cars has typically leveraged the old chicken-and-egg allusion. Something has to happen first—the fuel-cell car or the hydrogen infrastructure? Up until now, the answer has been predictably, maybe conveniently, neither.

Now with the Equinox FCV, we don't just have a chicken, we have ourselves a prancing, chest-puffing, cock-a-doodle-dooing rooster. GM has taken the long list of fuel-cell never-will-happens and ripped up the piece of paper. It drives great; the range is tolerable; refueling time is acceptable (at competent stations); the thing didn't blow up. And it's kind of fun.—*Kim Reynolds*

And we can tell you that it's real, uses already existing parts, and realistically provides what it claims.

Delivering main power for this vehicle is a 1.9-liter turbodiesel inline-four, which came from GM's Vauxhall division, as did the six-speed manual transmission. During the contest, it ran on B20 soybean-based biodiesel, but during our week with the Equinox, we filled it with ULSD and it ran just as well. The packaging of the I-4 is considerably smaller than that of the standard 3.4-liter V-6, making room in the engine bay for other necessary components. MSU integrated a 67-kilowatt electric motor into the powertrain and redesigned the rear suspension to accommodate the added weight. In this through-the-road parallel hybrid, the Equinox runs on mostly electric power at low speed (we never got it to run solely on electric power). At higher speed, though, it serves as a gradual power boost, with a smooth but noticeable transition from electric to diesel power. The engine and battery pack put out a total of 240 horsepower and approximately 230 pound-feet of torque, compared with the stock 185 horsepower and 210 pound-feet of torque. And, compared with the OE setup, it gets about 35 mpg combined and has gotten as much as 40-plus mpg on the highway.

Graphics aside, this Equinox looks essentially the same as a stock 2005 model. It uses run-flats, which are heavier than the stock tires, but not needing a spare made room in and below the cargo area. There's a kill-switch on the outside of the vehicle and another on the driver's side near the instrument cluster, but those are typical precautions with any project vehicle. The interior is somewhat stock, but a monitoring system is built into a nav screen in the center stack.

Anyone who enjoys shifting gears would love this AWD Equinox—it's just like driving anything else with three pedals. Acceleration is fairly quick, but the added weight of the new components ensured that it wasn't as spry at the track as the stock Equinox.

Also, the hybrid system's batteries heated up during multiple track runs, putting them into a safe mode to prevent them from self-destructing. That made the vehicle essentially run in limp mode, and despite MSU's 7.5-second 0-to-60 time, our guys got a 9.2-second time out of it. But considering the extra weight and smaller engine, that its slow time was only 0.1-second slower than the stock Equinox, that ain't bad. Behind the wheel, the most noticeable difference between this and a typical small SUV is that the brakes, likely because of the regen system, are somewhat grabby. Braking from 60 required 131 feet, three feet less than the stock model.

More work and polishing would need to happen before this type of vehicle could make it into dealer showrooms, but it's encouraging to know that viable diesel/electric hybrid technology exists, and that it can work using components from GM's parts bin.

The teams that participated in Challenge X proved there are plenty of talented engineers in our colleges and universities. If anyone can make it work for mass production, they can. The next university-based event, called EcoCAR, will offer a new set of challenges for the teams. Visit www.ecocarchallenge.org for more information about EcoCAR and to read about the other competitors from Challenge X. ***TT***