

# P THE PLANET

AMERICA'S OBSESSION WITH THE AUTOMOBILE

WINTER 2010



# GLOBAL GEARHEADS

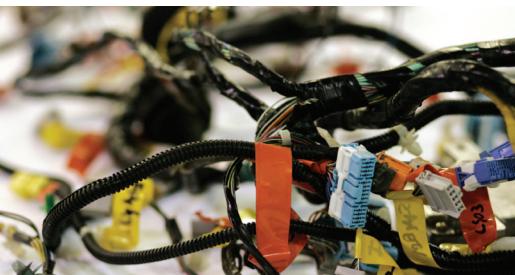
## VRI: A TEAM BEYOND ITS YEARS

BY JAMES ANDREWS PHOTOS BY JORDAN STEAD

The uncompleted Viking 45 sits in the VRI workshop. Its chassis—the frame—is made from carbon fiber-reinforced plastic, a lightweight alternative to steel and aluminum.



## For a small, oil-stained pack of gearheads in the parking lot behind Western Washington University's automotive technology garage, Jan. 29, 2010, was a very good day.



**FROM TOP DOWN:**  
Wrenches hang in the VRI workshop; During the construction of Viking 45, masses of wires often splayed across workshop tables until they could fit into the car; The dashboard on Viking 40; Viking 45's steering wheel; Viking 40, the prototype to Viking 45, weighs 1,300 pounds and carries a 250 horsepower engine.

Throughout January, a calendar inside the garage featured a white kitten with a glassy-eyed gaze and perky ears. The aesthetic it brought to the shop contrasted sharply with the action unfolding around it, where students sawed at car parts with power tools and bounced on wheel wells to test suspension.

But like everything else in the crowded workshop, the calendar served a purpose. Deadlines. Under Jan. 31, a note scrawled in black ink read, "CAR! RUNNING! NOW!!"

The ultimatum was directed at the Vehicle Research Institute's X Prize team, a group of Western students who have invested nearly three years of late nights and many 70-hour work weeks into the production of a gas-electric hybrid sports car, aiming to exceed a fuel efficiency of 100 miles per gallon. The car is Viking 45, the team's entry into the Automotive X Prize, a worldwide competition meant to inspire production-ready cars that reach 100 miles per gallon - or the equivalent in electric energy - to combat the effects of peak oil and fossil fuel emissions.

And, because worldwide recognition and environmental kudos are never enough, the team will earn Western a \$2.5 million check if they win their division.

With the final stages of the competition taking place at the Michigan International Speedway this summer, the team had a major qualifying checkpoint to reach by the end of January: Prove the car runs.

At 6 p.m. on Jan. 29, teammates gathered in the parking lot to watch team leader Brent Wise drive their baby, Viking 45, while recording video proof.

It was not a pretty sight. Wise sat on a bare frame with no windshield or doors, let alone an exterior body to hold them. The engine, docked behind the two seats, had no cover. The fan was zip tied to the radiator, while the battery pack and a mass of wires the size of a child squeezed behind the engine, nearly falling off the tail. The gas tank rode shotgun.

Shortly before starting it, Wise glanced over the car once more and asked a teammate, "Tony, are we forgetting anything?"

"Only our sanity and dignity."

Sanity intact or not, when the engine finally rumbled and Wise rolled around in a few careful circles, the group burst into cheers. They met the fourth checkpoint with two days to spare.

During the last year, a burgeoning list of requirements whittled the pool of X Prize teams from 111 to 41, representing 10 countries. Among them, Western and Cornell University are the only collegiate ones left.

VRI students Brent Wise (driver) and Ben Romeijn-Stout (passenger) test drive Viking 40, the prototype to Viking 45. Though the shapes of the two cars will be similar, the final design of Viking 45 will be black and have an enclosed roof.



The X Prize Foundation announced the Automotive X Prize in April 2007, offering a \$10 million prize purse split between three divisions: the mainstream four-seat class, the two-seat side-by-side and the two-seat tandem. Viking 45, a side-by-side two-seater, is now competing against 18 remaining cars in its division and is one of two that primarily runs on gasoline.

After 30 years in operation, with 44 previous vehicles under its seatbelt - including Viking 40, the project's prototype - the VRI could now very well have its most successful vehicle to date.

Everything in the car has been designed by students with a median age of around 22, a fact that most clearly distinguishes them from their biggest competitors - teams of experienced engineers in most cases, some of whom likely started building cars while these guys were still in diapers.

But the team is supremely confident, and they seem to have the technology and persistence to back it up.

"The only thing that can stop us from winning is our attention spans," said Andrew Brady, the team's engine specialist.

In an unexpected move, the January 2010 issue of Popular Science named them the favorites to win their division. Others, like Eric Boyd, who operates the independent Web site XPrizeCars.com, expect a three-wheeled, electric-powered, super-aerodynamic car dubbed the Aptera 2e to claim the prize money.

The Viking 45 team agrees that Aptera is their biggest threat. Before the competition's announcement, the California-based company had already invested years of development into the 2e. At their Web site, they take preorders with a \$500 deposit.

That factor most distinguishes the Prize from other high-

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mileage contests. These are not just "concept cars". The first checkpoint required teams to develop a business plan demonstrating how a factory could realistically produce at least 10,000 units in a year.

"Right from the beginning, the Automotive X Prize was different because they wanted to have real, production-capable cars that people would want to buy," Boyd said. "If they just let the teams be, you'll end up with a lot of one-off cars, no business plans and a \$10 million prize potentially to a team that doesn't have enough structure to be a business or even an acquisition target."

So, how does a team of students build a safe, desirable and production-ready car while still hitting that 100 miles per gallon sweet spot? They start by confronting gravity.

Most manufacturers today build cars on steel or aluminum chassis, the basic frame of the vehicle. While durable and cheap, metal frames are incredibly heavy. Instead, the chassis on Viking

45 is composed of recycled, aerospace-grade carbon fiber-reinforced plastic. The result is a sturdy chassis that weighs less than half that of a conventional one.

"There's been a trend in the auto industry lately where each new model that comes out is a little heavier than the last one," Wise said. "It's sort of counterintuitive to improving mileage. If you need to propel a vehicle that weighs 3,000 pounds, it's going to take a lot more energy than one that weighs 1,500."

For the record, Viking 45 will weigh 1,100 pounds. With 51 miles per gallon, the Toyota Prius is the most fuel-efficient car on the market. It weighs more than 3,000 pounds.

While the carbon fiber chassis is an unconventional alternative in the automotive industry, Wise considers it a future "trickle-down technology", something more manufacturers will adopt over time.

"Seatbelts, airbags, anti-lock brakes, traction control - all that sort of stuff was in really expensive, high-end cars before they became standard," Wise said, before adding a disclaimer: "Of course, it's hard to tell which technologies will catch on."

But the team designed Viking 45 with a high-end sports car audience in mind. Formula 1 racecars, for instance, began using carbon fiber chassis in the early '80s.

Viking 45 boosts mileage in more practical ways, too.

According to Environmental Protection Agency tests, at 50 miles per hour, a modern car can use more than half of its power just pushing air aside. At 70 miles per hour, the requisite amount of power doubles. Ben Romeijn-Stout, a lead engineer on the team, said an aerodynamic body is perhaps a car's greatest asset for high-speed fuel economy.

Viking 45 is the sixth car to use body molds first made for Viking 7, a high-efficiency car designed in the '80s. The key to the molds' efficiency, Romeijn-Stout said, involves their thin nose and tail, curved windshield and low center of gravity.

Mass-market cars such as the Prius, on the other hand, owe their efficiency not to specialized chassis or superior aerodynamics, but to their electric motors. Benjamin Vos, the team leader until he graduated in Spring 2008, said the team hoped to overcome the largest shortcoming of hybrid cars: Their electric motors are just not efficient enough.

"Ultimately, we wanted to build a hybrid that didn't make me want to rip my hair out," he said. "If you can't ever drive it all-electric, it's a very bad hybrid. You should be able to drive 30 miles all-electrically. If we can get that up to 40 miles in a day, that covers 90 percent of people who drive - without using any fuel."

The Viking 45 hybrid engine comes donated from a totaled Honda Insight. The 3-cylinder, 70 horsepower gasoline engine houses a built-in 13 horsepower electric motor, but the tiny motor left the team hungry for more power and less fuel dependence, so they attached another 50 horsepower electric motor. By com-

parison, the latest Prius has a 98 horsepower engine with an 80 horsepower motor.

Coupled with the car's light weight, the extra motor will allow Viking 45 to run on electric power under approximately 35 miles per hour, though it also demands a much bulkier battery with eight times the power.

With the engine and battery box crowding the rear, the front holds only the headlights, the radiator and one of the car's most vital elements, the front crush structure. In the event of a front-end collision, the nose carries a three-foot long "honeycomb" arrangement of carbon fiber designed to crumple and absorb severe force.

The team insists the car is as safe as comparably sized cars, but Wise admits that big automakers deliver comforts that Viking 45 cannot. While it has features such as heating and air conditioning, the car's low height, for example, makes objects like speed bumps and potholes more intimidating. Owners might not find much space for golf clubs, either.

"You can strip down a car to make it lighter, but it might be louder or less comfortable," Wise said. "People accept lower mileage as a necessary evil in order to have those comforts."

But the tradeoff needs to swing back if consumers want progress, Vos said.

Early in development, the team realized that their original competition car, Viking 40, fell short of the strict contest requirements. Returning to the design table, they applied the lessons learned from Viking 40 into making Viking 45, and Vos believes similar self-analysis must occur in today's automotive industry.

"We need to shift the mindset of consumers because we've basically gotten used to driving houses on wheels," he said. "We need to reset the vehicle. We need to show people what a proper vehicle is with fewer parts, less emissions and less fuel."

After their two day break at the end of January, the Viking 45 team returned to the shop to pull the engine, change suspension springs and fit the battery box. The final round of tests and races in Michigan begins April 26, with the winners announced in Washington D.C. in September 2010.

A joke photo hanging inside the garage shows a computer model of Viking 45 superimposed at the Washington Monument. In the picture, tourists appear to amble past the car without notice, as if this sleek, efficient vehicle blended naturally into the American landscape.

With any luck, someday it might. 

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# WHAT'S OLD IS NEW

BY AMANDA HALLE PHOTOS BY COLIN DILTZ

**With its sleek aerodynamic design, side raising wing doors and glossy, red paint, Craig Henderson's Avion is worthy of admiration from any sports car enthusiast.**

But what admirers might not know is the Avion's greatest feature lies underneath its attractive exterior. The Avion can drive more than 100 miles per gallon, and it has been since 1984.

"There is no special trick," Henderson said. "Anyone can get in this car, drive 60 miles per hour and average around 100 miles per gallon."

To many, Henderson's exceptionally fuel-efficient Avion looks like a gem amongst a plethora of gas guzzling automobiles on the road. For over 25 years, Henderson has dipped the Avion in and out of the consumer spotlight, unfortunately, without much success. But now, Henderson said he believes the time is right for the Avion to once again be unveiled to the public.

Henderson, 53, created the car as a student in the Vehicle Research Institute at Western Washington University in the late '70s. After working on numerous lightweight and fuel-efficient Viking prototype cars, Henderson decided to create a car that could also be practical for mass-production. With the help of fellow student Bill Green, Henderson began working on the Avion in 1979.

Scott Stoner, close friend of Henderson, said he met Henderson and Green at Western. When they told him they were planning to build a car, Stoner said he was surprised and doubtful.

"It would be like one of your friends telling you they are going to build an airplane," Stoner said. "It was amazing to see it all come together."

Green, now an industrial design professor at Virginia Tech University, said he created the design for the car and Henderson took charge of assembly. Henderson and Green wanted to make the car practical for production, such as designing the vehicle for two riders unlike the single-occupant Viking cars they had worked on. After five years of planning and work, the Avion was completed in 1984.

"The car came out exactly the way we planned," Green said.

The Avion, which in French means "airplane," got its name because it is more closely constructed to an airplane than a car, and its aerodynamic build allows it to almost "fly" down the road. The car is built with an aluminum and steel frame and carbon fiber body making the vehicle weigh less than 1,500 pounds - significantly less than the average compact car weighing more than 4,000 pounds, according to the U.S. Environmental Protection Agency. The Avion's engine, located behind the car's seats, runs on biodiesel fuel and can reach up to 110 miles per hour.

Although Henderson does not use the Avion as a primary vehicle, he said he enjoys the attention it gets from onlookers when he does drive it. Henderson's wife, Marian, said she has experienced the attention the Avion gets in public.

"People will wave and smile at you," she said. "People don't ignore you when you drive the Avion."

Currently Henderson, who describes himself as a "tinkerer," is working on a second Avion, with hope of finalizing the designs to put the car into production. Henderson said he hopes to start