

Where are they now?

Hybrid Vehicle Team Alumni Section

Kenneth Frederick (Happy) was involved with the team for about three years, starting during the tail end of the Intrepid, working on the Taurus, and finishing at the start of the Suburban. He worked on weight reduction, moved to the mechanical group, and eventually became the Mechanical Group Leader during his last semester.

Since graduation, Kenneth has been working at Ford Motor Company. With the nickname “Happy” following him, Kenneth went through the Ford College graduate program for two years, where he worked on an engine development program for an Atkinson cycle engine. He was a design and release engineer for regen breaks, and conducted benchmarking on Interactive Vehicle Dynamics systems and Traction Control systems, launching the 2003 Lincoln Towncar.

For the past four years, Kenneth has been working on powertrain controls for the Hybrid Escape and on Ford’s first production hybrid. He works on the drivability of the hybrid powertrain, using software to make the vehicle feel and drive like a conventional vehicle. Kenneth says that most of his work “centers around trying to make the transition from electric to gas no rougher than an upshift in a conventional automatic transmission.” ■



UW Hybrid Vehicle Team - Quarterly Cow
University of Wisconsin-Madison
1500 Engineering Drive
Madison, WI 53706

UW Awards in 2006 from Challenge X

SECOND PLACE OVERALL

Best Written Technical Reports, third place

Best Acceleration

Best Technical Presentation

Best Vehicle Development Review

Dr. Donald Streit Sportsmanship Award

Best Engineering & Fabrication Workmanship

Outstanding Long-Term Faculty Advisor

Most Improved Outreach Program

Freescal Semiconductor:

Silicon on the Move, first place

Best realization of VTS, third place





An update from the University of Wisconsin-Madison Hybrid Vehicle Team

Challenge X 2006

by Lehla Vakili

It's a hot June day in Mesa, Arizona, and two Corvettes are revving their engines, arousing spectators with anticipation. Abruptly, they take off and speed toward each other, and just before eminent disaster, they gracefully spin around each other, circling as if they were dancing. The "dancing Corvettes" stunt show was presented on the last day of the Challenge X competition sponsored by GM.

UW-Madison's Hybrid Vehicle Team devoted months of hard work in preparation for the second year of the Challenge X competition. Seventeen universities from across North America compete to re-engineer a Chevrolet Equinox to be more fuel efficient and cleaner without sacrificing consumer acceptability. This hard work paid off for the UW team who won second place overall.



The Moovada at the Mesa Proving Grounds

The rear axle is powered by a 59 kW Ballard induction motor/gearbox and a 44-module (317 V) NiMH hybrid battery pack from Johnson Controls. A 1.9L Fiat diesel engine powers the front wheels and "through the road" also recharges the batteries via induction motor.

The fuel is B20 diesel, which has a lower GHGI impact than conventional diesel. The hybrid controller is a Motorola MPC555-based Powertrain Control Module (PCM) specifically designed for automotive applications. The UW team uses ANSI C language to develop code and MotoTron to program the controller.

Year two of Challenge X competition has four types of events: qualifying, dynamic, static, and recreational (which is not scored). Competition kicked off with a recreational event called "Skit Night." We ate a traditional Southern dinner, listened to judges speak about competition, and then watched each team present a skit of their own creation. UW's skit was a lighthearted play in which our mascot, Bessy the cow, was mutated to poke fun at veteran teams and the organizers.

The next day began with the qualifying event, tech inspection, and braking tests, all of which we passed



Bessy and the UW Hybrid Vehicle Team

The UW entry, nicknamed Moovada, is a four-wheel-drive, charge-sustaining, split-parallel, diesel-electric crossover vehicle. Fuel economy, greenhouse gas impact (GHGI), acceleration, component packaging, and consumer acceptability were considered in establishing Moovada's technical specifications.

without incident. Later that day, we started the dynamic events on the handling course. This was fun to watch—especially because UW did so well. Next came the high-speed stability event, but unfortunately the transmission neutral sensor malfunctioned.

After lunch everyone rushed to make repair. This turned out to be the only mechanical problem during competition, which is a sign of the UW team's excellent workmanship and solid design.



Daniel Mehr and the Mississippi Team

The traction control event could have gone better, but as a result, the team now knows where to focus attention for the third and final year of competition. Despite installation delays, the emissions event was successful. The urea injection system performed as expected, but the drive cycle had aggressive transients, so the numbers were less than desirable. However, all schools had similar results.

Before temperatures got too high outside, the acceleration event took place. UW's 0-60 mph acceleration was a very respectable 8.22 seconds, and 50-70 mph acceleration was the shortest at 4.83 seconds. Next was the fuel economy event, which was basically a controlled overheat of the battery/motor. After finishing the first half this event, the motor was 80°C, and the battery was 49°C. The ambient air entering the intercooler was 110°F, so it was a hot day!

The AVL event evaluates acceleration, cruising, and braking for an overall score for balance of drivability and fuel economy. UW tipped out an excellent score of about 9 out of 10. The stock vehicle managed about 7 – 8, and other teams averaged 5 – 6. Following the dynamic events were the static events such as the controls and technical presentations. Despite hard-hitting questions from the judges, the presenters responded quickly and accurately.

Between these events, the teams had opportunities to enjoy the GM proving grounds. Traveling to each event through the GM proving grounds was like sneaking a peek at your presents before your birthday.

Unreleased models of GM vehicles were being driven around, and while waiting for an event, the team spied a new motorcycle being tested at 100 mph on the outer-perimeter speedway.

Each day, GM provided lunch for the teams in a building where everyone could congregate and converse. During these lunch breaks, teams often played cards or other games. During one lunch, there was a competition among a few schools as to who could stack the paper lunch boxes highest. The fun didn't end after leaving the GM proving grounds.

Most days at competition, the UW team finished early, so the team found fun ways to occupy their free time. Most days, the team went to the hotel pool to relax or played a game of ball. All teams received a free ticket for a go-kart ride, which the UW team used sprightly. Also, GM arranged a tour of the Caterpillar testing facility that included a presentation of the company's new technologies; a demonstration of the remote-controlled D10 Dozer, strain gage demonstrations, and a tour of the facility.



Teams at Caterpillar Proving Grounds

For two nights, we setup our projector in the hotel room to play movies, during which we had visitors from other teams join us. One day, some UW team members visited the local desert garden. Every night we dined at local restaurants, and one night, the Akron team bought us a pitcher of milk that we drank felicitously. Out of all the fun we had that week, the awards ceremony topped it all.

In total, UW-Madison received twelve awards at the ceremony, the largest number awarded to any one team in Challenge X this year. Among these awards, Madison was honored to receive the Donald Streit Sportsmanship award, given to a team that offers the most assistance to other teams and organizers despite their own burden of work.

Finally, the UW Hybrid Team advisor Dr. Glenn Bower was awarded the National Science Foundation's Outstanding Long-Term Faculty Advisor Award, along with a check for \$15,000. Overall, the UW Team won \$28,250 this year at competition. ■

Moovada's New Rear Subframe

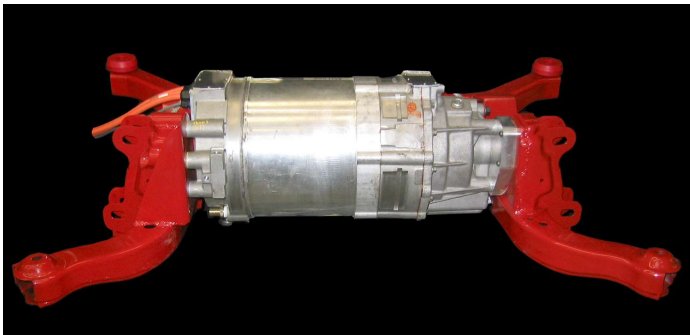
by Dave Ahlman

A major step in the transition from gasoline to diesel-electric is reengineering the rear subframe to meet our design criteria. After a full academic year on the project, the UW-Hybrid team has successfully integrated the Ballard electric motor and overcome the many associated challenges.

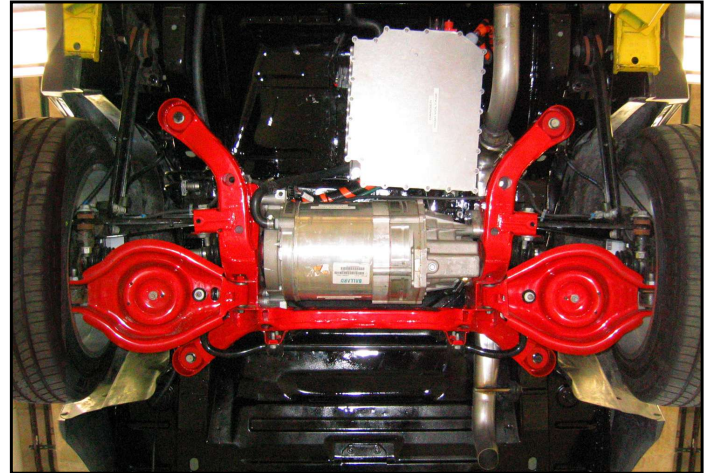
The first problem was how to make the motor fit under the vehicle and maintain adequate ground clearance. Removal of the motor controller (the shiny box in the photo at right) for adjacent installation was the answer. Then came the mounting of the motor to the subframe itself.

The stock subframe held the rear differential which was considerably smaller, so major structural changes were made to accommodate the motor's geometry and mounting points. Fortunately, the motor's housing is solid enough to be a structural member, and thus eliminates the need for reinforcements.

The second problem was that the motor interfered with the mounting points of the A-arms. The solution was to shorten the A-arms by 2.5 inches and move the mounting points outward the same distance. This change in suspension geometry required new, stiffer springs to maintain ride height.



Rear subframe with the electric motor installed



Complete rear subframe installed in the Moovada

The next step was installing half shafts on each side of the motor to drive the wheels. Part of this linkage involved fabrication of custom CV joints which were made by welding the female spline connector from one CV joint to the cup of another.



Custom CV joints

All modified components were powder coated in Wisconsin red to highlight our workmanship. The undercarriage of the vehicle was painted black to enhance the contrast and aesthetic appeal.

Once assembled with the motor and suspension components, the subframe was mounted to the vehicle with polyurethane spacers to ensure proper fit and reduce vibration transmitted to the vehicle.

Overall, the project was a great success and made possible by the hard work and competent engineering of many of our team members. ■

**Wisconsin's
Hybrid Vehicle
Team**

ChairBecky Gunn
Editor.....Dave Ahlman
WritersLehla Vakili
Megan Britson

Quarterly Cow is published by the Hybrid Vehicle team of the University of Wisconsin-Madison, College of Engineering. Please address all correspondence to Hybrid Vehicle Team Editor, 1550 Engineering Drive, Madison, WI 53706, email at grbower@wisc.edu or call 608-263-7252.



Moovada