

TECHNOLOGY FEATURE

After the Dust Settles

Vehicles built by student teams often take on new lives as educational tools for the general public after the dust settles from the competitions. Two of the most important public outreach activities of this type occur at auto shows and state/county fairs.

For the last three years, the U.S. Department of Energy (DOE) has assisted university teams in displaying their competition vehicles at the five auto shows having the largest attendance (New York, Chicago, Los Angeles, Detroit, and Washington, D.C.). Collectively, these shows attract over four million people per year. Many of the attendees see an alternative-fueled vehicle for the first time when they visit a student display. They inevitably come away with a positive impression. The student vehicle displays are always manned by energetic students who are thrilled to talk about the vehicle they spent a year or more designing,



building, and finally testing in competition.

DOE enlists the firm of ABACUS to secure free display space at the auto shows for nearby schools. ABACUS also helps to set up and take down the display booths. In addition to showing off the students and their vehicles, these shows have allowed DOE to conduct valuable surveys on the attendees' knowledge of and interest in alternative fuels and alternative-fueled vehicles.

Schools may also display their vehicles at auto shows without DOE sponsorship. For example, the University of Alberta often sends a student vehicle to the Vancouver auto show.

State and county fairs also offer great opportunities for schools to display their vehicles, thereby winning recognition for both their schools and sponsors. Many schools have displayed their vehicles at fairs that attract hundreds of thousands of people.

High school teams have been every bit as successful at this form of

public outreach as those from universities. For example, the "Shocker" electric vehicle built by students from four high schools in North Carolina was shown at the North Carolina State Fair in 1995 after the vehicle won first place in all three competitions it entered (EV Grand Prix, 1994 and 1995, and APS Electrics, 1995). The vehicle was also shown at the state capitol and was driven by the Governor.

Major sponsors of the school vehicles receive automatic recognition by placing their signs and logo decals on the exteriors of the colorful school vehicles. These sponsors gain attention and public relations benefits not only at the competitions, but also at all the other events at which the vehicles are displayed—as when, for example, DOE had seven student vehicles on display at its headquarters in Washington during one week in October 1995 as part of Energy Awareness Month.

Philip Patterson
Industry Economist
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Purpose

To inform past, present, and potential sponsors, participants, organizers, volunteers, and others interested in DOE-sponsored vehicle competitions about the plans for and results from the competitions.

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Happy 1st Birthday, *FutureDrive*



With this issue, *FutureDrive* marks its first full year of publication. Without question, it's been a year of growth. Circulation now exceeds 4,000 and includes nearly 1,500 students and faculty members from colleges, universities, and technical schools; 2,400 from industry; 400 from trade associations, and 200 from the media. *FutureDrive*'s readership extends beyond American borders into Canada, Mexico, Australia, Japan, Puerto Rico, France, Germany, Thailand, and other foreign countries. From the start, *FutureDrive*'s mission has been "to inform past, present, and potential sponsors, participants, organizers, volunteers, and others interested in vehicle competitions sponsored by the U.S. Department of Energy (DOE) about the plans for and results from the competitions."

To fulfill this mission over the past year:

- ◆ We've showcased innovative advances in electric, hybrid electric, solar, natural gas, and propane vehicles. For example, the University of Tennessee's entry in the Chrysler Neon Class at the 1995 Hybrid Electric Vehicle Challenge attained emissions levels that were better in every category than those of the California Ultra-Low Emissions Vehicle (ULEV) standard.
- ◆ We've publicized competition results—not only focusing on the winners but also providing a context for understanding the impact of the results and the opportunities arising from superb competition performance. (The Autumn 1995 issue provided full coverage of 10 DOE-sponsored competitions.)
- ◆ We've recognized participating student and faculty achievements through "Team Spotlight" articles and highlighted our sponsors' contributions in "Sponsor Profile."
- ◆ We've stimulated further student and sponsor participation in student vehicle competitions by providing timely information on upcoming events through our "Competition Calendar" and "Competition Update," as well as by describing the benefits to all participants. New sponsors supporting upcoming competitions include Chrysler Corp. (American Tour de Sol) and the Texas Railroad Commission (1997 Propane Vehicle Challenge).
- ◆ We've enhanced the visibility of student vehicle competitions overall, which continue to accrue benefits long after the dust of competition has settled. (See article on p. 1.)

Has *FutureDrive* been successful in its mission so far? We've gotten some favorable, unsolicited feedback on that account. One reader, Kyle L. Davis, Technology Advancement Office, South Coast Air Quality Management District, Diamond Bar, Cal., said: "Our agency routinely funds local university programs to advance the development and demonstration of alternative-fuel vehicles. I appreciate the work that you are doing and look forward to receiving future issues of *FutureDrive*." As we begin our second year of publication, we'd like to hear more about what you think. How can we improve *FutureDrive*, making it even more useful? Feel free to contact me (Fax: 202/586-9815; E-mail: shelley.launey@hq.doe.gov) with your suggestions.

Shelley Launey
 Manager of Vehicle Competitions
 DOE Office of Transportation Technologies

Dynamometer Testing of HEVs at the FutureCar Challenge

Hybrid electric vehicles (HEVs) are the most promising candidates for meeting the high vehicle efficiency targets of the FutureCar Challenge competition and the Partnership for a New Generation of Vehicles (PNGV). These programs aim at efficiencies up to three times those of today's vehicles. However, the advanced vehicle concepts that may lead to this achievement pose significant challenges for FutureCar organizers because the vehicle designs operate so differently from conventional vehicles. New approaches to dynamometer testing must be developed for these vehicles (such as HEVs) that take up where SAE and PNGV specifications leave off.

Because HEVs incorporate both on-board fuel and electrical energy, HEV designers are free to develop an overall vehicle-control strategy that optimizes the efficiency of each energy source. Nevertheless, driving on two energy sources complicates the measurement of fuel efficiency. The miles-per-gallon (MPG) figure commonly used to express a vehicle's efficiency is obviously inadequate for an HEV that derives some of its energy by regularly recharging from the electrical grid. Another complication is that even an HEV that does not take electricity from the grid may always be in a state of flux in terms of the on-board electrical energy that is continually stored and released during tests, resulting in an unpredictably different MPG result every time the vehicle is tested.

Roughly 25% of the points awarded in FutureCar are based on vehicle efficiency and another 15% are based on emissions, both of which are measured with a dynamometer. The way electrical energy is incorporated into the MPG and the emissions rate calculation is made involves a special method that constructs a virtual 250-mile "trip." Off-board electrical energy used during this trip is given fuel-consumption and emissions rates based on the



expected characteristics of power plant electricity generation around the year 2000. For example, if a vehicle can operate for 40 miles in the electric-only mode, then its emissions and fuel usage rate for 40 out of 250 miles will be based on the emissions and fuel usage associated with generating the electrical energy consumed by the vehicle during the 40 miles.

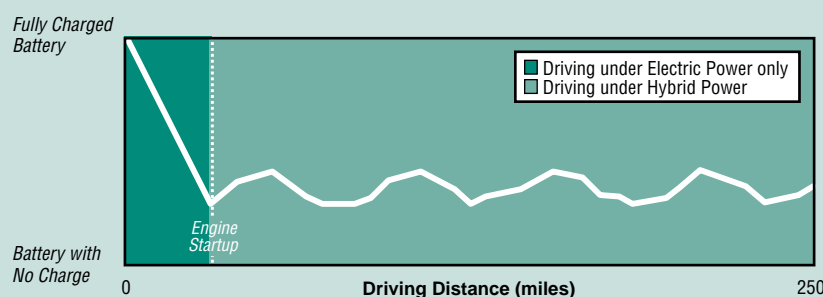
Next year, this analysis may increase in depth by incorporating nationwide driving statistics on trip lengths to more accurately portray the expected impact of electric energy use. Furthermore, power-plant-efficiency and emissions-rate

projections are continually being updated. The values used for the 1996 FutureCar Challenge will most likely be updated for the 1997 event.

Because the FutureCar Challenge competition is dealing with leading-edge vehicle technologies before they emerge from the automakers, its organizers must take a leading role in addressing important issues regarding vehicle testing and evaluation on a continuing basis. Look for future articles on the development of FutureCar dynamometer testing.

Michael Duoba
Engineering Specialist
Argonne National Laboratory

The Virtual 250-Mile Trip





Goodyear Becomes a Sponsor of the American Tour de Sol

The Goodyear Tire & Rubber Company has a long history of involvement with electric vehicles (EVs) and hybrid EVs, and has devoted many years to the research and development of tires that work well with these vehicles. The tire

manufacturer likes to “keep its finger on the pulse of what’s happening in the EV arena,” says Bill Egan, a Goodyear chief engineer, by way of explaining the company’s active role in EV competitions for the last six years.

Because EVs cannot store as much energy as standard internal-combustion engine vehicles, it is especially important that they use as little energy as possible. Over the years, Goodyear has provided EV competitors with its special low-roll-resistance tires to help increase the vehicles’ energy efficiency. As their name implies, these tires expend less energy by keeping their shape better.

Goodyear has been involved in the American Tour de Sol since it began in 1989, supplying contestants with tires and advice on their use. The company also provided sets of tires as prizes.

Now, for the first time, Goodyear has agreed to be an official sponsor of the American Tour de Sol for two years. As before, its tires will be available to contestants who wish to use them. Moreover, a portion of the fee the company is paying for each year of sponsorship will be awarded to competition winners who use its tires. Goodyear technical representatives will attend the event to exchange ideas, information, and advice with the participants and observers.

Other competitions Goodyear has been involved with include the EV Grand Prix, held in Richmond, Virginia, and APS Electrics, held in Phoenix, Arizona. The company has been part of the HEV Challenge since its inception, supplying tires for the Ford Escorts and Ground-Ups in the first and second competitions and for the Chrysler Neons in the last one. Goodyear is supplying tires for all vehicles entering the 1996/1997 FutureCar Challenge.

For more information about Goodyear’s low-roll-resistance tires, contact Bill Egan at the Goodyear Technical Center in Akron, Ohio, by phone at (216) 796-2715 or e-mail at weegan@goodyear.com.

Marita Moniger
Technical Communicator
Argonne National Laboratory



GOODYEAR



Alternative-Fueled Vehicles Ignite Student Interest at Texas Tech

The enthusiasm for alternative-fueled vehicles is infectious at Texas Tech University, says faculty advisor Tim Maxwell, making it easy for him to sustain student interest. Since 1989, Texas Tech teams have built and competed with vehicles powered by methanol, natural gas, ethanol, and electricity. Last year's team came in second in the 1995 HEV Challenge with a Dodge Neon that ran on natural gas and electricity. The current team is preparing for the 1996 Propane Vehicle Challenge, which starts on May 29th in Windsor, Ontario, Canada. Not only are the students having fun competing, they're also learning valuable skills.

Each year, 10 to 15 students design and build a vehicle as part of their senior design project in a two-semester interdisciplinary engineering course. The course helps students put their creativity to work in a team setting to solve a complicated engineering design problem. Both mechanical and electrical engineering students participate, working together to build what they hope will be a winning entry. Two team leaders (one from each discipline) and four faculty advisors guide the process. Team members meet weekly to brainstorm and discuss their progress.


In building their car, the students consider various aspects of vehicle design, such as customer needs, safety, reliability, economics, feasibility, and even aesthetics. They learn to develop, analyze, and evaluate concepts and put their ideas to work in arriving at practical solutions. They function as a multi-disciplinary team, similar to those in the real world. After building, testing, and competing with their

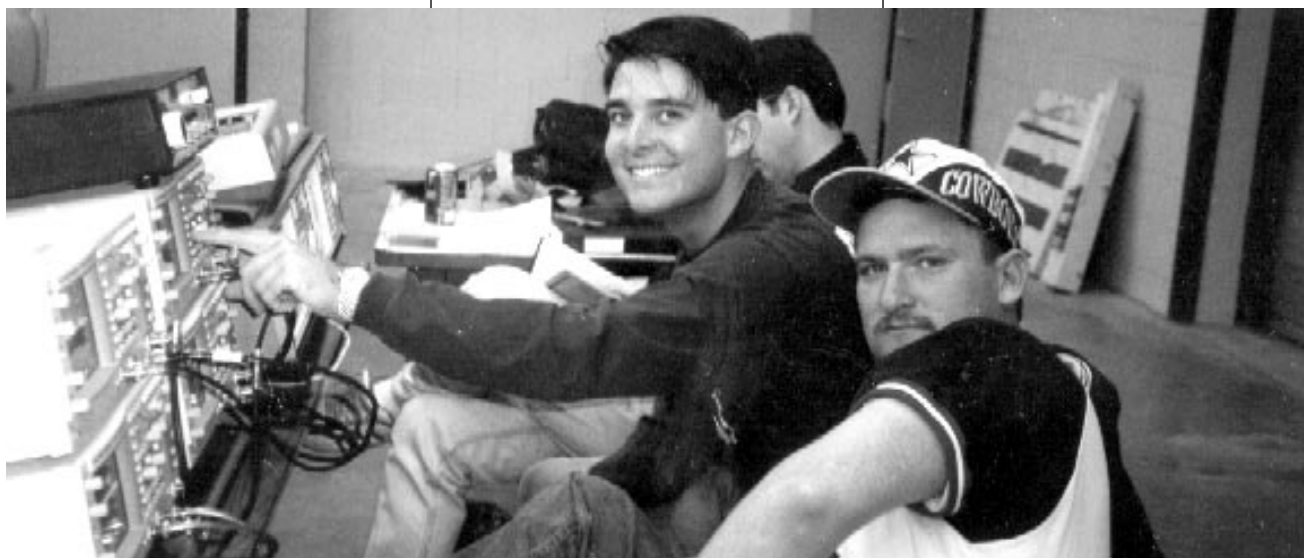
vehicle, the students present oral and written reports on their work.

Texas Tech is one of twelve universities to receive a 1996 minivan from Chrysler Canada Ltd. for the Propane Vehicle Challenge. Their Plymouth Voyager arrived in January. The students began by studying the original gasoline-powered engine and its fuel systems to understand how they work before designing their propane-fueled engine and new control systems. They are building their own fuel controller for gaseous injection, and they intend to adjust the engine for optimal fuel economy and emissions control. The students plan to pull out the gasoline engine and install their propane engine by early May so that they can test, adjust, and fine-tune the vehicle in time for the competition.

"The competitions are an incredible experience for the students," says Tim Maxwell. "They learn to work together, compare notes with other students, and they get to meet with representatives from the automobile industry. It's an extremely worthwhile program."

Betty Waterman
Technical Communicator
Argonne National Laboratory


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COMPETITION HIGHLIGHT

Twelve HEVs to Enter the American Tour de Sol

Twelve student-built hybrid electric vehicles (HEVs) will take part in the 1996 American Tour de Sol, which will start on May 10th and run through May 17th. The remainder of the field of 50 vehicles will consist of electric vehicles built by industrial and student teams.

The HEVs will begin a week of emissions testing on May 6th in New York at the New York City Department of Environmental Protection. The testing method used during this pre-competition event will consist of a modified version of the proposed SAE HEV emissions test procedure. This testing will yield both the emissions and energy consumption of each of the vehicles for the standard EPA city driving cycle. Some EVs and gasoline-powered control vehicles will be tested during this week to obtain a comparative measure of their energy consumption for the same driving cycle.



On Sunday May 12th, the vehicles will leave New York on the first leg of a five-day road rally that courses through New Jersey, Pennsylvania, and Maryland before finishing on the Mall in Washington, D.C. Public displays and other events will be held in cities along the route. Many events are scheduled to take place at the finish line in Washington. The HEVs will be evaluated to determine their consumer acceptability. Several of the teams will be invited to visit area schools, and there will be displays on the Mall and at the U.S. Department of Energy (DOE).

Sponsors of the American Tour de Sol include DOE, the Chrysler Corporation, Goodyear Tire and Rubber Co., and the Northeast Alternative Vehicle Consortium. The event also has a great deal of support from state and local governments, electric utilities, and other interested parties.

COMPETITION UPDATE

APS Electrics

APS Electrics was held March 1-3 in Phoenix, Arizona. It was open to electric and hybrid electric vehicles. First place finishers included the University of Idaho in the Hybrid Division and Ohio State University in the ABB University Spec Series. The overall Formula E winner was Billy Roe of Chandler, Arizona.



EV Grand Prix

The EV Grand Prix will be held April 25-27 at the Richmond International Raceway in Richmond, Virginia. This high school competition will involve vehicles (cars and trucks) that have been converted to electric operation.



American Tour de Sol

The eighth annual American Tour de Sol will be held May 10-17. The electric vehicle road rally will run from New York City to Washington, D.C., with pit stops and free displays in New York, New Jersey, Pennsylvania, Maryland, and Washington, D.C. (See article above.)

Colorado Junior Solar Sprint

The fourth annual Colorado Junior Solar Sprint will take place on May 11th at the National Renewable Energy Laboratory's Solar Energy Research Facility in Golden, Colorado. (See article on p. 7.)

Formula SAE

The Formula SAE competition gives engineering students the opportunity to conceive, design, fabricate, and compete with small formula-style racing cars. The competition will again be held at the Pontiac Silverdome in Michigan. The competition is scheduled for May 15-18, with registration on the 14th and the awards banquet on the 19th. DOE will again sponsor the awards for the M-85 class and Outstanding Teamwork Award.

Propane Vehicle Challenge

Twelve college teams from the United States and Canada will compete in the 1996 Propane Vehicle Challenge to be held May 29-June 4 in Windsor and Toronto, Canada. The competition will give students the chance to convert 1996 Chrysler minivans to dedicated propane operation.

Junior Solar Sprint Lets Grade-Schoolers Design, Build, and Compete with Solar Cars

The Junior Solar Sprint is a series of annual competitions in which 7th- and 8th-grade students design, build, and compete with model cars powered by solar energy. Student teams are given kits that include a motor, solar panel, and educational materials. The students provide the chassis, wheels, and transmission, which may be made from any materials the students choose. The students

are encouraged to use math and science principles together with their creativity in a fun, hands-on educational program that stimulates enthusiasm for science at a crucial stage in their education.

More than 100,000 students nationwide participate in Junior Solar Sprint activities annually. In 1995, 53 competitions were held in 36 states, from Maine to Hawaii. Most

competitions are held in the spring; however, states with much sunshine such as California and Hawaii have competitions throughout the year. The Junior Solar Sprint is managed by the Center for Science Education at the National Renewable Energy Laboratory (NREL).

For more information, call 1-800-NEW-ENGY; fax: (303) 275-3076; e-mail: linda_lung@nrel.gov.



COMPETITION UPDATE

Midwest Supermileage

The SAE Midwest Supermileage competition will be held at the Eaton Corp. Proving Grounds in Marshall, Michigan, on May 31 through June 1. The event is open to colleges and universities with one-person vehicles running on straight iso-octane fuel, and is judged strictly by fuel economy. Several cash prizes will be awarded.

West Coast Supermileage

The 1996 SAE West Coast Supermileage competition will be held June 8-9 at the California Highway Patrol Academy in West Sacramento. It is open to colleges and universities with one-person vehicles fueled by either iso-octane fuel or M-85. The competition offers engineering students real-world experience by giving them a chance to design their own fuel-efficient vehicles.



FutureCar Challenge

The FutureCar Challenge is a multi-year competition aimed at designing and building a mid-size passenger car capable of achieving up to 80 miles per gallon. Student teams from 12 North American universities have been selected to participate. The competition is scheduled for June 1996 and 1997, with the 1996 events taking place June 17-24 in Dearborn, Michigan.

Cleveland Electric Formula Classic

The 1996 Cleveland Electric Formula Classic will be held at Burke Lakefront Airport, Cleveland, Ohio, June 27-30. Open to open-wheeled electric race cars, it is sponsored by Centerior Energy Corp. This is the third year of the competition.



IN MEMORY OF SIMON VEGA

Argonne National Laboratory's Center for Transportation Research will present an award at the 1996 Propane Vehicle Challenge to honor the memory of Simon Vega. Simon Vega, a key member of the University of Texas at El Paso's Propane Vehicle team and Hybrid Electric Vehicle team, died suddenly in an accident on March 15. We have decided to establish the Simon Vega Spirit of Competition Award to be given annually to the collegiate team building an alternative-fueled vehicle that best embodies the positive attitude, abundant energy, and hard work towards goal achievement that Simon stood for.

COMPETITION CALENDAR

March 1-3

APS Electrics
Electrics and HEVs
Phoenix, Arizona

◆ *Contact:*
Donald Karner
Electric Vehicle Technology
Competitions, L.C.
Phone: (602) 256-2599
Fax: (602) 256-2606

April 25-27

EV Grand Prix
High school electric conversions
Richmond, Virginia

◆ *Contact:*
Cindy Dickerson
Virginia Power
Phone: (804) 775-5624

May 10-17

8th Annual American Tour de Sol
Road rally for electrics
New York City to Washington, D.C.

◆ *Contact:*
Northeast Sustainable
Energy Association
Phone: (413) 774-6051
Fax: (413) 774-6053

May 11

Colorado Junior Solar Sprint
Solar cars by 7th- and 8th-graders
Golden, Colorado

◆ *Contact:*
Linda Lung
NREL
Phone: (800) NEW-ENGY

May 15-18

Formula SAE
Formula-style racing cars
Pontiac Silverdome, Michigan

◆ *Contact:*
Educational Relations
Phone: (412) 776-4841, ext. 224
Fax: (412) 776-1615

May 29-June 4

Propane Vehicle Challenge
Chrysler minivans converted
to propane operation
Windsor and Toronto, Canada

◆ *Contact:*
Shelley Launey
U.S. Department of Energy
Fax: (202) 586-9815
E-mail: shelley.launey@hq.doe.gov

May 31-June 1

Midwest Supermileage
One-person iso-octane vehicles
Marshall, Michigan

◆ *Contact:*
Fred Kinney
Eaton Corp.
Phone: (616) 342-3314

June 8-9

West Coast Supermileage
One-person iso-octane and
alternative-fueled vehicles
West Sacramento, California

◆ *Contact:*
Jon Manji
Caltrans
Phone: (916) 227-9683

June 17-24

FutureCar Challenge
Mid-size vehicle conversions
Dearborn, Michigan

◆ *Contact:*
Shelley Launey
U.S. Department of Energy
Fax: (202) 586-9815
E-mail: shelley.launey@hq.doe.gov

June 27-30

**Cleveland Electric
Formula Classic**
Open-wheeled electric race cars
Cleveland, Ohio

◆ *Contact:*
Donald Karner
Electric Vehicle Technology
Competitions, L.C.
Phone: (602) 256-2599
Fax: (602) 256-2606



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