FutureTruck 2003

UNCONVENTIONAL THINKING EXTRAORDINARY RESULTS

FutureTruck

Ford

The Nation's Premier, College-Level
Automotive Engineering Competition

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"FutureTruck brings government, industry, and academia together to explore new innovative approaches to developing fuel-efficient, low-emissions sport utility vehicles. The advanced automotive engineering technologies explored in FutureTruck are important tools to reduce the U.S. and Canada's dependence on foreign oil."

—Spencer Abraham,
Secretary of Energy

FutureTruck
www.futuretruck.org

Ford Motor Company™

FutureTruck

June 2, 2003

Dear FutureTruck Team Members,

Ford Motor Company is pleased to co-sponsor this year's competition at the Ford Michigan Proving Grounds in Romeo. We are excited to be involved in this year's effort to push the boundaries of hybrid-electric technologies in your highly-modified Explorers.

As we begin our second hundred years in designing and manufacturing vehicles that satisfy and excite our customers, it is increasingly important that vehicles like the Explorer continue to offer high customer satisfaction in the areas of energy efficiency and emissions reduction as well as in safety, performance, function, style and cost. The FutureTruck competition allows us to partner with you in exploring not only the latest technologies, but also the customer's perception of those technologies as applied in various designs.

In the past year, you have had the opportunity to reflect on the 2002 competition and develop new alternatives or technology implementation in your vehicles. Hopefully, this year has been rewarding for each of you as you progressed from planning through development to implementation. We are confident that the hands-on experience has been invaluable in teaching you many valuable lessons and some basic skills in communication and teamwork that will be with you for the remainder of your professional lives.

When you began FutureTruck, you committed yourselves to a long program of hard work and personal sacrifice. You are to be commended for the dedication you have demonstrated to your team and its goals. We at Ford Motor Company, as well as our co-sponsor—the United States Department of Energy—and all the other corporate and governmental sponsors look forward to interacting with you and acknowledging your achievements during the competition.

We at Ford believe that the cooperation between industry, the U.S. and Canadian governments, and the 15 universities is an important part of the FutureTruck program. We encourage you to promote similar cooperation as you pursue your individual careers. Fostering positive relationships and communication among various facets of society as we face the future's challenges is critical to the success of our society.

Ford Motor Company welcomes you to Michigan and wishes you all the best possible success!

Randal Visintainer
Director of Engineering—
SUV's & Body-on-Frame Products

Allan Kammerer
Executive Director—
SUV's & Body-on-Frame Products

Chris Theodore
Vice President—
NA Product Development

Welcome to the Future

FutureTruck is a unique four-year engineering program that brings together the resources of industry, government, and academia in a cooperative effort to address important environmental and energy-related issues posed by the growing demand for sport utility vehicles (SUVs).

FutureTruck 2003 challenges teams of students from 15 top North American universities to reengineer a conventional, mid-size Ford Explorer into a lower-emissions vehicle with at least 25% higher fuel economy, without sacrificing the performance, utility, safety, and affordability consumers want. To meet these challenges, students employ cutting-edge automotive technologies, including advanced propulsion systems, lightweight materials, and alternative fuels, such as hydrogen, ethanol, and biodiesel. All of the teams in FutureTruck 2003 are implementing hybrid electric design strategies, which have both an internal combustion engine with a battery and an electric motor.

Where Is FutureTruck?

After months of preparation, teams will participate in eleven days of intense testing and other events, scheduled for June 2-12, 2003. First, vehicles will undergo a comprehensive safety evaluation, followed by dynamic testing and static design events at Ford's Michigan Proving Ground in Romeo. Ford's Allen Park Test Laboratory

will also evaluate the tailpipe and greenhouse gas (GHG) emissions of the FutureTruck vehicles. The competition will culminate in a vehicle display and awards ceremony held in conjunction with Ford's Centennial Anniversary at Ford World Headquarters in Dearborn.

Who Is Involved?

The U.S. Department of Energy (DOE) partnered with Ford Motor Company as the headline sponsors of FutureTruck 2002 and 2003. Ford provided the Explorer SUVs that the teams are modifying, almost $275,000 in seed and prize money, engineering consulting for each team, competition facilities, and operational support.

DOE provides competition management, team evaluation, and technical and logistical support. More than 300 participants from 15 top North American universities will participate in the program. Thirteen private and public organizations joined DOE and Ford to support this innovative engineering program.

Why Is FutureTruck Important?

Today more than 50% of all new vehicle sales are SUVs and light-duty trucks, contributing to increased GHG emissions and further dependence on foreign oil because SUVs historically have been less energy efficient than cars. FutureTruck shows that the cooperation of industry, government, and academia is the best approach to develop more energy-efficient and "greener" automotive technologies, to improve our economy and our environment, and to keep North American technology competitive on a global basis. The competition also helps develop hundreds of highly skilled engineers with a greater awareness of these technologies – preparing them to lead the automotive industry in the 21st century.

FutureTruck 2003 Reaching beyond the horizon.

FUTURETRUCK 2003 TECHNOLOGIES

Team	Configuration	Strategy	Engine	Transmission	E-Motor	Batteries	Fuel
California Polytechnic State University, San Luis Obispo	Series	Charge Sustaining	1.9L TDI VW	GM 4L60E Automatic, 4-Speed	NetGain WarP 11", DC Series, 336kW Peak	Hawker Genesis PbA - 288V	B35
Cornell University	Through the Road Split Parallel – Electric on Front Axle	Charge Sustaining	2.0L Nissan SR20DET	Nissan RER01A Automatic, 4-Speed	AC Propulsion AC-150, AC induction, 150kW Peak	Hawker Genesis PbA - 336V	RFG
Georgia Institute of Technology	Through the Road Parallel – Electric on Front Axle	Charge Sustaining/ Charge Depleting	3.0L Lincoln V6 (LS)	Ford 5R55N Automatic, 5-Speed	AC Propulsion AC-150, AC induction, 150kW Peak	Hawker Odyssey PbA 336V	RFG
Michigan Technological University	Through the Road Parallel – Electric on Rear Axle	Charge Sustaining	2.0L Ford Zetec I-4	Ford XS4P Automatic, 4-Speed	UQM SR218 Perm. Magnet, 75kW Peak	Hawker Genesis PbA - 312V	RFG
Ohio State University	Pre-Transmission Parallel	Charge Sustaining	2.5L Detroit Diesel	Ford M5OD-R4 Manual, 5-Speed	Siemens/Ecostar, AC Induction, 32kW Peak	Hawker E-Cell PbA - 300V	B35
Pennsylvania State University	Post-Transmission Parallel	Charge Sustaining	2.5L Detroit Diesel	Ford M5OD-R4 Manual, 5-Speed	Solectria, AC Induction, 37kW Peak	Hawker Odyssey PbA - 180V	B35
Texas Tech University	Post-Transmission Parallel	Charge Sustaining	2.3L Ford SVO	Ford A4LD, Automatic, 4-Speed	Solectria, AC Induction, 75kW Peak	Panasonic NiMH - 273.6V	H_2
University of Alberta	Pre-Transmission Parallel	Charge Sustaining	2.0L Ford Zetec I-4	GM 4L60E Automatic, 4-Speed	UQM SR120, DC Brushless, 60kW Peak	Worley LiON - 185V NESS Ultra Capacitors -200V	E85
University of California, Davis	Pre-Transmission Parallel	Charge Sustaining	Saturn 1.9L I-4	NVG Manual, 5-Speed	UQM SR218N, Perm. Magnet, 82kW Peak, Enova EDU, AC Induction, 60kW Peak	Ovonic NiMH - 317V	E85
University of Idaho	Post Transmission, Soft Parallel	Charge Sustaining	3.0L Lincoln V6 (LS)	Ford 5R55N Automatic, 5-Speed	GE 5BC49JB1132 DC Series Wound, 14.4kW Peak, Zena Alternators	Maxwell Ultra Capacitors – 48.6V	E85
University of Maryland	Pre-Transmission Parallel	Charge Sustaining	3.0L Lincoln V6 (LS)	Ford 5R55N Automatic, 5-Speed	Honda MF2, 10kW Perm. Magnet	Panasonic NiMH - 276V	E85
University of Tennessee	Pre-Transmission Parallel	Charge Sustaining	2.3L Ford	Ford M5OD-R1 Manual, 5-Speed	UQM SR218H Perm. Magnet, 75kW Peak	Hawker Genesis PbA - 300V	E85
University of Wisconsin – Madison	Post-Transmission Parallel	Charge Sustaining	1.8L Ford Lynx Diesel	Borg Warner Manual, 5-Speed	Delphi UW-EV1-1, AC Induction, 108kW Peak	Panasonic NiMH - 273.6V	B35
Virginia Tech	Series	Charge Sustaining	2.0L Ford Zetec	Single Speed 3.73:1	Siemens 1PV5133, AC Induction, 78.5kW Peak, GE EV2000, AC Induction, 85kW Peak	Hawker Genesis PbA - 336V	H_2
West Virginia University	Post-Transmission Parallel	Charge Sustaining	2.5L Detroit Diesel	New Venture Gear Manual, 5-Speed	Ballard UX 168, AC Induction, 67kW Peak	Hawker Genesis PbA - 324V	B35

The teams in the FutureTruck competition are employing many novel ideas, approaches, and technologies that provide near-term and long-term solutions to increase the efficiency and reduce the overall environmental impact of SUVs. Various hybrid electric vehicle (hybrid) designs – many of which are either in production or are being considered by original equipment manufacturers – are demonstrated by the student-modified vehicles, including series and parallel hybrids.

Engines modified to run on bio-based fuels, such as ethanol and biodiesel, represent a near-term approach; more advanced engines, such as homogeneous-charge compression-ignition engines and hydrogen internal combustion engines represent more long-term approaches. Exemplifying the long-term approach to reducing on-board energy consumption, one team has chosen a "charge-from-the-wall" philosophy to extend the short electric-vehicle range of its hybrid.

The teams are combining these advanced power units with emerging exhaust gas aftertreatment technologies to reduce emissions and total GHG production. Other systems, such as selective catalytic reduction to control oxides of nitrogen emissions, are being used with high-efficiency diesel engines. Advanced electric drive systems enable hybrid features such as regenerative braking, high load assist, and transient smoothing to further improve vehicle-level efficiency.

These student-designed and -modified vehicles truly represent the future of automotive powertrains.

FutureTruck 2003 Events & Awards

Pre-Competition Reports (30 Points)

Event Co-Captains: ***Nicole LeBlanc*** *and* ***Justin Kern****, Argonne National Laboratory*

FutureTruck teams are required to submit two design description reports during the competition year to update FutureTruck organizers about the fuels and technologies that they will be implementing. In addition, teams are required to submit two project updates that detail the team's organization and include timelines, organizational charts, and schedules for the project. Each pre-competition report is worth 15 points, for a total of 30 points.

Vehicle Inspections and Dynamic Readiness (60 Points)

Event Co-Captains: ***Stephen Gurski*** *and* ***Justin Kern****, Argonne National Laboratory*

Competition vehicles are inspected several weeks before and during the first days of the competition to ensure that the vehicles are operational and that all the main systems are functional. Up to 25 points are available for these pre-inspections. Up to 10 points are available for passing and completing the Safety/Technical Inspections, which are held at the onset of the competition. Vehicles are evaluated for safety and verified for compliance with all competition rules for chassis, mechanical, electrical, and fuel systems. The inspections must be successfully completed before a vehicle is allowed to compete in dynamic events. Dynamic readiness points are tied to dynamic events and focus on vehicle reliability and robustness. Up to 25 readiness points are available to teams for completing the dynamic events.

Braking and Handling (15 Points)

Event Co-Captains: ***Tim Carritte****,* ***Kevin Halsted****, and* ***Matt Konarski****, Ford Motor Company*

After Safety/Technical Inspections, teams must pass the Braking and Handling events to qualify for participation in the FutureTruck competition. The Braking and Handling events are designed to test dynamic vehicle safety and verify compliance with competition requirements.

The Best Dynamic Handling award ($500) is presented to the team with the best handling time.

Trailer Tow (50 Points)

Event Captain: ***Vickie Jaje****, Ford Motor Company*

The goal of this event is to demonstrate that the vehicle can tow a 2,000-lb trailer over a designated route at a reasonable speed; this is the highest load condition that will be placed on the vehicle at the competition. The event consists of stages that must be completed in order for the team to receive the full points. Stage 1 consists of a 1.25-mile loop starting with a .5-mile 7% grade. Stage 2 consists of a 2.5-mile loop with a variety of grades, including a short distance with a grade at 17%. Stage 3 consists of three additional laps that combine the Stage 1 and the Stage 2 loops.

Regulated Tailpipe Emissions (100 Points)

Event Co-Captains: ***Mike Duoba*** *and* ***Justin Kern****, Argonne National Laboratory, and* ***Mike Martin****, Allen Park Test Laboratory*

Reducing emissions from on-road consumer vehicles is very important to future air quality. Manufacturers must design new SUVs to comply with more stringent regulatory limits on emissions levels. To earn points in this event, FutureTruck vehicles are required to meet real-world requirements by simultaneously controlling pollutants and meeting minimum Federal Tier 0 emissions standards. The goal of the event is to

meet California's Super Ultra Low Emissions Vehicles standard. Teams that achieve the Ultra Low Emission Vehicles standard or lower emissions levels are eligible for 100% of the event points.

The Lowest Regulated Tailpipe Emissions award ($2,000) is presented to the team with the highest bracket in the Regulated Tailpipe Emissions event.

Greenhouse Gas Impact (100 Points)

*Event Co-Captains: **Stephen Gurski** and **Justin Kern**, Argonne National Laboratory*

The objective of the Greenhouse Gas (GHG) Impact event is a reduction in GHG emissions compared to the stock model year 2002 Explorer. The GHG emissions of each vehicle consist of two measured components: (1) upstream fuel-cycle emissions and (2) dynamometer emissions measurements. The GHGs measured and used in scoring this event are carbon dioxide, methane, and nitrous oxide. Upstream fuel-cycle GHG emissions are those that result from a fuel's production and distribution cycle. These include GHG emissions from the primary energy recovery, transportation, and storage; the fuel production process; and the fuel transportation, storage, and distribution. Each vehicle will be assigned upstream GHG emissions based on the type of fuel used, according to a peer-reviewed analysis of GHG emissions contained in the Greenhouse gas, Regulated Emissions and Energy use in Transportation (GREET) model. The amount of energy consumed in the combined city and highway dynamometer tests will be used to calculate the amount of upstream GHG emissions attributable to each vehicle's operation. The dynamometer emissions are determined by using tailpipe emissions produced from combined city and highway dynamometer tests. The upstream fuel-cycle emissions and the dynamometer emissions for each vehicle are then combined to obtain the GHG impact number.

The Lowest Greenhouse Gas Emissions award ($2,000) is presented to the team with the lowest GHG impact number (score) determined from this event.

On-Road Fuel Economy (100 Points)

*Event Co-Captains: **Tim Bickes** and **John Morris**, Ford Motor Company*
*Fueling Co-Captains: **Mike Finnern** and **Tom Hoppinthal**, Ford Motor Company*

This event demonstrates the robustness and on-road fuel economy of each vehicle. The total distance traveled (within prescribed speed limits) divided by the amount of energy used determines the fuel economy, and thus the score. The event includes stop-and-go, urban, and highway driving segments. Teams completing all laps with a fuel economy 25% above that of the stock Explorer are eligible for 100% of the event points.

The Best On-Road Fuel Efficiency award ($2,000) is presented to the team with the highest fuel efficiency in the On-Road Fuel Economy event.

Acceleration (85 Points)

*Event Co-Captains: **Sal Gusmano** and **Don Stange**, Ford Motor Company, and **Guy Pinard**, Natural Resources Canada*

Passing and freeway merging performance remain key customer satisfaction criteria. To evaluate acceleration, the vehicles accelerate from a standard start on each lap of the On Road Fuel Economy event and run a 1/8-mile section on a straight course. Elapsed times are measured by using photocell-based timing equipment, and trap speeds at the end of the run are recorded by radar (for reference only). Scores are calculated using the average elapsed time of the best seven out of eight runs. To be eligible for full points, teams must meet or beat the stock Explorer's average time.

The Best Acceleration award ($1,000) is presented to the team with the fastest average acceleration time.

FUTURETRUCK 2003 Raising the bar.

FutureTruck 2003 Events & Awards

Off Road (50 Points)

*Event Co-Captains: **Jay Corey** and **Gary Frederick**, Ford Motor Company, and **Stephen Gurski**, Argonne National Laboratory*

To remain true to the heritage of SUVs, FutureTruck vehicles must demonstrate a high degree of off road mobility, defined as a vehicle's ability to successfully negotiate off road obstacles and routes. Four-wheel-drive capability is crucial to successfully negotiate all obstacles without damage or loss of function. The team's score is based on the sum of points for each measurement and obstacle a team passes. The measurement and inspection section is worth up to 12 points, the obstacle section is worth up to 20 points, and the challenge section is worth up to 18 points.

The Best Off Road Performance award ($1,000) is presented to the team with the best score in the Off Road event.

Written Design Report (100 Points)

*Event Co-Captains: **Nicole LeBlanc** and **Christine McGhee**, Argonne National Laboratory*

To demonstrate technical communication skills, each team submits a written design report documenting its approach for meeting the FutureTruck goals. The report includes information on the concept, design elements, engineering analysis, and development of the vehicle. These reports are judged by a group of industry and government experts on content and mechanics.

The Best Technical Report award ($1,500) is presented to the team with the highest score for the technical report.

Power of teamwork.

Oral Presentation (100 Points)

*Event Captain: **Shelley Launey**, U.S. Department of Energy*

Up to two members of each team give an oral presentation, then answer questions from a panel of government and industry experts. The presentation addresses how the team attempted to meet the competition goals, such as increased fuel economy and decreased emissions, without sacrificing the safety, performance, or utility of the stock vehicle. Teams validate or justify any modeling or performance prediction methods they used for their design. Judges evaluate the teams based on presentation style and technical content. Presentation style is worth up to 30 points, technical content is worth up to 60 points, and an additional 10 points can be awarded at the judges' discretion.

The Best Oral Presentation award ($1,500) is presented to the team with the highest score in the Oral Presentation event.

Consumer Acceptability (110 Points)

*Event Co-Captains (Inspection): **Paul Bryan** and **Dave Reis**, Ford Motor Company*
*Event Captain (Dynamic): **Rob Bussone**, Ford Motor Company*

The Consumer Acceptability event consists of a vehicle inspection and a dynamic evaluation. The event compares the FutureTruck vehicles to the stock Explorer, from the prospective buyer's point of view. During the general inspection, which is worth 30 points, judges evaluate the vehicle in three distinct sections: the driver area, general vehicle interior, and exterior of the vehicle. In the dynamic portion of the evaluation, which is worth 50 points, judges evaluate the refinement and quality of the vehicle on a set road course. Separate from the judged events, teams will receive 10 points for each of the following items retained in the vehicle: stock luggage capacity, 3rd row seat, and spare tire.

The Best Consumer Acceptability award ($1,000) is presented to the team with the highest combined scores from the vehicle inspection and dynamic evaluation of the Consumer Acceptability event.

Vehicle Design Inspection (100 Points)

Event Captain (Dynamic): ***Mike Ogburn****, Ford Motor Company*
Event Captain (Static): ***Duane Hartsell****, Ford Motor Company*

The Vehicle Design Inspection event consists of both a static and dynamic evaluation. In the static evaluation, which is worth 75 points, teams give a presentation and answer questions from a team of industry and government judges. Judges evaluate the vehicles in the following areas: engineering concept, component selection and assembly, weight and cost minimization, material selection, serviceability, systems integration, and overall execution of the vehicle and its components. During the dynamic evaluation, which is worth 25 points, judges evaluate the basic operation of the vehicle and review vehicle performance data from prior dynamic events to determine how successfully the team demonstrated the intent of its design. Specifically, the judges will evaluate the team's passive control strategy, hybrid operation, and powertrain operation. This is not an evaluation of one technology over another, but an evaluation of the implementation of the design strategy.

The Best Vehicle Design Inspection award ($1,500) is presented to the team with the highest combined score in the Vehicle Design Inspection event.

Best Workmanship Award

This award is presented to the team with the best combined and exterior vehicle presentation, based on the scores and input from the judges in the Vehicle Design Inspection event.

Best Appearing Vehicle Award

Event Captain: ***Lynda Palombo****, Natural Resources Canada*

The Best Appearing Vehicle award ($1,000) is presented to the team with the highest score in the Vehicle Appearance event. Each vehicle must provide a visual impression that displays quality, value, and the professional pride of the team. The interior and exterior appearance of the competition vehicles will be judged for overall harmony of appearance, visual impact, graphics organization, color aerodynamic enhancements, fit and finish, and visual appeal.

Dr. Donald Streit Sportsmanship Award

This award is presented to the team that offers the highest level of assistance and support to other teams and organizers despite their own circumstance. This award is in honor of Dr. Donald Streit, who served as a dedicated faculty advisor to the Pennsylvania State University FutureTruck team and embodied the true meaning of sportsmanship. Although Dr. Streit's life ended prematurely, his memory and his example are carried on by the students who have and will continue to participate in FutureTruck.

Spirit of the Challenge Award

This award, presented by the competition organizers, is given to a team that exhibits the following characteristics: exceptional perseverance in the face of adversity, maintaining a positive attitude throughout the competition despite significant challenges and obstacles, and pursuing exceptionally high technical goals and standards for their team that best represent the spirit of the FutureTruck competition.

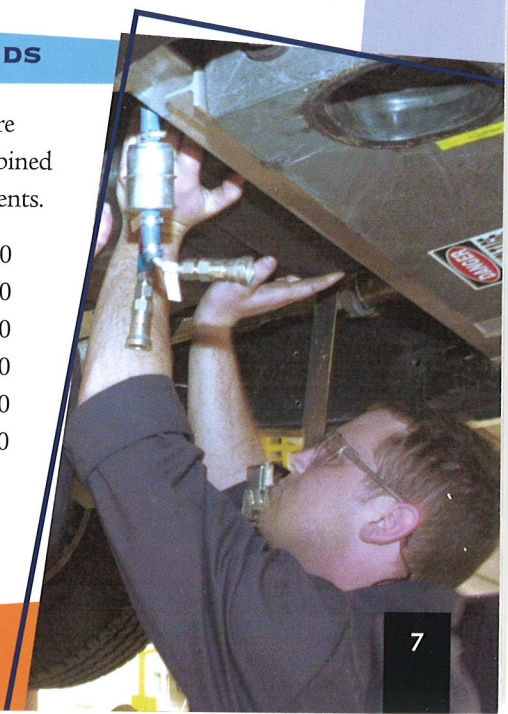
Most Improved Team Award

This award is presented to the team that demonstrates the most improved overall performance over previous FutureTruck competitions. Improvement may be determined by performance in individual events or the overall competition.

Top Place Awards

Top competition finishers are determined by the best combined scores from all the scored events.

First Place	$6,000
Second Place	$5,000
Third Place	$4,000
Fourth Place	$3,000
Fifth Place	$2,000
Sixth Place	$1,000

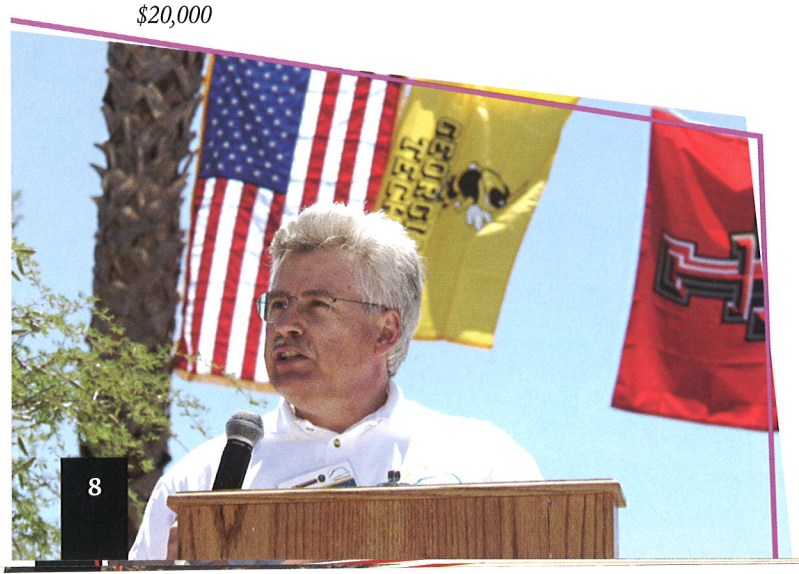


FutureTruck 2003 Sponsored Awards

National Science Foundation Outstanding Faculty Advisor Award

Event Co-Captains: ***Delcie Durham****, National Science Foundation and* ***Shelley Launey****, U.S. Department of Energy*

It takes an enormous amount of time and energy for a faculty advisor to pull together a team of students and professors who may be reluctant to undertake a time-consuming project such as FutureTruck. Yet most participating students claim that FutureTruck is one of the highlights of their university experience. The National Science Foundation (NSF) has supported this award since 1997, and this NSF-sponsored faculty award will continue to provide recognition to the faculty advisors who, through their leadership and research, are advancing the frontiers of science and engineering while passing on a legacy to their students that extends throughout the automotive industry. This award is presented to the faculty advisor who best incorporates Advanced Vehicle Technology Competition (AVTC) activities into the classroom and who has had the most significant impact on the engineering education of his students or used AVTCs to enhance the engineering education experience. These funds are placed into a university account to be used to enhance the integration of the AVTC experience into the undergraduate curriculum for the benefit of the students.
$20,000



Cisco Systems Telematics Award

Event Captain: ***Shivkumar Kutty****, Cisco Systems*

This award recognizes teams for the best implementation of wireless Internet connectivity to their vehicle using Cisco networking gear and other standards based on off-the-shelf products. Three teams that demonstrate excellence in systems integration combined with practical Telematics applications will be selected for the award.
First Place–$1,000, Second Place–$750, Third Place–$500

Delphi Advanced Powertrain Technology Award

Event Captain: ***Bob Larsen****, Argonne National Laboratory*

This award recognizes the contribution FutureTruck teams make toward advanced automotive technology. Underscoring Delphi's commitment to advanced hybrid technologies, Delphi is sponsoring the Advanced Powertrain Technology award to recognize three teams that successfully integrate innovative and advanced technologies to meet the goals of the FutureTruck program.
First Place–$1,000, Second Place–$750, Third Place–$500

National Instruments Most Innovative Use of Virtual Instrumentation Award

Event Co-Captains: ***Gopi Patel*** *and* ***Michael Zeller****, National Instruments*

This award encourages FutureTruck teams to use virtual instrumentation technology to develop a cost-effective FutureTruck vehicle design. National Instruments is sponsoring the award, which will recognize three teams that use LabVIEW™ Real Time or other computer-based measurement and automation systems to meet the goals of the FutureTruck competition. Teams will be scored on innovation, integration, reliability of design, cost-effectiveness, and overall quality and performance.

First Place–$1,000, Second Place–$750, Third Place–$500

The MathWorks Modeling Award

Event Co-Captains: ***Paul Smith****,* ***Peter Maloney****, and* ***Joe Mazur****, The MathWorks, and* ***Aymeric Rousseau****, Argonne National Laboratory*

This award recognizes FutureTruck teams for using The MathWorks software products, MATLAB and Simulink, and Argonne National Laboratory's Powertrain Systems Analysis Toolkit (PSAT) to develop models of the engine, motor, transmission, controllers, and other subsystems that result in a more energy-efficient vehicle. To be eligible for the award, FutureTruck teams must submit a model of their design, participate in a formal project review, and submit a final model and report. The 1st and 2nd place winners are invited to submit a technical report for publication with follow-up analysis of their models and results from the competition. Both teams can receive an additional $250 for their efforts.

First Place–$750, Second Place–$500, Special Recognition–$250

FutureTruck 2003 Organizers

Anna Abbott	Ford Motor Company
Fawzan Al-Sharif	Ricardo, Inc.
Laurie Ambrose	Argonne National Laboratory
Bob Bartholomew	PenTeleData
Tim Bickes	Ford Motor Company
Brent Boecking	National Instruments
Ted Bohn	Argonne National Laboratory
Paul Boisvert	Argonne National Laboratory
Paul Bryan	Ford Motor Company
Steve Burke	Ford Motor Company
Rob Bussone	Ford Motor Company
Jonathan Butcher	Ford Motor Company
Liz Callanan	The MathWorks
Tim Carritte	Ford Motor Company
Colette Cashin	BP
Matt Chouinard	Ford Motor Company
Jay Corey	Ford Motor Company
Mike Costello	PenTeleData
Adam Crosley	Reel Impact
Jack Dawson	Dana Corporation
Frank Deen	Natural Resources Canada
Kristen De La Rosa	Argonne National Laboratory
Stephanie Dollschnieder	Reel Impact
Mike Duoba	Argonne National Laboratory
Delcie Durham	National Science Foundation
Bill Egan	Goodyear Tire & Rubber Co.
Ray Evans	Ford Motor Company
Bob Fillhart	Ford Motor Company
Mike Finnern	Ford Motor Company
John Firment	Consultant
Pat Ford	Ford Motor Company
Gary Frederick	Ford Motor Company
Dennis Gerlach	Ford Motor Company
Frank Gignac	Ford Motor Company
Dave Giroux	ArvinMeritor
Phil Gonzales	Ford Motor Company
Stephen Gurski	Argonne National Laboratory
Sal Gusmano	Ford Motor Company
Kevin Halsted	Ford Motor Company
Duane Hartsell	Ford Motor Company
Bob Himes	Ford Motor Company
Kimberly Hippler	Strat@Comm
Tom Hoppinthal	Ford Motor Company
Mark-Tami Hotta	Ford Motor Company
Kelly Hysan	Strat@Comm
Vickie Jaje	Ford Motor Company
Al Kammerer	Ford Motor Company
Philip Keeler	Reel Impact
Ryan Kennel	Ford Motor Company
Brad Kenoyer	Ford Motor Company
Justin Kern	Argonne National Laboratory
Richard Klimisch	Aluminum Association
Matt Konarski	Ford Motor Company
Shivkumar Kutty	Cisco Systems
Bob Larsen	Argonne National Laboratory
Shelley Launey	U.S. Department of Energy
Nicole LeBlanc	Argonne National Laboratory
Dave Loos	Illinois Department of Commerce & Economic Opportunity
Peter Maloney	The MathWorks
Mike Martin	Allen Park Test Laboratory
Misty Matthews	Delphi
Dave Maxim	Ford Motor Company
Christine McGhee	Argonne National Laboratory
Jamie Morgan	Ford Motor Company
John Morris	Ford Motor Company
Frank Niezabytoski	Ford Motor Company
Mike Ogburn	Ford Motor Company
Mike Paggi	Ford Motor Company
Lynda Palombo	Natural Resources Canada
Gopi Patel	National Instruments
Guy Pinard	Natural Resources Canada
TG Powell	U.S. Department of Energy
Dave Reis	Ford Motor Company
Aymeric Rousseau	Argonne National Laboratory
Damon Scott	Ford Motor Company
Kathi Sherby	Kat & Dog Studio
Dave Shimcoski	Argonne National Laboratory
Tom Smyth	Natural Resources Canada
Rick Spankie	Ford Motor Company
Don Stange	Ford Motor Company
Sara Tatchio	Ford Motor Company
Daniel Vernier	Ford Motor Company
Betty Waterman	Argonne National Laboratory
Sean West	Ford Motor Company
Dennis Yacks	Ford Motor Company
Michael Zeller	National Instruments

FUTURETRUCK 2003 MENTORS

A Ford Motor Company engineer was assigned to each team to provide technical mentoring. The mentors helped guide the teams through the vehicle design process and provided an industry perspective on their design approach. Ford mentors also helped the teams explore the benefits of their chosen technologies to help them produce the most efficient, consumer-acceptable vehicle possible.

"It is to industry's benefit to sponsor and support advanced automotive technology competitions such as Future Truck. These events provide the opportunity to evaluate the school's engineering talent and obtain ideas for advanced technology and methodologies. The mentoring program produces ambassadors who can develop relationships that benefit both Ford Motor Company and the next generation of automotive engineering talent."

Jim Potter, Control Strategy Design — Transmission
Ford Motor Company

"Working on FutureTruck has been a wonderful experience for me. It's been fun to help future engineers work through the types of issues we, in the auto industry, see all of the time. Then to have the students come up with fresh, innovative ways of dealing with those issues is really exciting."

John Nalevanko, NVH Engineer — Wind Noise
Ford North American Truck

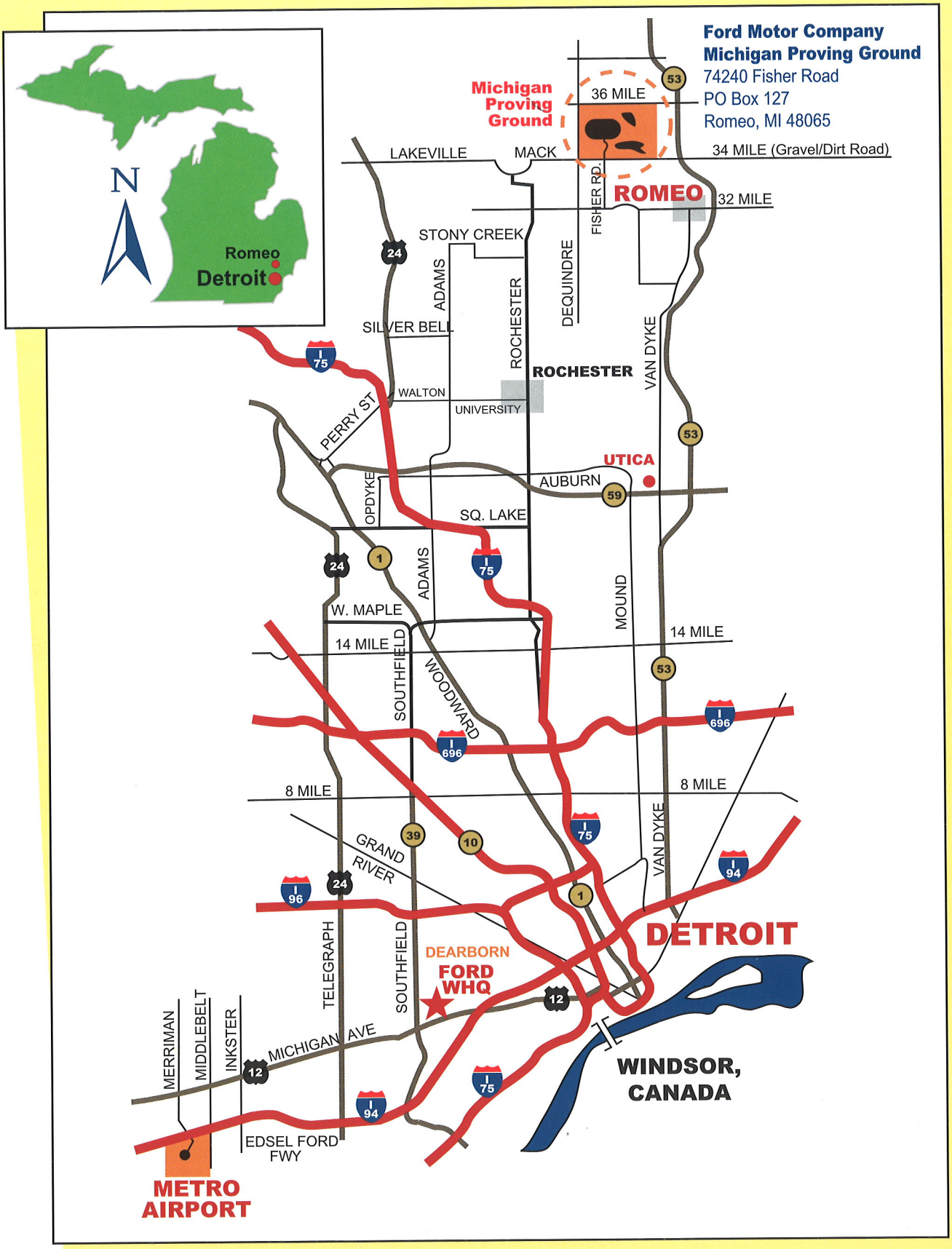
"I'm truly amazed at the passion, drive, commitment, and knowledge level of the students involved in this project. We (the industry) need to find a way to allow these ambitious, energetic people to apply themselves to our business without impeding them with some of the corporate drag we have in our day-to-day activities. The students show me how much work can be accomplished when only essential activities are worked on."

Tom Schramski, Axle/Driveline/4x4/AWD Systems Supervisor, Global Core Engineering
Ford Motor Company

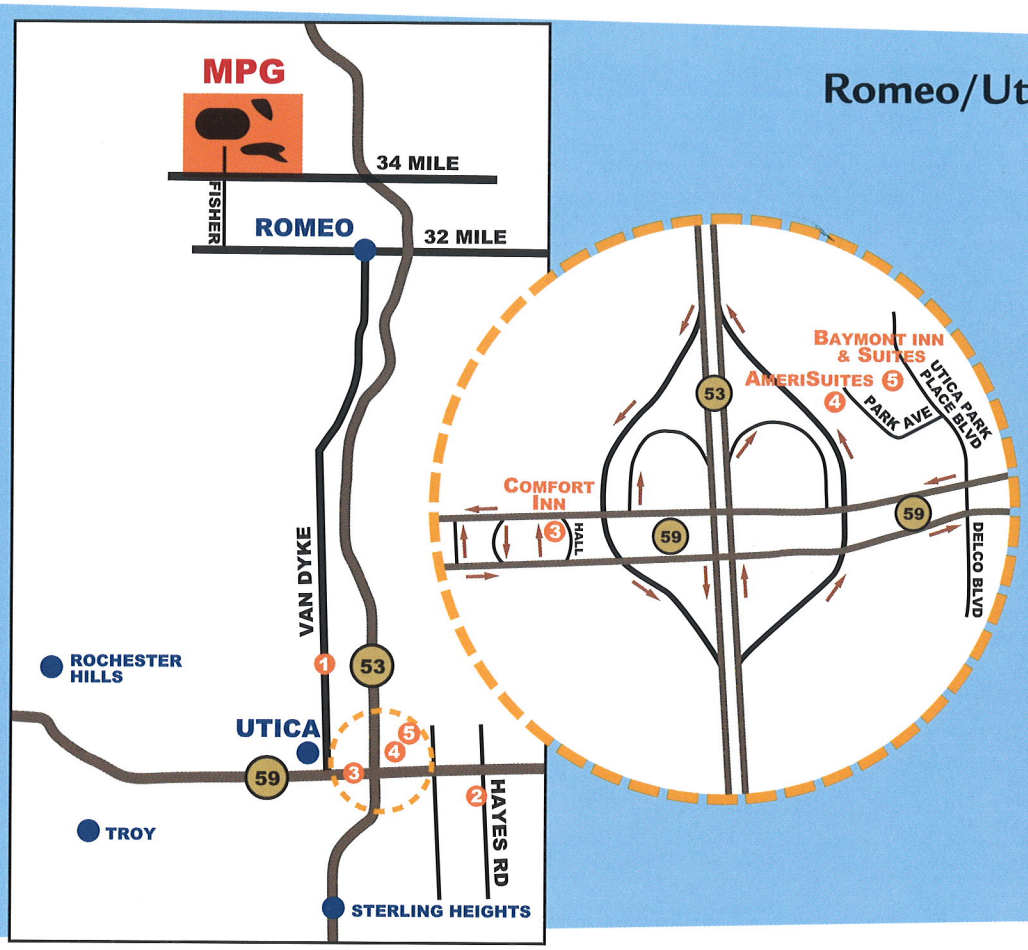
NAME	ASSIGNMENT	SCHOOL
Scott Bodjack	Escape/Tribute Vehicle Integration Supervisor	University of Tennessee, Knoxville
Ken Frederick	Hybrid Electric Vehicle Commissioning Engineer	University of Wisconsin – Madison
Chris Lear	Hybrid Electric Vehicle Calibration Engineer	California Polytechnic State University, San Luis Obispo
Brandon Masterson	Vehicle Development Engineer	Michigan Technological University
Ryan McGee	Hybrid Electric Vehicle Strategy Engineer	Cornell University
John Nalevanko	NVH Engineer – Wind Noise	Georgia Institute of Technology
James Potter	Control Strategy Design – Transmission	Ohio State University
Tom Schramski	Axle/Driveline/4x4/AWD Systems Supervisor	University of California, Davis
Jack Szpytman	EcoStar Electric Drive Systems Manager	West Virginia University
Hoang Troung	Ranger Program Management	Texas Tech University
Tom Watson	Hybrid Electric Vehicle Powertrain Manager	University of Alberta
Bill Weidenaar	Truck Vehicle Engineering Supervisor	University of Idaho
Russ Worosz	E-Series Powertrain Program Management	University of Maryland
Peter Worrel	Regenerative Braking Product Design Supervisor	Pennsylvania State University
Min Zhu	Manual Transmission & Clutch Engineer	Virginia Tech

FutureTruck 2003

Detroit Area Map



Romeo/Utica Area Map



1. **Club Monte Carlo**
   50265 VanDyke
   Utica
2. **Villa Penna**
   42985 Hayes
   Sterling Heights
3. **Comfort Inn**
   11401 Hall Road
   Utica
4. **AmeriSuites**
   45400 Park Ave.
   Utica
5. **Baymont Inn & Suites**
   45311 Park Ave.
   Utica

Dearborn/Allen Park Area Map

6. **Ford World Headquarters**
   One American Road
   Dearborn
7. **Hyatt Regency Dearborn**
   Fairlane Town Center
   Dearborn
8. **Allen Park Test Laboratory**
   1500 Enterprise Drive
   Allen Park
9. **Quality Inn, Fairlane**
   21430 Michigan Ave.
   Dearborn

FUTURETRUCK 2003 COMPETITION

Monday, June 2	EVENT	TIME	LOCATION	MAP KEY
	Registration	10:00 a.m.-5:00 p.m.	AmeriSuites Hotel	4
	Skit Night	6:00 p.m.-9:30 p.m.	Club Monte Carlo, Utica	1

Tuesday, June 3	EVENT	TIME	LOCATION	MAP KEY
	Safety/Tech Inspections	10:00 a.m.-12:00 p.m.	B3, MPG	B
	Fueling	10:00 a.m.-12:00 p.m.	Fuel Station, North Lot, MPG	A
	Lunch, NO EVENTS	11:00 a.m.-1:00 p.m.	B1, MPG	B
	Braking and Handling	1:00 p.m.-5:30 p.m.	North Lot, MPG	A
	Safety/Tech Inspections	1:00 p.m.-5:30 p.m.	B3, MPG	B
	Fueling	1:00 p.m.-5:30 p.m.	North Lot, MPG	A
	Team Leader Meeting	6:30 p.m.-7:00 p.m.	B1, MPG	B

Wednesday, June 4	EVENT	TIME	LOCATION	MAP KEY
	Event Captain Registration	7:00 a.m.-11:00 a.m.	HQ	B
	Safety/Tech Inspections	7:00 a.m.-11:00 a.m.	B3, MPG	B
	Braking and Handling	7:00 a.m.-11:00 a.m.	North Lot, MPG	A
	Trailer Tow	7:00 a.m.-11:00 a.m.	Trailer Tow Course, MPG	C
	Fueling	7:00 a.m.-11:00 a.m.	Fuel Station, North Lot, MPG	A
	Lunch, NO EVENTS	11:00 a.m.-1:00 p.m.	B1, MPG	B
	Safety/Tech Inspections	1:00 p.m.-5:30 p.m.	B3, MPG	B
	Braking and Handling	1:00 p.m.-5:30 p.m.	North Lot, MPG	A
	Trailer Tow	1:00 p.m.-5:30 p.m.	Trailer Tow Course, MPG	C
	Fueling	1:00 p.m.-5:30 p.m.	Fuel Station, North Lot, MPG	A
	Team Leader Meeting	6:30 p.m.-7:00 p.m.	B1, MPG	B

Thursday, June 5	EVENT	TIME	LOCATION	MAP KEY
	Safety/Tech Inspections	7:00 a.m.-11:00 a.m.	B3, MPG	B
	Braking and Handling	7:00 a.m.-11:00 a.m.	North Lot, MPG	A
	Trailer Tow	7:00 a.m.-11:00 a.m.	Trailer Tow Course, MPG	C
	Fueling	7:00 a.m.-11:00 a.m.	Fuel Station, North Lot, MPG	A
	Lunch, NO EVENTS	11:00 a.m.-1:00 p.m.	B1, MPG	B
	Safety/Tech Inspections	1:00 p.m.-5:30 p.m.	B3, MPG	B
	Braking and Handling	1:00 p.m.-5:30 p.m.	North Lot, MPG	A
	Trailer Tow	1:00 p.m.-5:30 p.m.	Trailer Tow Course, MPG	C
	Fueling	1:00 p.m.-5:30 p.m.	Fuel Station, North Lot, MPG	A
	Team Leader Meeting	6:30 p.m.-7:00 p.m.	B1, MPG	B

Friday, June 6	EVENT	TIME	LOCATION	MAP KEY
	Braking and Handling	7:00 a.m.-11:00 a.m.	North Lot, MPG	A
	Trailer Tow	7:00 a.m.-11:00 a.m.	Trailer Tow Course, MPG	C
	Fueling	7:00 a.m.-11:00 a.m.	Fuel Station, North Lot, MPG	A
	Emissions Testing	7:00 a.m.-5:30 p.m.	APTL	8
	Lunch, NO EVENTS	11:00 a.m.-1:00 p.m.	B1, MPG	B
	Braking and Handling	1:00 p.m.-5:30 p.m.	North Lot, MPG	A
	Trailer Tow	1:00 p.m.-5:30 p.m.	Trailer Tow Course, MPG	C
	Fueling	1:00 p.m.-5:30 p.m.	Fuel Station, North Lot, MPG	A
	Team Leader Meeting	6:30 p.m.-7:00 p.m.	B1, MPG	B

Saturday, June 7	EVENT	TIME	LOCATION	MAP KEY
	Emissions Testing	7:00 a.m.-5:30 p.m.	APTL	8
	Braking and Handling	7:00 a.m.-4:00 p.m.	VDA, MPG	A
	Team Leader Meeting	6:30 p.m.-7:00 p.m.	B1, MPG	B

SCHEDULE

Sunday, June 8	EVENT	TIME	LOCATION	MAP KEY
	Emissions Testing	7:00 a.m.-5:30 p.m.	APTL	8
	Fueling	1:00 p.m.-6:00 p.m.	Fuel Station, North Lot, MPG	A
	Team Leader Meeting	7:00 p.m.-7:30 p.m.	AmeriSuites	4

Monday, June 9	EVENT	TIME	LOCATION	MAP KEY
	On-Road Fuel Economy/Acceleration	8:30 a.m.-10:30 a.m.	High Speed Track, MPG	E
	Fueling	10:30 a.m.-3:30 p.m.	Fuel Station, North Lot, MPG	A
	Lunch	11:30 a.m.-12:30 p.m.	B1, MPG	B
	On-Road Fuel Economy/Acceleration	12:30 p.m.-2:30 p.m.	High Speed Track, MPG	E
	Panoramic Photo	4 p.m.-5 p.m.		
	Faculty Dinner	6:30 p.m.-9:00 p.m.	Mountain Jacks, Clinton Township	

Tuesday, June 10	EVENT	TIME	LOCATION	MAP KEY
	Team Leader Meeting	6:30 a.m.-7:00 a.m.	Off Road Course, MPG	F
	Off-Road Event	7:30 a.m.-9:30 a.m.	Off Road Course, MPG	F
	Team Leader Meeting	10:00 a.m.-11:00 a.m.	VDA, MPG	G
	Lunch, NO EVENTS	11:00 a.m.-12:00 p.m.	VDA, MPG	G
	Static Design Events Vehicle Design Inspection, Consumer Acceptability, Oral Presentations	12:00 p.m.-6:00 p.m.	VDF, MPG	G
	Dynamic Events Dynamic Vehicle Inspection, Dynamic Consumer Acceptability	12:00 p.m.-6:00 p.m.	VDA, MPG	G
	Sponsor Social	6:30 p.m.-9:30 p.m.	Villa Penna, Sterling Heights	2

Wednesday, June 11	EVENT	TIME	LOCATION	MAP KEY
	MEDIA DAY			
	SPONSORED AWARDS AND EVENTS Cisco Systems Telematics Award, Delphi Advanced Powertrain Technology Award National Instruments Most Innovative Use of Virtual Instrumentation Award	7:30 a.m.-12:00 p.m.		G
	Dynamic Events Resume	7:30 a.m.-12:00 p.m.	VDA, MPG	G
	Vehicle Appearance	7:30 a.m.-12:00 p.m	VDF, MPG	G
	Static Design Events Resume	8:30 a.m.-12:00 p.m.	VDF, MPG	G
	Lunch, NO EVENTS	12:00 p.m.-1:00 p.m.	VDA, MPG	G
	Static Design Events Resume	1:30 p.m.-3:30 p.m.	VDF, MPG	G
	SPONSORED AWARDS AND EVENTS RESUME	1:30 p.m.-6:30 p.m.	VDF, MPG	G

Thursday, June 12	EVENT	TIME	LOCATION	MAP KEY
	Dinner and Awards Ceremony	6:30 p.m.-10:00 p.m.	Hyatt Regency, Hubbard Ballroom, Dearborn	7

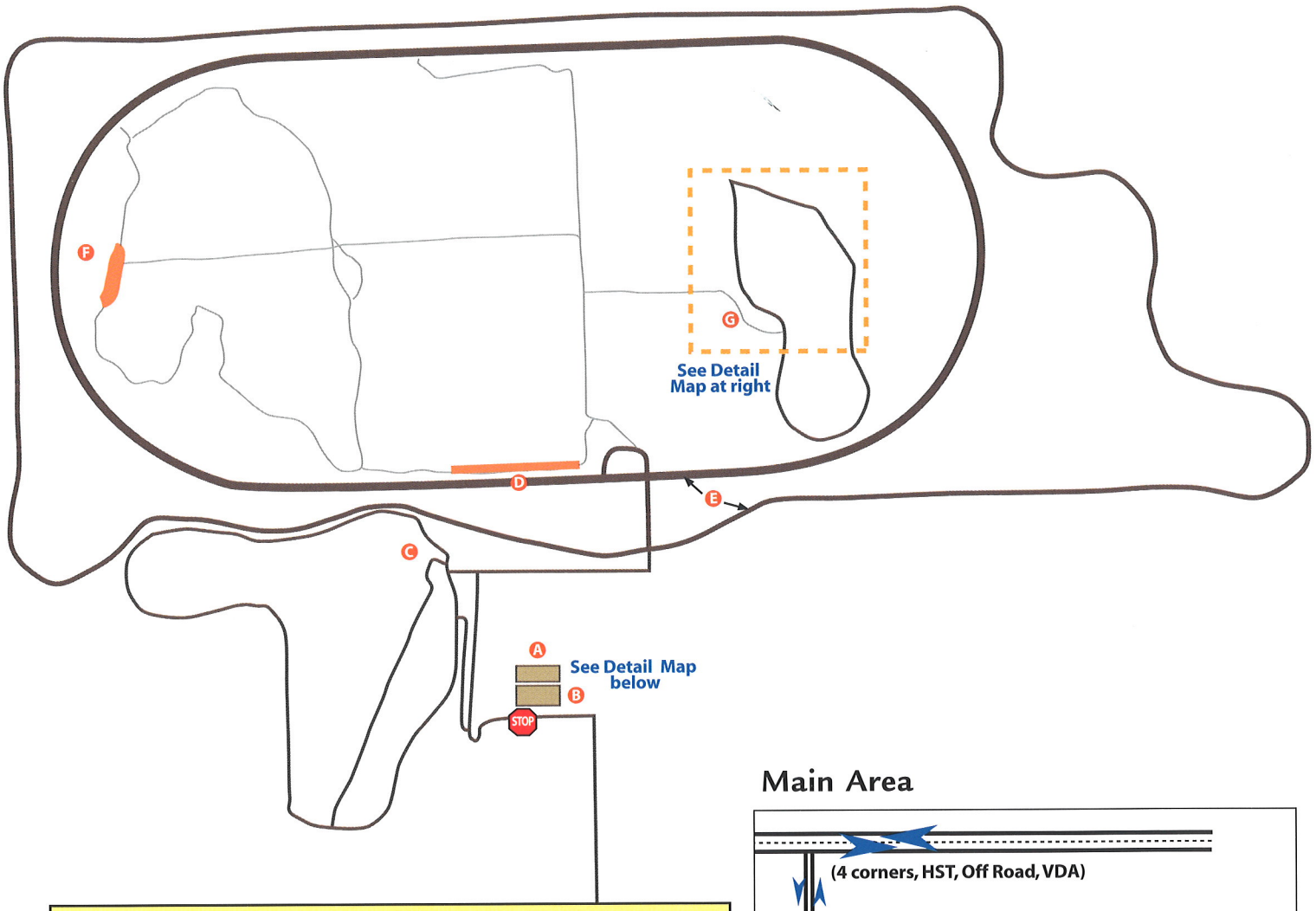
Friday, June 13-Monday, June 16	EVENT	TIME	LOCATION	MAP KEY
	FutureTrucks on Display at Centennial		Ford WHQ, Dearborn	6

APTL – Allen Park Test Laboratory
VDA – Vehicle Dynamics Area
VDF – Vehicle Dynamics Facility
HQ – Organizer Headquarters
(between Bays 3 and 4, Garage, MPG)

B1 – Bay One, Garage
B3 – Bay Three, Garage
B4 – Bay Four, Garage
WHQ – Ford World Headquarters
MPG – Michigan Proving Ground

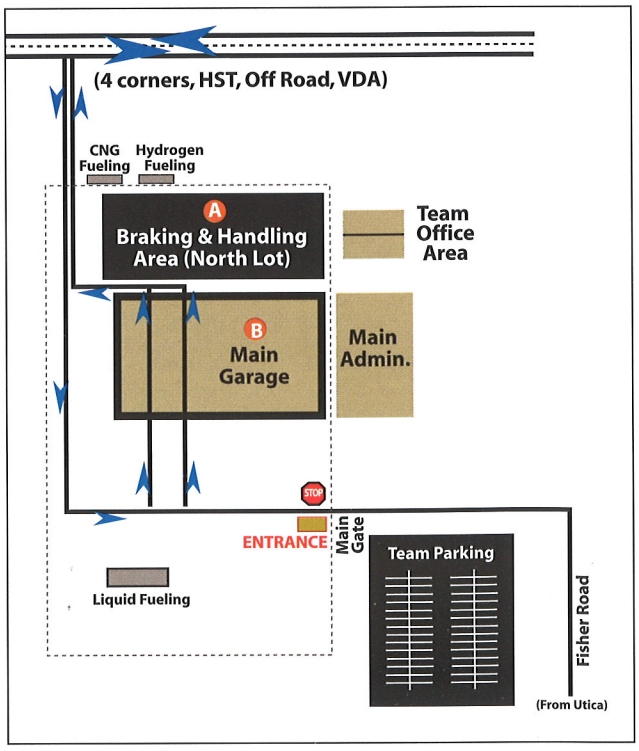
FUTURETRUCK 2003

Maps of Michigan Proving Ground

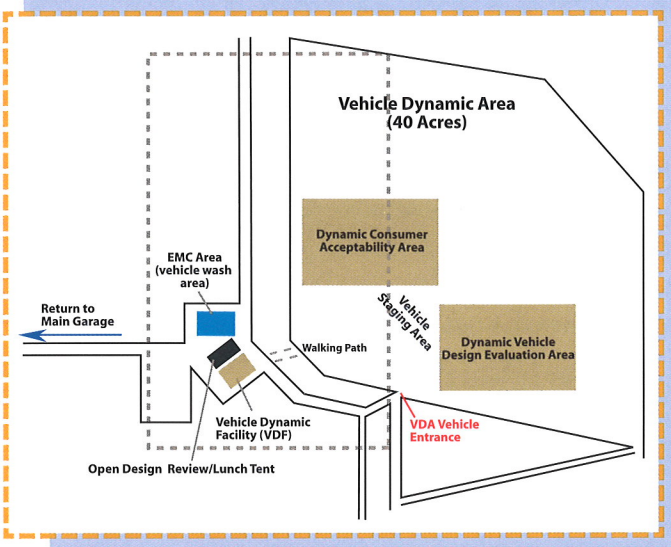


- A BRAKING & HANDLING
- B PITS
- C TRAILER TOW
- D ACCELERATION
- E FUEL ECONOMY
- F OFF ROAD
- G DESIGN EVENTS

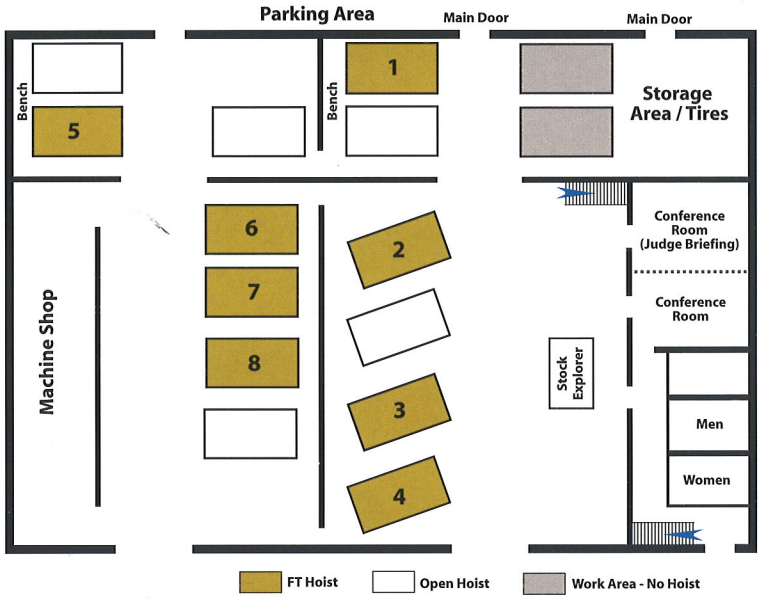
Main Area



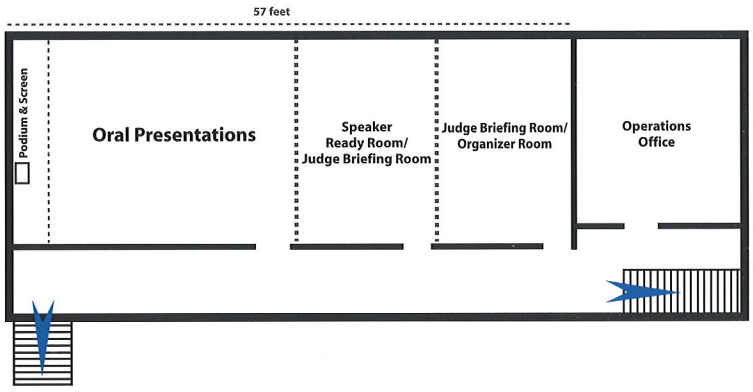
Vehicle Dynamic Area/ Vehicle Dynamic Facility



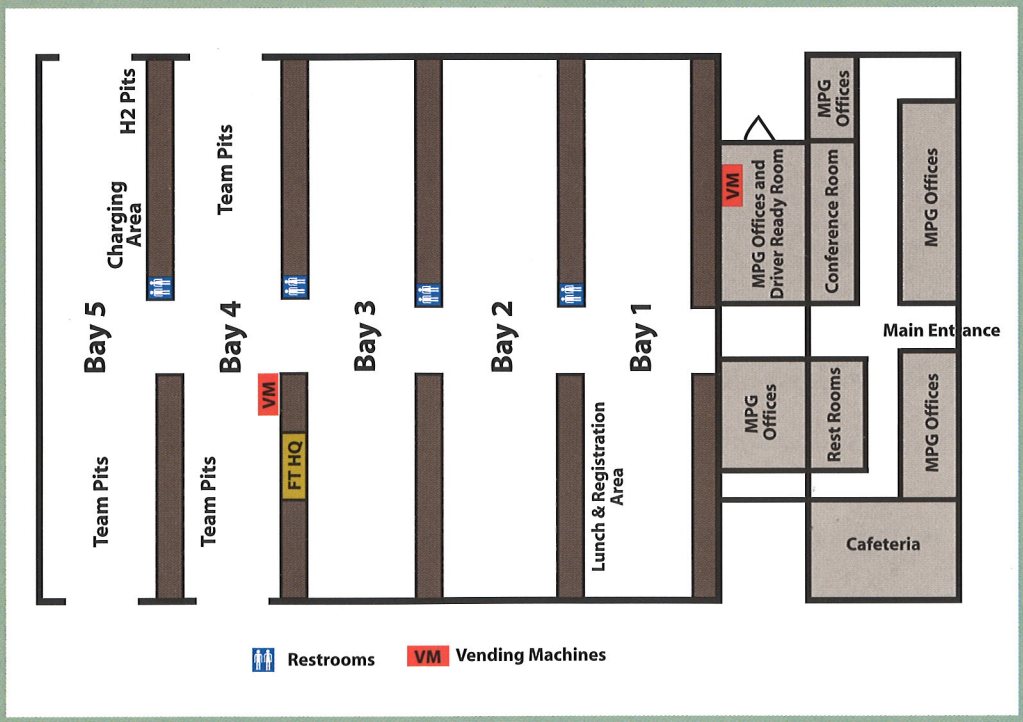
VDF Building 1st Floor



VDF Building 2nd Floor



Main Garage



FUTURETRUCK 2003 TEAM SUMMARIES

California Polytechnic State University, San Luis Obispo

Faculty Advisors: Dr. Chris Pascual and Dr. Brian Higgins
Team Leaders: Jon-Michael Kasten and Ryan Hoest

Approach to Hybrid Design

The Cal Poly Hybrid Development Team developed a traditional series hybrid electric vehicle with a unique control and power management strategy. The strategy blurs the lines between real-time generation and thermostatic control strategies to allow the use of a number of reliable, off-the-shelf components. Each component operates at peak efficiency to provide a drivetrain with equivalent performance, reduced fuel consumption, and lower greenhouse gas emissions than the stock Ford Explorer. The series design not only provides impressive improvements using today's technology, but it also leads to simple integration of future technology such as fuel cells, advanced engine technology, improved generators, and batteries.

Goals for Participating in FutureTruck

In addition to the competition's goals, the Cal Poly team is also striving to implement a high standard of engineering and fabrication, such that the finished product is indistinguishable from a stock Ford Explorer in performance, utility, and comfort.

Cornell University

Faculty Advisor: John Callister
Team Leader: Jake Timm

Approach to Hybrid Design

Our approach to hybrid design this year is a split parallel hybrid design with two powertrains. The mechanical powertrain is run by the power-dense Nissan SR20DET engine; the electrical powertrain is run by an AC Pro 150kW electric motor. The electric motor is powered by a pack of Hawker Genesis batteries, which lay in front of the rear bumper. In our split-parallel hybrid design, the electric motor is used to power the front axle of the truck, while the engine powers the rear axle.

Goals for Participating in FutureTruck

Our goals for participating in FutureTruck are to offer students a chance at real-life engineering work and the opportunity to apply classroom learning to a real problem. The research and design work necessary for FutureTruck is a challenge that our students welcome. We hope to build a working, reliable hybrid truck, and compete successfully at the Ford Proving Grounds during FutureTruck 2003.

Georgia Institute of Technology

Faculty Advisors: Jerome Meisel and Gail Palmer
Team Leaders: Richard Guyton and James McClearen

Approach to Hybrid Design

The Georgia Tech team has designed the Model GT to have a split-parallel through-the-road hybrid powertrain. This powertrain configuration is selected to minimize the required manufacturing modifications. The spark-ignited engine driving the rear wheels and the induction electric motor driving the front wheels are sized to achieve increased fuel efficiency and reduced emissions without sacrificing either vehicle performance or customer acceptability. The high-speed motor requires a speed reducer. Since no commercially available reducer met the required specifications, the Model GT team designed and built a custom speed reducer. The newly installed catalytic converters reduce emissions significantly, and the fiberglass, Kevlar-reinforced battery boxes reduce the overall weight of the boxes. The redesigned aluminum crossmember holds the new speed reducer and is lighter and stronger than its predecessor. The narrowness of the new crossmember allows additional room for the battery boxes. Simulation results have been used in conjunction with on-road testing to develop an improved torque-blending control strategy for the powertrain.

Goals for Participating in FutureTruck

Georgia Tech's Model GT team looks forward to the 2003 competition. The team's goals are as follows: to enhance the Georgia Tech design curriculum by creating a hands-on learning experience in designing, building, and testing advanced powertrain concepts; to advance research on the control aspects of parallel hybrid powertrains that will substantially decrease gasoline consumption; to produce a vehicle that performs very well in the competition; and to enjoy a safe and fun-filled competition.

Michigan Technological University

Faculty Advisor: John Beard
Team Leader: Nick Manor

Approach to Hybrid Design

The Michigan Tech FutureTruck utilizes a through-the-road parallel design. This configuration allows for increased packaging space and easy integration into the stock platform. The team has also focused on weight reduction in order to reduce fuel consumption. Weight reduction has been accomplished through the use of such advanced materials as aluminum, titanium, carbon fiber, polycarbonate plastics, cro-moly steel, and others. The use of these materials in such vehicle components as body panels, suspension, frame, and windows, has kept vehicle weight below stock despite the addition of hybrid components. This strategy, along with an electronic cooling system, electric power steering, electric air conditioning and advanced battery management, create a reliable and portable hybrid powertrain.

Goals for Participating in FutureTruck

The team has set goals to continue practical vehicle design through testing and optimization of current powertrain components. The main areas of focus are the vehicle control system and engine efficiency optimization. MTU is also working to increase integration of the FutureTruck program into the curriculum, ensuring a lasting undergraduate involvement in advanced vehicle design.

Ohio State University

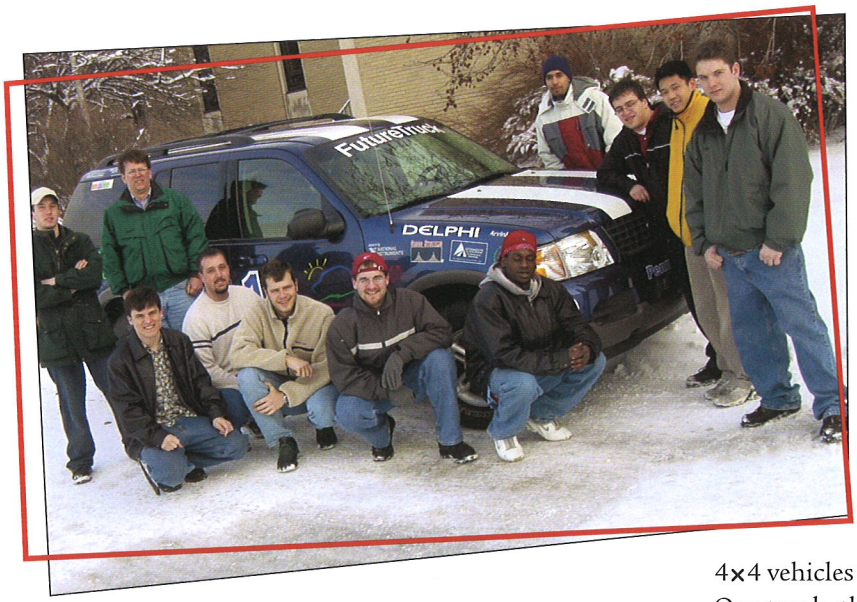
Faculty Advisors: Dr. Giorgio Rizzoni and Frank Ohlemacher
Team Leader: Mary Gilstrap

Approach to Hybrid Design

Our team has chosen to use a charge-sustaining, parallel hybrid strategy. The main power source is an advanced combustion-ignition direct-injection (CIDI) engine with outstanding efficiency and emission characteristics, coupled to a 5-speed manual transmission. The engine uses bio-diesel fuel to significantly mitigate the greenhouse gas impact of the vehicle. A 32kW AC induction motor belt coupled to the crankshaft provides additional power and regenerative braking. A user-transparent control strategy is implemented to optimize the powertrain performance, fuel consumption, and emissions, as well as manage the battery state-of-charge.

Goals for Participating in FutureTruck

We believe FutureTruck provides an invaluable experience for the students, as well as a real contribution to the advancement of automotive technologies. Through hands-on experience, students are able to apply the knowledge they have gained throughout their education and also learn lessons about engineering and teamwork that cannot be taught in any classroom. We hope to exhibit that there are reasonable alternatives to conventional vehicles that provide real environmental savings, while maintaining consumer-acceptable cost and performance.



Pennsylvania State University

Faculty Advisor: Daniel Haworth
Team Leaders: Brad Beebe and Kandler Smith

Approach to Hybrid Design

Penn State's goal is to develop a reliable SUV, based on proven technology, that could be put directly into production. Our hybrid Explorer is designed to be a work truck, capable of a full range of off-road and hauling applications. Although most SUVs today never leave dry pavement, there is a significant market for 4x4 vehicles that can perform well in adverse conditions. Our truck, the "Wattmucher," targets this market.

Goals for Participating in FutureTruck

Students involved with Penn State FutureTruck will walk away with a solid understanding of hybrid-electric vehicle design and teamwork on a large project.

FUTURETRUCK 2003
Inspiring innovation.

Texas Tech University

Faculty Advisors: Dr. Maxwell and Dr. Parten
Team Leader: Andrew Leslie

Approach to Hybrid Design

Future Truck 2003 leads Texas Tech University into the research area of a hydrogen internal combustion engine (H_2ICE). Combined with the technology of an H_2ICE is Texas Tech's hybrid design that is considered a post-transmission parallel hybrid electric vehicle. Texas Tech is also taking advantage of the National Instruments Labview software that manages the electric assists and on-board battery monitoring.

Goals in Participating in FutureTruck

The main goal for Texas Tech in using hydrogen as an alternative fuel is to retrofit a mass-produced internal combustion engine to efficiently run on hydrogen and set the stage for widely used hydrogen infrastructure, which will bring this technology to households throughout the nation/world. Once the hydrogen infrastructure is in place, it will pave the way for hydrogen fuel cells to become mass produced and, inevitably, less expensive.

University of Alberta

Faculty Advisor: Dr. David Checkel
Team Leader: Clayton Bond

Approach to Hybrid Design

The University of Alberta has designed a pre-transmission parallel hybrid. The system uses a 2.0-L Zetec engine coupled with two electric motors: one as a traction motor, the other as a multi-function motor/generator. A unique coupling system that includes an electronically actuated clutch and a torque converter allow the vehicle to be run as a zero-emissions vehicle (ZEV) or hybrid electric vehicle (HEV). The power from both the traction motor and the engine pass through an automatic transmission to ease driving of the vehicle. Electrical energy is stored in lithium ion batteries, which run in parallel with ultra capacitors. These advanced technologies provide excellent specific energy and versatility.

Goals for Participating in FutureTruck

The goals for the 2003 University of Alberta FutureTruck team are to provide an opportunity for young engineers to learn in a practical environment. Working with industry and government partners gives the students a better understanding of how engineering is applied outside the classroom. The final goal of the University of Alberta FutureTruck team is promoting HEV technology and its increasing viability.

University of California, Davis

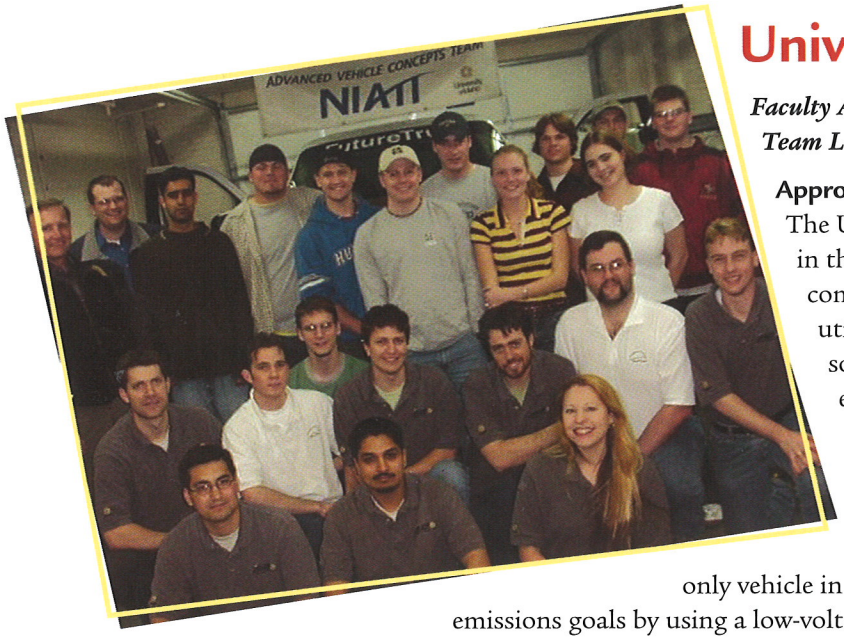
Faculty Advisors: Dr. Andrew Frank and Dr. Mark Duvall
Team Leaders: Dahlia Garas, Joey Holdener, and Charnjiv Bangar

Approach to Hybrid Design

Our vehicle is capable of achieving double the stock fuel economy while having a minimal greenhouse gas impact on the environment through the use of light-weight components, aerodynamic improvements, custom powertrain elements, embedded electronics, and an advanced control strategy. A large battery pack and electric motor allow our plug-in hybrid to take full advantage of electricity's high energy efficiency to provide a 50-mile all electric zero-emissions vehicle (ZEV) driving range.

Goals for Participating in FutureTruck

Three primary goals drive the UCD team. Providing practical engineering experience to students allows the integration of classroom concepts and theory with practical application. Developing and expanding new and existing technologies demonstrates viable alternatives to current technologies while continuing the bond between industry and academia. Finally, keeping the public informed and aware of new vehicle technologies and their respective societal and environmental impacts is paramount to the continued efforts in the development and implementation of clean transportation.



University of Idaho

Faculty Advisor: Frank Albrecht
Team Leader: Ryan Slaugh

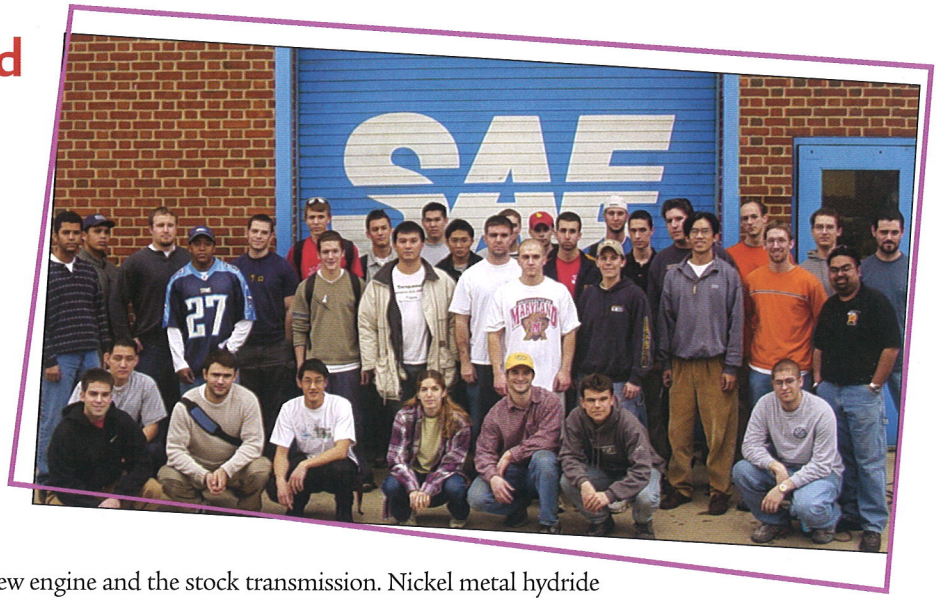
Approach to Hybrid Design

The University of Idaho is in its fourth year of participation in the U.S. Department of Energy's FutureTruck competition to design more efficient and cleaner sport utility vehicles. This year the UI team is designing a soft parallel hybrid that will combine a lighter, more efficient engine and both electric and hydraulic motors to improve the efficiencies of regenerative braking and power assist.

Goals for Participating in FutureTruck

A unique aspect of the UI design is that it is the only vehicle in the competition to achieve the fuel economy and emissions goals by using a low-voltage electric system which, compared to high-voltage systems, is safer, less costly to produce, and easier to maintain. The relatively low cost and high efficiency of the electric-hydraulic hybrid system allows the concept to be of value for several vehicle types, from on-road passenger vehicles to off-road utility vehicles.

University of Maryland



Faculty Advisor: Dr. David Holloway
Team Leaders: Sarabpreet Bumra and Gregory Herwig

Approach to Hybrid Design

For the 2003 FutureTruck competition, the University of Maryland will continue to modify the hybrid-electric system first used by the team at the 2002 competition. The University of Maryland's powertrain design comprises an E-85 fueled 2000 Lincoln LS 3.0-liter, six-cylinder engine and a 2002 Honda Insight electric motor in a parallel-hybrid configuration. The Lincoln LS engine has been modified so that it is a dedicated ethanol (E85) engine. The electric motor is coupled between the new engine and the stock transmission. Nickel metal hydride (NiMH) batteries will power the Honda Insight electric motor. The goals of this system are to increase the fuel economy and reduce the emissions and the greenhouse gas impact while, at the same time, retaining the power and performance of a factory 2002 Ford Explorer.

Goals for Participating in FutureTruck

The University of Maryland is participating in the 2003 FutureTruck competition with several team goals. We hope to investigate approaches to developing environmentally friendly hybrid vehicles. Along the way, we will learn about vehicle design and dynamics and apply this knowledge to our Ford Explorer competition vehicle. With our vehicle designed and built, the team is anticipating a positive showing at the FutureTruck competition. We hope to build upon our previous success at FutureTruck competitions and display an innovative and operational solution to hybrid vehicle design.

University of Tennessee

Faculty Advisor: Dr. David (Butch) Irick
Team Leaders: Aaron Williams and David Smith

Approach to Hybrid Design

The University of Tennessee's FutureTruck team has designed a pre-transmission, parallel, hybrid powertrain for our Ford Explorer. A 2.3-liter, four-cylinder Ford engine optimized to run on E85 and a 53kW Unique Mobility electric motor will power this system. The design will allow us to shut down the engine when the engine is stopped, launch and restart using the electric motor, and operate as a zero-emissions vehicle (ZEV) during some phases of driving.

Goals for Participating in FutureTruck

FutureTruck is one of the capstone design projects at UT. The team is composed of mainly seniors in mechanical and electrical engineering who gain experience by working in multidisciplinary groups while redesigning the Ford Explorer to achieve better fuel economy and lower emissions.

University of Wisconsin — Madison

Faculty Advisor: Dr. Glenn Bower
Team Leader: Katie Orgish

Approach to Hybrid Design

The UW's strategy is to design an efficient hybrid drivetrain and to implement lightweight components. The drivetrain includes a common rail, direct-injection diesel engine coupled to a 5-speed manual transmission. The motor has been optimized for efficiency and requires a single gear reduction as it runs at three times the driveshaft speed. Because weight reduction is a key factor in reducing fuel consumption and emissions, we reengineered components from advanced materials to reduce weight, improve dynamic performance, and increase safety.

Goals for Participating in FutureTruck

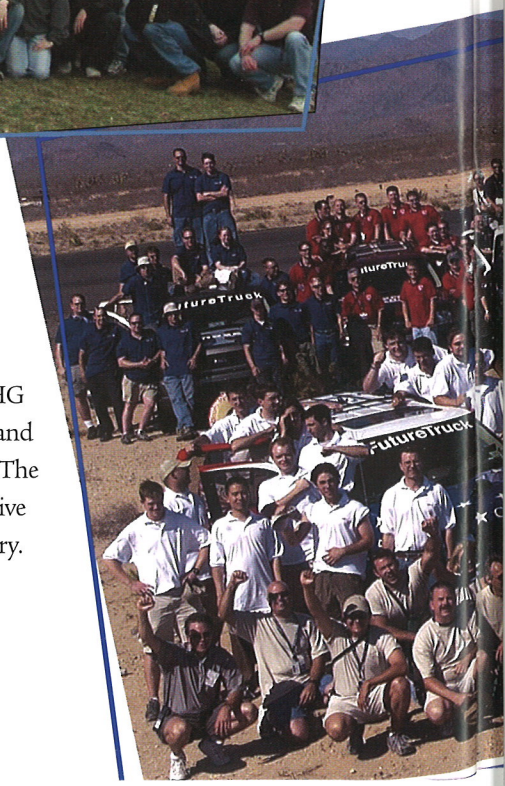
The UW FutureTruck team has bonded though challenges and accomplishments, while developing personal and professional skills. Routinely, our team displays our vehicle while educating the community about advances in vehicle technology. We believe that the technologies explored through the FutureTruck program should be implemented for the good of society. We are proud to be involved in the endeavor to advance automotive technology in an effort to preserve our environment.

Virginia Tech

Faculty Advisor: Doug Nelson
Team Leader: Henning Lohse-Busch

Approach to Hybrid Design

The Hybrid Electric Vehicle Team (HEVT) of Virginia Tech is using a hydrogen-fueled Ford Zetec engine coupled to a generator to power its vehicle, Magellan. This strategy increases efficiency and decreases overall emissions from driving the vehicle (both tailpipe and fuel production). We chose this approach because combustion of pure hydrogen fuel results in close-to-zero tailpipe emissions and reduced well-to-wheels greenhouse gas (GHG) emissions. Magellan is a charge-sustaining, series hybrid that uses an electric drivetrain to increase overall efficiency. Hydrogen can be efficiently produced from low-carbon fuels like natural gas or from renewable energy sources.



Goals for Participating in FutureTruck

HEVT is proving the viability and safety of hydrogen as a transportation fuel, while reducing GHG emissions and retaining the stock performance of a 2002 Ford Explorer. FutureTruck students, and others at Virginia Tech, are exposed to environmental issues and solutions through this project. The leadership, hands-on design implementation, and team experiences that members of HEVT receive from FutureTruck are some of the most valuable tools that students take with them into industry.

West Virginia University

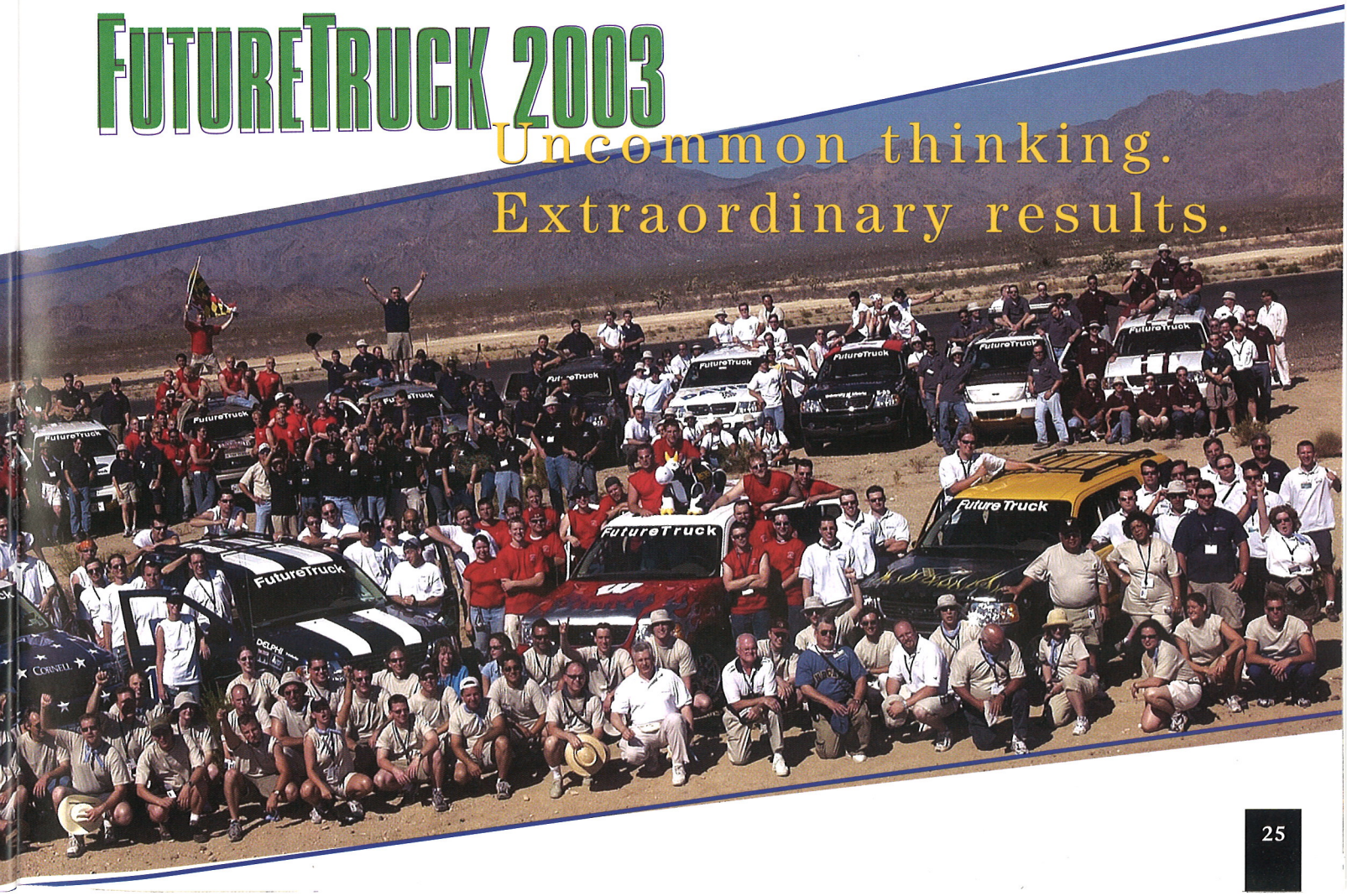
Faculty Advisor: Nigel Clark
Team Leader: Lawrence Feragotti

Approach to Hybrid Design

This year's version of the Exclaim, West Virginia University's hybrid SUV, will be using a parallel hybrid system combining an electric motor with a very efficient diesel engine. The diesel engine is a 2.5-liter Detroit Diesel with common rail injection and a waste-gate turbocharger. The diesel was chosen because of its high thermal efficiencies coming from the internal combustion. By pairing this engine with the electric motor from the EV Ranger that Ford previously produced, the gas mileage is almost doubled, and our modified exhaust will also help to control emissions from the vehicle. Within the exhaust, we will be injecting urea to lower the nitrous oxides created from the engine. We will also employ a particulate matter trap and a selective reduction catalyst.

Goals for Participating in FutureTruck

The goals for this year's team are to improve upon past designs and to improve our finish in this year's competition. We feel that this competition is important not only to the students competing, but also to society. The success of this competition will not only benefit the environment, but will reduce our dependence on foreign nations for resources such as oil.



FutureTruck 2003 Sponsors

Major Sponsors

The National Science Foundation, well known for promoting science, mathematics, and engineering, has established an award to recognize and honor the critical role of the FutureTruck faculty advisor. Faculty advisors, through their leadership and research, are advancing the frontiers of science and engineering while passing on a legacy to their students that extends throughout the automotive industry.

On the web at **www.nsf.gov**

Cisco Systems is returning to FutureTruck this year to support the competition and the Cisco Telematics event. Cisco will provide the networking and wireless infrastructure for each team to integrate into the vehicle, as well as technical assistance and competition support.

Telematics is a fast-growing industry with huge market potential that is going to change the way people live, work, and play. Simply stated, telematics is the ability to do things remotely or while in motion. The congruence of wireless technologies and onboard computing will enable a vehicle to be an extension of the Internet.

In the Telematics event, FutureTruck teams explore emerging wireless technologies as well as onboard computing for vehicle diagnostics, navigation, and "infotainment" applications. These technologies can enhance driver and vehicle safety and help reduce the vehicle's overall environmental impact.

On the web at **www.cisco.com**

ArvinMeritor, a global supplier of integrated automotive systems and modules, is returning to sponsor the FutureTruck competition for the third year. A $7-billion global supplier of integrated systems, modules, and components for the automotive industry, ArvinMeritor is headquartered in Troy, Michigan, and employs 36,000 people at more than 150 manufacturing facilities in 26 countries. The company serves light vehicle, commercial truck, trailer, and specialty original equipment manufacturers and related aftermarkets. The Exhaust Systems Division is a premier supplier of air and emissions management solutions.

On the web at **www.arvinmeritor.com**

Delphi, a world leader in mobile electronics and transportation components and systems technology, is returning for its fourth year as a Major Sponsor of the FutureTruck competition. Delphi engineers and staff will be involved in judging and coordinating competitive events for the program, and the company is sponsoring the Delphi Advanced Powertrain Technology award for the first time.

Multi-national Delphi conducts its business operations through various subsidiaries and has headquarters in Troy, Michigan, USA; Paris; Tokyo; and São Paulo, Brazil. Delphi's two business sectors — Dynamics, Propulsion, and Thermal Sector and Electrical, Electronics, Safety & Interior Sector — provide comprehensive product solutions to meet complex customer needs. Delphi is committed to reducing the environmental impact of automobiles and has a history of innovative solutions that improve fuel economy, help reduce emissions, decrease vehicle mass, and increase recyclability.

On the web at **www.delphi.com**

National Instruments (NI) leverages commercial technologies, such as industry-standard computers and the Internet, to deliver customer-defined measurement and automation solutions. Headquartered in Austin, Texas, NI has more than 2,800 employees and direct sales offices in more than 35 countries. NI increases the productivity of engineers and scientists

worldwide by delivering easy-to-integrate software and modular hardware. For the past four consecutive years, FORTUNE magazine has named NI one of the 100 best companies to work for in America.

NI is proud to sponsor the competition and an award for "The Most Innovative Use of Virtual Instrumentation." The award encourages the use of PC-based technology in designing and controlling a cost-effective FutureTruck and is presented to the team that exhibits the best use of virtual instrumentation to achieve the goals of the FutureTruck competition.

In addition to providing an NI Application Engineer advisor to each team for product support and expertise through all phases of the competition, NI also donated more than $350,000 in software and hardware products to participating teams.

Through its support of the FutureTruck competition, NI continues its commitment to education by providing tomorrow's engineering leaders with tools to be successful today and in the future.

On the web at **www.ni.com**

The MathWorks is the leading developer and supplier of technical computing software in the world. Employing more than 1,000 people, The MathWorks was founded in 1984 and is headquartered in Natick, Massachusetts, with offices and representatives throughout the world.

The MathWorks customers are over 500,000 of the world's leading technical people, in over 100 countries, on all seven continents. These technical people work at the world's most innovative technology companies, government research labs, financial institutions, and at more than 3,500 universities. They rely on us because MATLAB and Simulink have become the fundamental tools for their engineering and scientific work.

Today for example, automotive engineers responsible for powertrain, chassis, body, and other systems must reduce development time while continuing to satisfy market demands for safe, high-performance, fuel-efficient cars and trucks. This requires the development of new technology and systems, particularly electronics and software in the vehicle. It also requires improved collaboration among carmakers and their suppliers to produce clearer specifications, faster design iterations, and verifiable implementations. Automotive companies are meeting these challenges by using development and testing processes based on model-based design, technical computing, and test-and-verification tools from The MathWorks.

The MathWorks is proud to sponsor FutureTruck 2003 and The MathWorks Modeling award. The MathWorks Modeling award is given to the top two teams that most creatively use MATLAB and Simulink in the development of realistic control strategies and the assessment of component behaviors in the automotive powertrain system environment. A special recognition award also will be given to a team based on the level of effort and marked improvement in the team's model over the course of the year. In addition to the award, The MathWorks donated a complete set of software to each of the 15 teams, provided experienced automotive engineers as mentors, and supplied experienced judges for the FutureTruck 2003 competition at both SAE and Ford Michigan Proving Grounds.

By sponsoring FutureTruck, The MathWorks realizes its mission of support for math and science educational endeavors, fostering growth opportunities for the people who will make contributions and discoveries in the future.

On the web at **www.mathworks.com**

Michigan Proving Ground runs 24 hours per day, five days a week, and offers customer support facilities and services, extensive mechanical services, full-vehicle evaluation, a variety of road surfaces, and twenty-two vehicle chassis dynamometers. With the exception of emissions testing, all of the scored FutureTruck events will be hosted at this world-class facility in Romeo.

Allen Park Test Laboratory provides a wide range of testing capabilities including the following: Advanced Powertrain Engineering Test Site, OBDII & Clean Air Act Phases I & II, Dynamic Systems Optimization, FFV-NMOG, Vehicle Prep & Parasitic Loss, Non-Regulated Emission Testing, Cold CO Certification, Fuel Systems Testing & Development, Gas Standards Laboratory, Powertrain Systems Analysis, and other testing. This facility will host the FutureTruck Emissions Testing and Greenhouse Gas Impact events.

COMPETITION SUPPORTERS

Natural Resources Canada (NRCan) has been a long-time supporter of the U.S. Department of Energy's advanced vehicle technology competition program, providing technical and program support for more than 20 competitions over 15 years. FutureTruck underscores NRCan's commitment to addressing the global issue of climate change and supporting sustainable energy policies and advanced automotive technologies.

NRCan provides knowledge, expertise, and program activities for the sustainable development and use of Canada's natural resources and to support the global competitiveness of its resource and related sectors. This includes energy activities that encompass policy development; market development programs; and international activities in energy efficiency, renewables, transportation technologies, alternative fuels, and conventional fuels.

On the web at **www.nrcan.gc.ca**

The Illinois Department of Commerce and Economic Opportunity (DCEO) works with industrial and agricultural organizations to promote and expand the use of ethanol as a clean-burning, renewable fuel. DCEO manages numerous ethanol fuel tests and demonstration projects designed to stimulate economic growth in both industrial and rural communities and sponsors new and innovative research and development projects, such as the FutureTruck competition, which focus on energy efficiency and advanced technology.

On the web at **www.illinoisenergy.org**

The Aluminum Association has been a sponsor of the U.S. Department of Energy's advanced vehicle technology competitions for more than four years, encouraging teams to explore aluminum to help boost environmental, safety, and handling performance, and for special emphasis on weight reduction for increased fuel efficiency.

One of the original FutureTruck partners, The Aluminum Association, based in Washington D.C., with offices in Detroit, Michigan, is the trade association for U.S. primary aluminum producers, recyclers, and manufacturers of semifabricated aluminum products. Member companies operate nearly 200 plants in 37 states. The Association's Automotive and Light Truck Group promotes the use of aluminum in automotive structures and components by demonstrating the reasons it is the material of choice for high-value, safe, environmentally friendly, and superior-performing vehicles. The FutureTruck competitions help teach students how to use aluminum, which has doubled in use in cars and light trucks during the last 10 years.

On the web at **www.autoaluminum.org**

BP is focused on finding, producing, and marketing the natural energy resources on which the modern world depends. In addition, the company is committed to making a positive contribution and taking a leadership role toward a cleaner environment. BP delivers cleaner-burning and lower-emissions fuels to more than 113 cities worldwide that have serious air quality problems. As vehicle technology continues to advance, fuels and lubricants must also change to keep pace with the new technology. Recently BP introduced ECD-1, an emissions control (ultra-low-sulfur) diesel fuel that helps sulfur-sensitive control systems operate effectively and is supplying the fuel to several of the FutureTruck teams.

On the web at **www.bp.com**

Together with its U.S. and international subsidiaries and joint ventures, **Goodyear** manufactures and markets tires for a wide variety of applications at 96 facilities in 28 countries. Goodyear is providing competition support, as well as low-rolling-resistance tires, to the FutureTruck teams to help increase the energy efficiency of their vehicles. By reducing rolling resistance with new tread compounds and designs and using lightweight materials and construction, Goodyear tire engineers expect to drive rolling resistance down even further to help the participating teams meet the lofty goals of the competition.

On the web at **www.goodyear.com**

In-Kind Supporters

Ricardo, Inc., the U.S. division of Ricardo Group plc, is a leading engineering technology and services provider, undertaking advanced engineering, design, and development services for the world's automotive manufacturers. In addition, Ricardo markets, develops, and supports a wide range of design and analysis software products, including WAVE, which are developed specifically for application during the powertrain development and vehicle integration processes. In addition to providing competition support, Ricardo will donate WAVE software to each of the FutureTruck teams.

On the web at **www.ricardo.com**

Founded in 1904, **Dana Corporation** is a global leader in the design, engineering, and manufacture of value-added products and systems for automotive, commercial, and off-highway vehicle manufacturers and their related aftermarkets. The company employs approximately 70,000 people worldwide — all dedicated to achieving innovation through close collaboration with customers. Based in Toledo, Ohio, Dana operates hundreds of technology, manufacturing, and customer service facilities in 34 countries. The company reported sales of $10.3 billion in 2001.

On the web at **www.dana.com**

FutureTruck 2003 Headline Sponsors

U.S. Department of Energy

The **U.S. Department of Energy** (DOE) provides overall competition management, team evaluation, and technical and logistical support. DOE launched its student vehicle competition program in 1989 to demonstrate and test technologies developed in laboratories. By combining the next generation of technical innovators with emerging advanced transportation technologies, the FutureTruck competition helps to ensure a sustainable, environmentally responsible transportation future. DOE and its network of national laboratories maintain an aggressive research and development program in advanced vehicle technologies, including fuel cells, energy storage, hybrid systems, advanced materials, alternative fuels, and heat engines. The FutureTrucks mirror much of this research and demonstration activity.

DOE's primary transportation mission is to turn the corner on oil imports by improving vehicle efficiency while also working to reduce vehicle emissions. Close to 20,000 students have received hands-on engineering experience in these competitions. Many of them have moved on to take jobs in the automotive industry, bringing with them an understanding of and enthusiasm for advanced vehicle technologies.

On the web at **www.eere.energy.gov**

Center for Transportation Research

As part of its mission as a U.S. Department of Energy (DOE) research facility, Argonne National Laboratory (ANL) is developing technologies that will make advanced vehicles a reality. The Transportation Technology R&D Center at ANL brings together scientists and engineers from many disciplines to find cost-effective solutions to the problems of transporting people and goods from one place to another – problems like increased energy consumption and energy emissions. The group has been conducting transportation research at ANL for the past three decades and has been organizing and supporting advanced vehicle technology competitions such as FutureTruck since 1987. More than ten thousand people have participated in these competitions, which have seeded the industry with enthusiastic engineers who have hands-on experience in advanced vehicle technologies.

Ford Motor Company

Ford Motor Company constantly develops and refines new technologies that enhance the efficiency of the company's wide variety of automotive products across all of its global brands. Ford understands the need of society to continually reduce its impact on the environment and strives to meet this goal while still satisfying the marketplace's ever-more-challenging safety, comfort, and performance demands.

By providing vehicles as well as facilities, financial assistance, technical assistance, and staffing, Ford is committed to helping ensure the success of the FutureTruck program. Ford encourages promising student engineers to develop competition vehicles that have increased fuel efficiency and reduced emissions without sacrificing vehicle functionality. Ford will hold its 100th Anniversary Celebration from June 12 – June 16 in Dearborn, Michigan. The centennial, entitled "THE ROAD IS OURS," will bring more than 100,000 car and truck enthusiasts together to Henry Ford II World Headquarters for the weeklong events. This historic celebration will feature vehicle displays, interactive exhibits, kids' activities, a concert series, and more. The winning FutureTruck team will be announced at a press conference June 12th at Ford World Headquarters as part of the centennial celebration. In addition, FutureTruck students will give presentations, and all 15 competing FutureTrucks will be on display.

On the web at **www.hybridford.com**

FutureTruck 2003

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Natural Resources Canada
Aluminum Association
Illinois Department of Commerce and Economic Opportunity
BP
Goodyear Tire & Rubber Company

In-Kind Supporters
Ricardo, Inc.
Dana Corporation

The Advantages of Sponsoring FutureTruck

The year-round, high-visibility program offers competition-level sponsors:

- International visibility and media coverage
- Opportunities to strengthen their association with advanced automotive technology
- Opportunities to provide a real-world engineering experience to young engineers who will lead the automotive industry in the 21st century
- Avenue for recruiting some of the top engineers in the U.S. and Canada
- First-hand exposure to new technologies, through judging competition events, technical papers, etc.
- Networking opportunities with other industry and government sponsors

The U.S. Department of Energy and Ford Take the Lead

The U.S. Department of Energy, Ford Motor Company, and the other industry and government sponsors are proud to support FutureTruck 2003, in which 15 North American engineering schools explore and develop new automotive technologies. These sponsors support FutureTruck's cooperative approach in developing fuel-efficient SUVs, leading to reduced petroleum use and a stronger economy.

Participating Schools
California Polytechnic State University, San Luis Obispo
Cornell University
Georgia Institute of Technology
Michigan Technological University
Ohio State University
Pennsylvania State University
Texas Tech University
University of Alberta
University of California, Davis
University of Idaho
University of Maryland
University of Tennessee
University of Wisconsin – Madison
Virginia Tech
West Virginia University

For more information, visit
FUTURETRUCK.ORG

FutureTruck

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Center for Transportation Research

FutureTruck is an advanced vehicle technology competition managed by Argonne National Laboratory's Center for Transportation Research

Information is current as of April 2003. For the latest FutureTruck updates, go to **FUTURETRUCK.ORG**