CORNELL

UNIVERSITY

Hybrid Electric Vehicle Team

2001 - 2002 Sponsorship Proposal

Table of Contents

Executive Summary

Hybrid electric vehicle (HEV) technology is rapidly gaining recognition as the most effective method of reducing the harmful environmental effects of automobiles. Hybrid vehicles use a large battery pack as an energy storage buffer, which stores normally wasted energy and gives it back when needed. Through the use of this technology, hybrid vehicles reach levels of efficiency unattainable by an automobile with a conventional internal combustion engine. As this environmentally sound technology matures, it will revolutionize the automotive industry.

Cornell University has assembled a multi-disciplinary team of students who are dedicated to forwarding hybrid technology, and hope to better society through their efforts. The Cornell University Hybrid Electric Vehicle (CUHEV) Team was formed in 1991 and has since built several award winning HEVs. The team worked for many years building ground-up vehicles for competitions such as the Hybrid Electric Vehicle Challenge and the American Tour de Sol, and has recently moved on to conversion vehicles in the FutureTruck competition.

In the upcoming academic year, the Cornell University Hybrid Electric Vehicle Team will modify a 2002 Ford Explorer in preparation for the third year of the FutureTruck competition. Over the past two years, the team has established a firm design foundation; this year, we will continue in our commitment to increase efficiency and decrease fuel consumption. Our ultimate goal is to greatly reduce the negative environmental impact of sport utility vehicles, while still maintaining the aspects of performance and feel which made these vehicles so popular. CUHEV has successfully met this objective in its previous FutureTruck efforts, and this year's team possesses the experience and drive to continue in our tradition of success.

Converting a production sport utility vehicle to an HEV requires significant resources. Much of the technology used to optimize such a vehicle is cutting edge, and therefore costly. Despite a dedication to minimizing costs, our average budget is approximately $50,000. The project was funded entirely by independent sponsors. This year, as the team looks to optimize the Explorer with more advanced designs, funding will be crucial. To reach this goal, the team is requesting sponsorship in the form of financial support, product donations, and/or technical support in order to make our design a reality. Monetary donations are applied to travel expenses, operating costs, and essential vehicle components.

Your sponsorship is a public demonstration of your concern for society. Sponsoring CUHEV will allow consumers to see your firm as a charitable and forward-thinking organization, highlighting your corporation's social responsibility. We hope that you will join us in our efforts; your support is essential to the successful completion of our project.

The Faculty and Members of the Cornell Hybrid Electric Vehicle Team

Benefits of Sponsorship

In return for your generosity, we offer numerous benefits, chiefly in the form of public exposure. For instance, donors of $1,000 or more are entitled to have their logo on the truck. In order to assure your approval of the appearance, we ask that you send us three vinyl decals of your logo. Moreover, all donations are tax deductible. Other benefits include, but are not limited to:

- Demonstrating your company's concern about environmental energy issues
- Assisting in the development of cutting edge technology
- Generating publicity through local and national media coverage
- Utilizing your products in an automotive application
- Introducing future engineers to your company and your company's products
- Publicity through FutureTruck, which has been highlighted in over 60 national and regional publications
- Generating exposure at an Ivy League institution through various campus displays
- Exposure to people around the world receiving Cornell University publications

Sponsors of the CUHEV team find their investment to be both cost-effective and rewarding. Sponsorship levels are determined as outlined below:

$10,000+ Platinum Sponsor

Benefits: Sponsor name and large logo on the truck, an on-campus display, team publications, as well as advertising items. Promotion through media events and press releases. Permission for your company to display and demonstrate the vehicle.

$5,000+ Gold Sponsor

Benefits: Sponsor name and large logo on the truck, an on-campus display, team publications, as well as advertising items. Promotion during media events and press releases.

$1,000+ Silver Sponsor

Benefits: Logo on the truck, an on-campus display, team publications, as well as advertising items. Sponsor's name and logo on sponsor board displayed at media events and competition.

Under $1,000 Bronze Sponsor

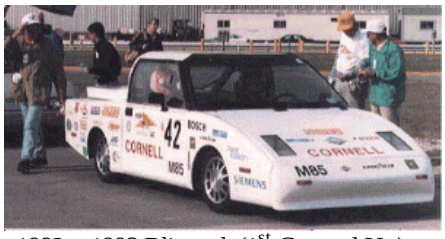
Benefits: Sponsor's name and logo on sponsor board displayed at media events and competition.

Background of HEVs

Our current dependence on the limited supply of fossil fuels and growing worldwide concern over the hazardous effects of pollution on the environment have led automobile manufacturers to investigate alternative methods of personal transportation. Major policy changes in several states to regulate emissions more tightly and new mandates for the increased sale of zero emission vehicles (ZEVs) has provided an impetus for the development of efficient, environmentally conscious automobiles.

Although purely electric vehicles (EVs) seem the ideal environmental solution, current battery technology has emerged as the bottleneck to the production of practical commercial EVs. Lead acid batteries have remained essentially unchanged for decades and cannot provide the required energy density to be a practical solution for anything but a commuter car. Although there are many exciting ideas in battery research such as nickel-metal-hydride, lithium-ion, and fuel cells, they are still too expensive for practical use in a marketable consumer vehicle.

A hybrid between an EV and a gasoline-powered vehicle creates an automobile that has the environmental consciousness of an EV while still maintaining the feel and functionality of a standard gasoline powered vehicle. By having energy stored in both combustible fuel and batteries, a hybrid car is a clean technology which conquers the range problem of EVs. It is for this reason that HEV technology will be our future, and why CUHEV feels so strongly about helping to expand this growing technology.



1992 – 1993 Blizzard (1st Ground Up)

1998 – 1999 Chevy Blazer (1st Conversion Vehicle)

1997 – 1998 Slipstream


1994 – 1995 Tempest

← 1996 - 1997 Tsunami

1993 – 1994 → Vortex

The History of CUHEV

CUHEV began in 1992, with the production of ground-up hybrid vehicles. The team was extraordinarily successful in various competitions taking first prizes at events such as the Ford HEV Challenge and the American Tour de Sol. In 1998, the team began converting sport utility vehicles.

HEV BLAZER (1998-1999)

With advance notice of the FutureTruck Challenge, the team decided to shift its focus toward designing and constructing an HEV that could compete in the 1999 American Tour de Sol, while striving towards the next year's competition goals. With a generous donation from General Motors, team members took on the task of converting a 1998 Chevrolet Blazer to a HEV. After receiving the vehicle at the end of the fall semester, the team worked tirelessly from January to May to ensure successful completion of the project. By the end of the academic year, CUHEV had built its first ever conversion vehicle, with a unique four-wheel drive electric powertrain, a reliable electronic engine throttle control, and seamless integration of HEV interior driver controls.

RED 5 (1999-2000)

Following on the heels of CUHEV's first conversion vehicle, the 1999-2000 team built its first parallel HEV. In this configuration, the engine is no longer run purely to spin a generator, but is coupled directly to the drive train. With Red 5's unique split parallel design, the electric motor was coupled to the front drive train while a turbocharged Mazda Miata engine, converted to run on ethanol (E85), powered the back wheels. This split parallel configuration allows for All-wheel drive and increases efficiency by eliminating the high losses in the stock transfer case. With the AC Propulsion electric motor and the turbocharged Miata engine, Red 5 packs a combined 400 hp, far more power than the stock truck.

CANYONARO (2000-2001)

For the 2001 FutureTruck Competition, the CUHEV team continued work on the 2000 Chevrolet Suburban, changing its name to Canyonaro. The team goal was to improve on the previous design by making the truck more reliable, user-friendly, and off-road capable. To do this we redesigned the electric powertrain in order to maintain stock ground clearance and save weight. We also installed a prototype catalytic converter, donated by Benteler Automotive, to filter our emissions. The same Miata engine configuration was used again as well as the same overall split-parallel configuration. In full hybrid driving mode, the Canyonaro can produce around 400 horsepower—an impressive amount for a hybrid, but necessary to move a 6,300 lb. vehicle.

Canyonaro Awards, 2001

- 5th Overall
- 1st Greenhouse Gas Emissions (46.2% decrease over stock)
- 2nd Handling
- 3rd Acceleration (1/4 mile in 19.38s)
- 4th Oral Presentation
- 5th Fuel Economy (18 mpg)

- Excellence in Renewable Fuels Award
- Most Improved Team Award

The team poses with the Fifth Place trophy and check.

Special attention ought to be given to the team's successes in renewable fuels and emissions – these are keystone awards of FutureTruck, and those with the greatest environmental relevance. These victories testify to CUHEV's commitment to fulfilling the broad vision of FutureTruck and the Partnership for a New Generation of vehicles.

Auto Shows and Media Events

The team looks forward to a year of constant exposure of its vehicle through auto shows and media events. In the past, CUHEVs have appeared on television and in print through promotional events for our sponsors and press releases for innovative vehicles. Past vehicles have appeared at the Automotive Technology Development Contractors' Coordination Meeting in Detroit, the Victor Auto Show outside of Rochester, NY, and the New York Auto Show held at the Jacob Javitz Center in Manhattan. Additionally, in June 2001 the Department of Energy held a ceremony honoring the fifteen universities who had participated in FutureTruck, and displayed the vehicles in front of the Capitol for the day.

As a member of the Ithaca community, we also have a great deal of enthusiasm to educate the local public about new and promising technology. Every year we show our vehicle at "Engineering Day at the [Pyramid] Mall," which focuses on educating the public, especially children, about engineering. In addition, we have many on campus displays of the vehicle and we visit local elementary schools in an effort to spark enthusiasm and interest in engineering. Through participation in such events, we are able to proudly exhibit not only the technology we have developed, but also the sponsors who have helped us along the way.

The FutureTruck 2002 Challenge

Born out of the FutureCar Challenge, the FutureTruck Challenge is a competition to turn one of the heaviest motor vehicles on the consumer market into a clean burning, fuel-efficient vehicle. Fifteen of the nation's top engineering schools were selected to participate in this prestigious event. Each receives an identical stock 2002 Ford Explorer for conversion to a more efficient vehicle. Students work endless hours designing and installing parts until, at competition, each design in painstakingly evaluated on criteria such as greenhouse gas emissions, fuel economy, towing, off road abilities, performance, consumer acceptability, and presentation-based categories.

According to FutureTruck Public Relations Reports, during the second year of competition, more than 31 million people read about the program in large circulation publications such as *The New York Times, Los Angeles Times,* and *Newsday,* just to name a few. More than 2.1 million people watched FutureTruck television stories which were broadcasted around the country.

The Future of the CUHEV Team

This year's FutureTruck entry promises to be our most successful. The team has two years of competition experience to stand upon, yet is simultaneously dedicated to the pursuit of new and innovative solutions. In the coming months, the team will design, manufacture, test and optimize those systems which will turn the Explorer into a clean, efficient vehicle. The drive and ingenuity of the team, combined with the generosity of our sponsors, should make the 2002 FutureTruck event CUHEV's most winning effort.

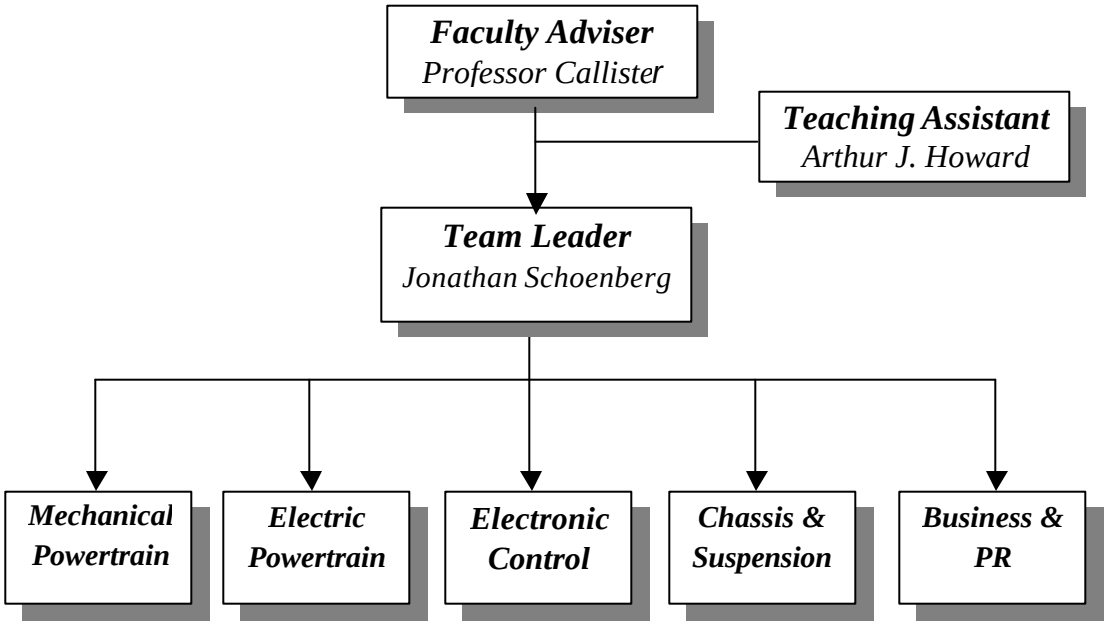
Team Structure

The 2001-2002 CUHEV team is composed of twenty-five students, primarily mechanical and electrical engineers. Students involved in the project receive academic credit, but the merits of participation go far beyond a typical course experience. The project is an intense engineering challenge which follows an open-ended technical problem from conceptualization, through the design of a solution, to final synthesis.

More so than any typical university course, CUHEV trains its members with real-world technical and leadership skills. Emphasis is placed on teamwork, as well as interpersonal and technical communication skills. Furthermore, members stay abreast of new technology and gain a thorough understanding of its application through close contact with industry representatives.

The team management structure is hierarchical, as depicted below. Each subgroup is led by a sub-team director, who reports the group's progress to the team leader.

Visual Representation of CUHEV Team Hierarchy:



Summary

This year, our goal is to build a team modeled after industry. Students will uphold professional standards in documentation, leadership, and experimental processes in developing an HEV. Through the application of these skills, we will create a vehicle that will be a prominent contender at competition and a source of pride for all involved.

The benefits of sponsoring the CUHEV team are not limited to low-cost advertising and tax deductions. By providing us with the materials, funds, and engineering expertise necessary to help us achieve our goals, your company is investing in the engineers of tomorrow. This investment will pay off not only through this year as we prepare for the competition, but in the future, as we tackle the energy, environmental and transportation problems facing our country. Thank you for your time in considering our proposal, and we look forward to working with you and your company during this very exciting year.

FOR MORE INFORMATION, PLEASE CONTACT:

Jonathan Schoenberg
2001-2002 Team Leader
Office Phone: (607) 255-0822
E-mail: jrs55@cornell.edu

Professor John Callister
Faculty Advisor, Mechanical Eng
Office Phone: (607) 255-5545
E-mail: jc62@cornell.edu

Susan Mueller, Business Manager
E-mail: ssm10@cornell.edu

Katherine Weber, Sponsorship Chair
E-mail: kew26@cornell.edu

Mailing Address:
Cornell Hybrid Electric Vehicle Team
Rhodes Hall
Ithaca, NY 14853-3801
(607) 255-0822

OR VISIT OUR WEB-SITE AT: WWW.HEV.CORNELL.EDU

Sponsors of the 2000 – 2001 CUHEV Team

Platinum Sponsors

General Motors
Benteler Automotive

Gold Sponsors

ANSYS, Inc
Carrier
Gates Rubber Company
The Raymond Corporation
United Technologies Corp.
Visteon Corporation

Silver Sponsors

3M Electrical Products
BGF Industries
Bridge Analyzers, Inc.
dmc^2
Emerson Power Transmission
E-Z Red Company
Fingerlakes Fabricating
Ford Motor Company
JR's Auto Repair
Kinko's
National Instruments
Newark Electronics
Sanden International
Teleflex Auto

Bronze Sponsors

Air Lift Company
Advanced Clutch Technologies
AJ's Foreign Auto
Baltek Corporation
Builder's Best
C II Technologies
Cole Muffler of Ithaca
D.A.R. Industrial Products, Inc.
Diversified Specialties
Eagle Transmission
Elmira Pattern and Foundry
Glauber Equipment Corporation
Haun Welding
Hernon Manufacturing
Intelligent Motion Systems
Keystone Restyling Products
Louis A. Green Corp.
Marx Machining
Metalmen Sales
Motorola, Inc.
NSK Corporation
Performance Accessories
Pleasant Valley Electric
Precision Gear
Resolution Performance Products
Rotor Clip
RWS Wire & Cable
Schott-Fostec LLC
TEMP Inc.

CUHEV 2001 – 2002 Team Members

Left: 2000 – 2001 5th Place Canyonaro Right: 2001 – 2002 Ford Explorer

Faculty Adviser
Prof. John Callister

Team Leader
Jonathan Schoenberg

Teaching Assistant
AJ Howard

Business Team
Susan Mueller*
Monica Mehra
Nicholas Parsatoon
Katherine Weber

Chassis Team
Jake Timm*
Anthony Rivara
Jieun Kim
Joshua Fishman

Control Team
John Hsu*
Mike Shafer
John Chiu
Dee Pong Lu
Paul Lin
Paul Rooney
Thomas Grillo
Lenny Sapronov
Lucas Delaney

Mechanical Powertrain
Matt Coble*
Ames Conant
Blake Koelmel

Electric Powertrain
Rob Woods*
Nicholas Moura
Patrick Byers
Chris Lassonde
Ian Block

*Subteam Leader