MIT EVT

Electric Vehicle Team

Introduction to the Electric Vehicle Team

The MIT Electric Vehicle Team (EVT) is a student-run organization dedicated to the research, design, and demonstration of electric vehicles. Since its inception in 2006, the team has grown into an environment where students can gain insight and hands-on experience regarding real challenges facing the development of electric vehicles. Support and generosity from faculty and industry have allowed us to undertake the *elEVen* project – the conversion of a 2010-model hybrid car into a rapid-recharge electric sedan – in the summer of 2009. With the *elEVen*, we set out to speed up that process by connecting emerging battery technologies with the needs of everyday drivers.

What We Do

- Design, produce, and test electric vehicles, with a focus on new battery and charging technologies.
- Provide MIT students with real-world educational opportunities and project experience, in the areas of electronics, fabrication, management, and marketing.
- Promote public awareness and understanding of electric vehicle technologies and the overarching need for clean transportation via demonstrations at energy showcases and community events.
- Publicize our sponsors through positive exposure and press coverage.

Demonstrated Success: Porsche 914 EV

The team's first project began in late 2006, when MIT professor Yang Shao-Horn and Dr. Quinn Horn of Exponent donated a 1976 Porsche 914, motor, charger, and controller. A handful of motivated students converted the car to electric power, removing the engine and its related parts and installing a 3-phase AC induction motor and 18 U-Charge® XP Lithium Phosphate batteries donated by Valence Technology.

From the beginning, EVT students designed this lithium-ion conversion to achieve two underlying objectives: establishing the vehicle's usefulness for research, and maximizing the electric system's safety. More recently, members of the team installed a real-time computer and touch panel (donated by National Instruments) to allow logging and analysis of all vehicle system parameters.

The Porsche 914 EV has similar driving performance to the original vehicle, with the added advantage of regenerative braking, which recaptures energy as the car slows down. The car provides students with a platform for hands-on design experience and reliable automotive research. The Porsche 914 EV is street legal, so students on the EVT can often be seen driving around the Boston area on test drives, or on the way to local events to educate the public about EV technology.

Range	100 miles
Charge Time	2.5 hrs
Top Speed	90 mph
Motor	47 kW peak, 20 kW cont, 3 φ AC induction
Batteries	23kWh, Valence LiFePO4

eMoto

ELECTRIC MOTORCYCLE

eMoto was designed and built in 2008 to demonstrate that **low cost EV's are possible**. Using all new parts available on the internet, eMoto was designed and constructed for $3,000 using lead-acid batteries. For more information: www.electricmotion.org.

eMoto has since been used by the EVT to demonstrate custom battery pack designs and rapid charging. In 2009 members of the EVT designed and built a set of **rapid-charging enabled battery modules** using A123's 26650 cells, along with a custom charger. The relatively lower power requirements of eMoto prepare the team for the demands of the higher power elEVen sedan, as it makes an excellent platform for which to test concepts on a smaller scale.

Range	25 miles
Charge Time	10 minutes
Top Speed	60 mph
Motor	15 kW peak, 7 kW cont, Brushed DC
Batteries	1.6kWh, A123 LiFePO4

elEVen

Our second vehicle conversion – the elEVen project – aims to travel 200 miles on an 11-minute charge. The elEVen is a battery-electric conversion of the Ford CD3 platform, used by the Ford Fusion, Mercury Milan and Lincoln MKZ.

The team began work on the vehicle in July 2009, removing the factory powertrain to make room for an electric motor, controller, lithium-ion battery pack and custom 12,000 RPM chain-drive speed reducer that was machined completely in-house. A 250-horsepower, 3-Phase AC induction motor, donated by SatCon and designed for use in a 33,000-lb transit bus will propel our 4,500-lb sedan from 0-60 miles per hour in under 9 seconds, with a top speed of 100 miles per hour (gear limited).

Initial conversion of the car over the summer of 2009 took less than six weeks, with six undergrads working 100+ hours per week to get it running before the end of the summer. Over the summer of 2010, the team aims to fully refine this vehicle to street-legal condition and rapidly charge its 20kWh battery pack in under 11 minutes, as a step to reaching the final goal of rapidly charging a 60kWh pack in the same time.

Range	60 miles (Goal: 200 mi)
Charge Time	2.5 hrs (Goal: 10 min)
Top Speed	100 mph
Motor	187 kW peak, 130 kW cont, 3 φ AC induction
Batteries	20kWh, A123 LiFePO4

Why Rapid Charging?

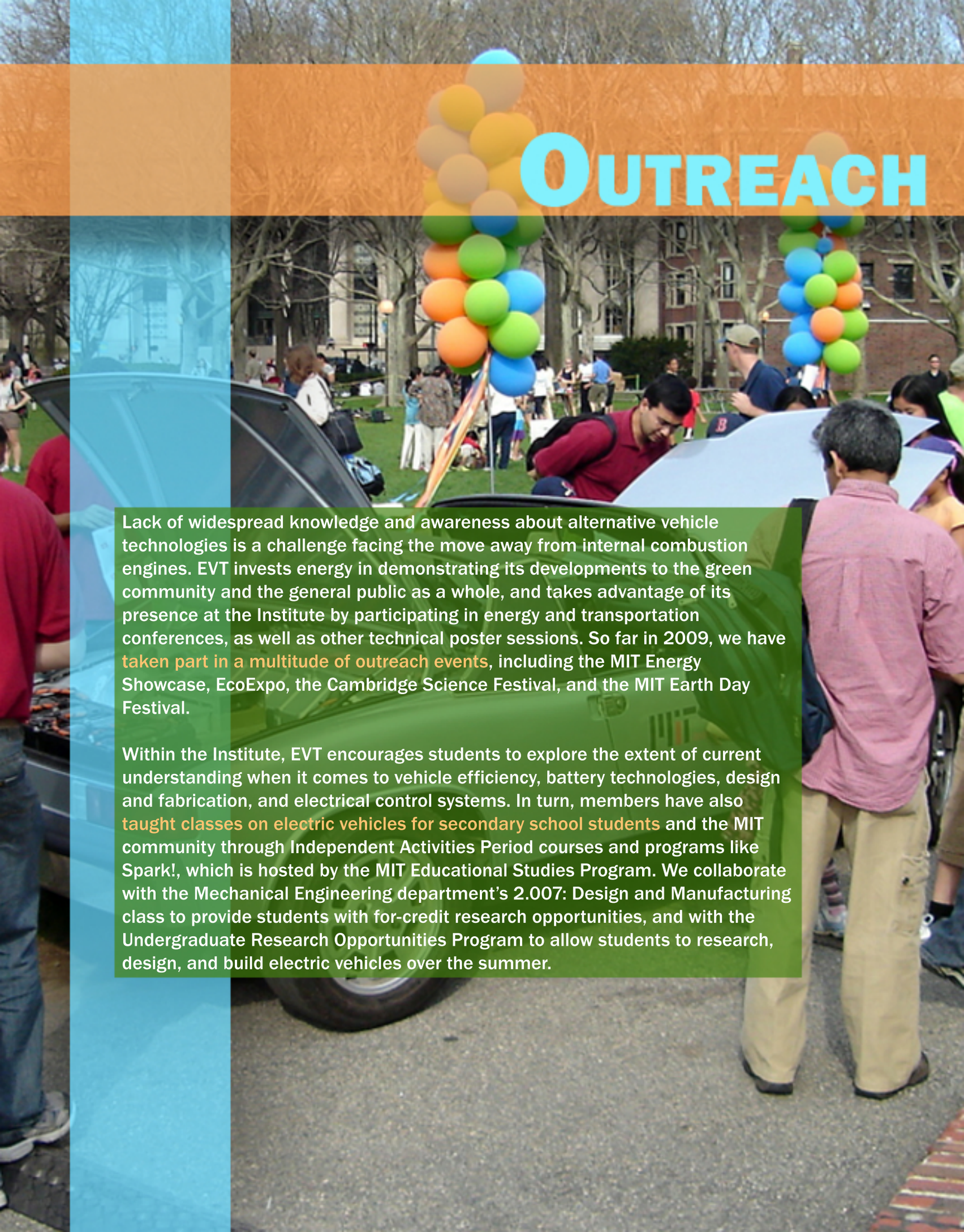
An obstacle to the adoption of EVs is range anxiety: the fear that once the battery runs out of energy, the driver has to wait for hours while it recharges. Unlike gasoline powered cars that can be refilled in less than five minutes at a pump, most electric vehicles take over three hours to recharge.

Reducing recharge time is key to the mainstream adoption of electric vehicles, allowing for long-distance trips and no compromises in functionality when compared to gasoline cars.

The team contributes a unique combination of ability and resources to this endeavor. Having successfully rapid-charged an A123 26650 cell over 1,500 times with only a 9% drop in capacity, the team is scaling to rapidly charge larger battery packs. Over the fall 2009 semester the team assembled a 1.6kWh battery pack for a motorcycle from the cell-level up, using 220 A123 26650 cells along with a dedicated DC-to-DC charging system capable of 10kW.

Over the summer of 2010, the team will raise the charging power level to 120kW to rapidly charge the 20kWh battery pack currently in the elEVen project. This is one step forward in reaching our goal of rapidly charging the 60kWh pack that will allow the vehicle to reach over 200 miles of range on a single charge, requiring 350kW of charging power.

Outreach

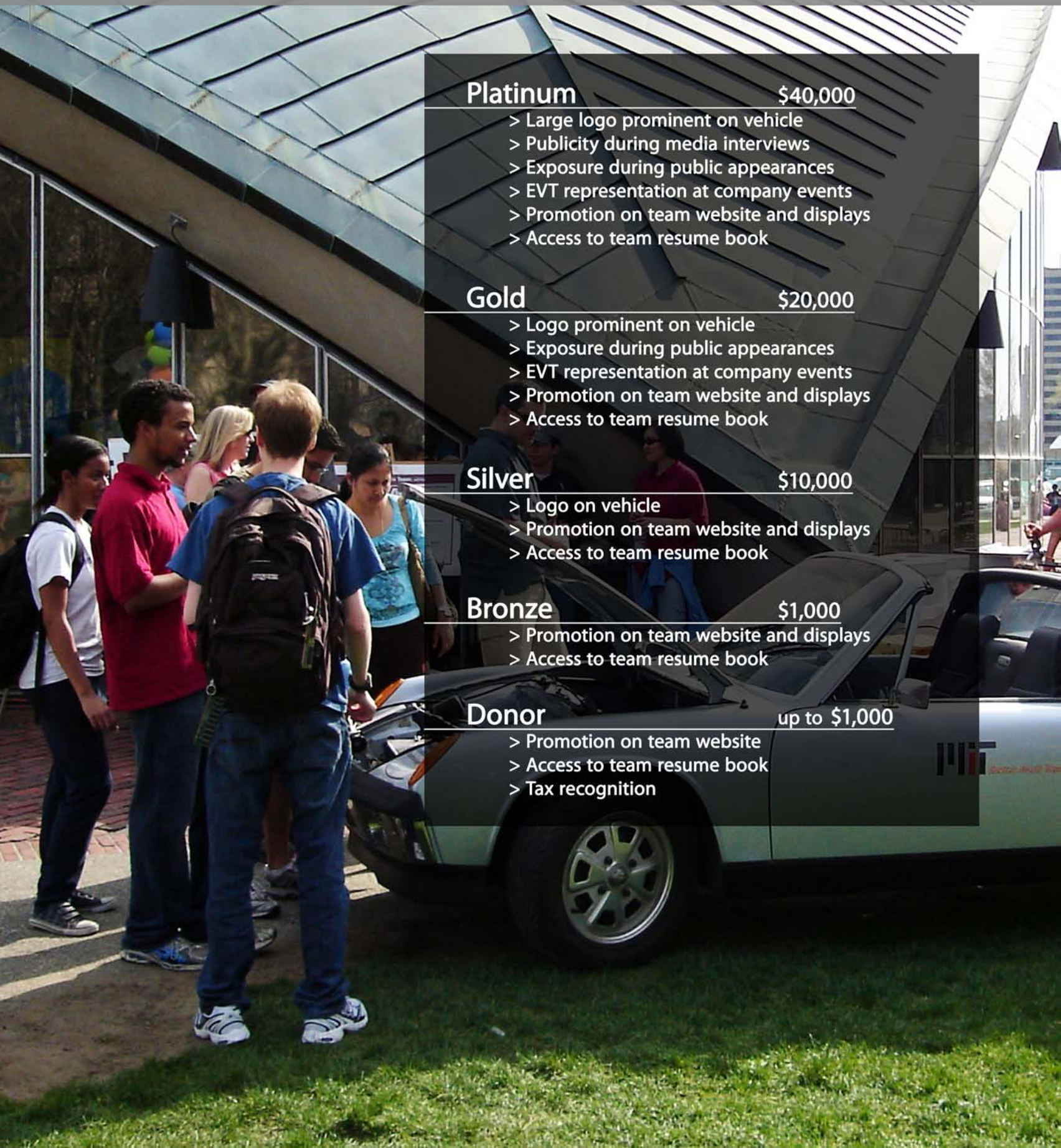


Lack of widespread knowledge and awareness about alternative vehicle technologies is a challenge facing the move away from internal combustion engines. EVT invests energy in demonstrating its developments to the green community and the general public as a whole, and takes advantage of its presence at the Institute by participating in energy and transportation conferences, as well as other technical poster sessions. So far in 2009, we have taken part in a multitude of outreach events, including the MIT Energy Showcase, EcoExpo, the Cambridge Science Festival, and the MIT Earth Day Festival.

Within the Institute, EVT encourages students to explore the extent of current understanding when it comes to vehicle efficiency, battery technologies, design and fabrication, and electrical control systems. In turn, members have also taught classes on electric vehicles for secondary school students and the MIT community through Independent Activities Period courses and programs like Spark!, which is hosted by the MIT Educational Studies Program. We collaborate with the Mechanical Engineering department's 2.007: Design and Manufacturing class to provide students with for-credit research opportunities, and with the Undergraduate Research Opportunities Program to allow students to research, design, and build electric vehicles over the summer.

Sponsorship

To date, over 85% of our financing has come from sponsors outside of MIT; our commitment to a cleaner future for transportation is made possible by the support of like-minded individuals and organizations. In return, we provide our sponsors with exposure through vehicle demonstrations and press coverage, along with real-time data from our own experimentation.



Platinum $40,000

> Large logo prominent on vehicle
> Publicity during media interviews
> Exposure during public appearances
> EVT representation at company events
> Promotion on team website and displays
> Access to team resume book

Gold $20,000

> Logo prominent on vehicle
> Exposure during public appearances
> EVT representation at company events
> Promotion on team website and displays
> Access to team resume book

Silver $10,000

> Logo on vehicle
> Promotion on team website and displays
> Access to team resume book

Bronze $1,000

> Promotion on team website and displays
> Access to team resume book

Donor up to $1,000

> Promotion on team website
> Access to team resume book
> Tax recognition