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Seeing Beyond Gasoline-Powered Vehicles

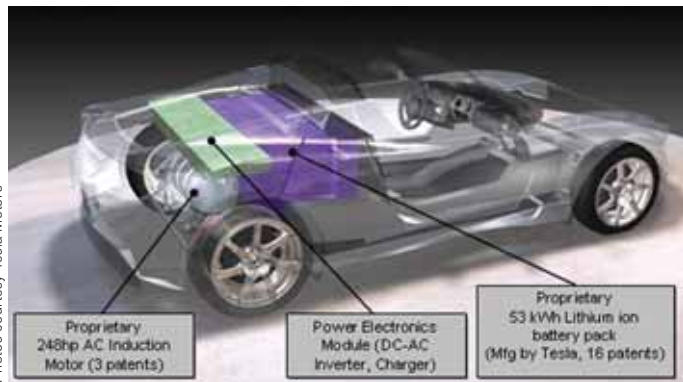
Our world's population now spends \$3 trillion a year on automobile- and gasoline-related purchases. This global economic spending on paper is a perfect split with \$1.5 trillion a year going to the auto industry and the same amount of money funding gasoline purchases. (*BusinessWeek* (2008, Feb. 4), p. 43)

The volatility of gasoline prices is slowly forcing auto manufacturers and consumers to recognize that at some point in the future automobiles will need to be completely weaned off gasoline. The current U.S. demand for hybrid vehicles shows that people are ready to switch to vehicles that squeeze more miles out of a gallon of gaso-

essentially indicated that GM celebrated its lawsuit victory by crushing all its EV1s.

However, the electric car didn't die, and with the major auto developers diverting their research to

Photo 1—The Tesla Roadster, an electric car that costs only 2¢ per mile to operate.



Photos courtesy Tesla Motors

Photo 2—Component details

line, are friendlier to the environment, and also help our country become less dependent on foreign oil.

General Motors (GM) was once a major innovator in the electric car movement. After the company basically announced that its EV1 was ready for market, it won a major lawsuit against California's ZEV mandate that called for extremely tough standards for fuel efficiency. GM successfully argued that only the federal government can set fuel-efficiency standards. The 2006 documentary *Who Killed the Electric Car?*

hybrid and fuel cells vehicles, the electric vehicle (EV) field was left open to smaller players like Tesla Motors. The dream of electric cars that don't require any gasoline is very similar to the original dream of Nikola Tesla, a world-famous early 20th century physicist, who dreamt of a world where electricity would flow to devices without wires. Tesla Motors adopted the Tesla name as its own to reflect its parallel vision of a world where people would drive cars that didn't use gasoline.

Full production of the car in

Photo 1 was scheduled to start on March 17, 2008. This makes Tesla Motors the first assembly line manufacturer of an EV. The Tesla Roadster has already met all Department of Transportation National Highway Traffic Safety Administration (DOT NHTSA) required standards for sale in North America, including all crash testing.

Since this vehicle's fuel is electricity, Tesla Motors wanted to determine the distance that its Roadster can go on a single charge compared with how far a car could

travel on an equivalent amount of gasoline. So Tesla Motors determined its vehicle's efficiency by using the combined highway and city driving testing procedures developed by the U.S. Environmental Protection Agency (EPA) to determine fuel efficiency for gasoline-powered vehicles. The combined EPA city and highway testing cycle showed that the Tesla Roadster averages 221 miles on a single charge.

The Tesla Roadster is 100 percent electric and still capable of going from 0 to 60 miles per hour in 3.9 seconds. However, the early production vehicles will have a transmission that will limit their 0 to 60 acceleration to 5.7 seconds. Tesla Motors is building the car from the ground up with an all-aluminum chassis and 100 percent carbon fiber body panels.

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It is powered by a rechargeable 1,000-pound, 53 kilowatt hour (kWh) lithium ion battery pack that sits behind the Roadster's seats. This battery pack is the purple object in Photo 2. Tesla Motors is building its own battery pack which includes 6,000 individual lithium cobalt cells. To prevent thermal runaway (resulting in the battery catching on fire), each cell is separated from its surrounding cells by a pocket of air, and each cell is liquid cooled by a fully integrated tubular cooling system. The battery pack is expected to last 100,000 miles, and it will carry a four-year, 50,000-mile manufacturer's guarantee.

To determine safety concerns if the battery pack should be damaged in a collision, Tesla Motors re-entered its Roadster at 50 miles an hour. This crash totally destroyed the vehicle and battery pack without causing any type of fire.

The power electronics module (green in Photo 2) is the inverter that transfers the energy from the battery to the 248 hp ac induction motor that powers the wheels. The first-generation motor can provide 211 pounds of torque to the wheels.

The Roadster can be fully recharged in 3-1/2 hours when plugged into a 70 A, 240 V electrical outlet. It can also be charged using any available 110 V outlet using its own fancy 110 V-rated extension cord.

The Tesla Roadster is selling for \$98,000, which sounds very high until you realize that the car's fuel bill will run you 2¢ per mile. The other plus pointed out at a February 20, 2008, conference in New York City is that as new efficient batteries are developed, the cost of power for the Tesla Roadster will go down at the same time that the cost of gasoline continues to rise.

Recalling the Facts

1. How is fueling a car similar to filling or replacing ink tanks on an inkjet printer?
2. What are the advantages and disadvantages of the all-electric Tesla Roadster over a Toyota Prius gas-electric hybrid? ☹



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