

ELECTRIC VEHICLES ARE TAKING OVER THE ROAD

AN INDUSTRY ANALYSIS BY FLOYD ASSOCIATES



FLOYD ASSOCIATES

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➤ **What is an electric car?**

An electric car is a rechargeable electric vehicle that operates using an electric motor and its controller instead of an internal combustion engine. An electric car is powered by a battery pack. The current battery chemistry of choice is lithium based. The battery pack supplies the electric motor with the energy necessary to move the vehicle while the controller regulates and controls the amount of power received from the batteries.

➤ **Motor technologies**

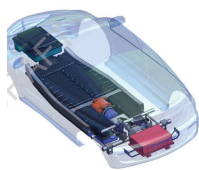
There are 4 types of electric motors: DC Brushless, AC Induction, Permanent Magnet and Switched Reluctance. The AC induction motor is the most utilized and proven; there is, however, the penalty of reduced motor efficiency. The DC Brushless has become popular due to its small packaging size and performance output though material costs do exact a price penalty. The DC Brushless will allow the car to have the highest top speed but the slowest acceleration. At additional cost, the AC Induction allows the car to have the fastest acceleration with average top speed. The Permanent Magnet motor offers average top speed and average acceleration. Switched Reluctance motors offer the most cost effective solution of the four motors although there is complex controller software involved to have it function quietly.

➤ **Battery technologies**

The 3 most common battery types are: Lead-acid, nickel-metal hydride, and Lithium Ion. The average lifespan of these batteries has historically been around 3 to 4 years. Among the three, lead-acid is the most commonly produced and cheapest. With a smaller size and higher performance than lead acid, nickel-metal hydride comes with a higher price tag. New Lithium- based battery chemistries (though the most expensive to date) have proven to have the longest life cycle and highest energy density. They are non-toxic and are the safest battery solution for transportation.

➤ **Future of electric cars**

According to the Electric Drive Transportation Association, the number of battery powered vehicles in the US grew to 76,000 in 2006 from 56,000 in 2004. From 1992 to 2006, the average growth for electric cars was around 28.5%. Automobile manufacturers are motivated to pursue battery powered technology due to the demand to reduce dependency on petroleum,



reduce greenhouse gas emissions, and provide a more cost-effective means of transportation.

➤ **US Investment Tax Credit (ITC)**

As part of the Emergency Economic Stabilization Act of 2008, the US government provides a tax credit for buyers of plug-in electric vehicles. Any buyer of an electric car would receive a base of \$2,500 plus an additional \$417 per kWh for batteries greater than 4 kWh up to a cap of \$7,500. Electric Vehicle manufacturers of the GM Volt or Phoenix Motorcars SUT and SUV would qualify for \$7,500 tax credit. President-Elect Barack Obama has claimed that he will support legislation providing a \$7000 tax credit to everyone who buys an electric car as an incentive to put a million electric cars on the road. California gives purchasers of plug-in vehicles a \$5,000 rebate and many other states are considering tax credits or rebates for purchasers of plug-in vehicles. For example, last month the Governor of Oregon announced a "Climate Change Agenda" that includes a \$5,000 tax credit for plug-ins and all-electric vehicles.

➤ **Operating costs & energy efficiency**

At \$3.78/gallon, a car powered by an internal combustion engine with 23 mpg efficiency would cost about \$9.80 per 60 miles. On the other hand, a battery version of that same car would cost \$1.75 per 60 miles. Maintenance costs are also lower for an electric car as you do not have to add or replace engine oil, transmission fluid, air filters, etc. Regenerative braking also allows an electric vehicle to recharge while decelerating or braking so brake linings and related parts wear out much more slowly and require far fewer replacements.

The energy consumption efficiency of a lithium-ion powered car is \$0.176 kWh/mi. The average gasoline operated car with 23 mpg has an efficiency of \$1.58 kWh/mi. A hybrid vehicle with 70 mpg has \$0.52 kWh/mi efficiency. Clearly, battery electric vehicles are much more energy efficient especially when looking at the truck and SUV market segment where relatively low fuel efficiency is the norm.

➤ **Charging**

Battery electric vehicles charge from the power grid, where electricity is generated from a variety of sources: Solar panels, wind-generated electricity, hydroelectricity, nuclear, and coal. Normally, a battery electric vehicle will be charged overnight using an integrated vehicle charger in around 5 to 6 hours using a 220 V source. Phoenix Motorcars has introduced the first EV that can also be charged to

around 95% charge capacity in as fast as 10 minutes. This requires off-board equipment and industrial 480V 3-phase power, already widely commercially available today, with the idea of “charging stations” using large stationary battery banks to charge at off-peak intervals (in the middle of the night, for example) or from other renewable energy sources.

Electric Vehicle Manufacturers

Phoenix Motorcars (Ontario, California USA)

A privately held company, based in Ontario, California, is one of the world’s leading developers of zero emission, all electric vehicles. Utilizing Lithium battery technology, Phoenix Motorcars is the first electric vehicle on the market that can **recharge in 10 minutes, drive over 100 miles AND travel at highway speeds**. Phoenix was the first automaker to introduce the all electric sport utility truck in 2006.



The lithium battery pack helps eliminate safety concerns and toxic emissions. These vehicles provide customers with a practical, cost-effective, and “green” solution for their fleet needs. Phoenix’s vehicles **passed the “five star” crash test safety rating**. They have a driving range greater than 100 miles and projected EPA rating of 135 mpg. There is little trade-off when it comes to speed and acceleration: Top speed is 95 mph with 0-60 acceleration in 10 seconds.



Tesla Motors (San Carlos, California USA)

A privately held automobile company, based in the Silicon Valley, focuses on the production of high performance, sport battery operated electric vehicles. Its Roadster is the most-publicized and most-hyped electric car to date.



The car has a range of 221 miles, top speed of 125 mph, and can accelerate from 0-60 in 4 seconds. The car was expected to be released in the first quarter of 2008 but the release date has been pushed back several times due to production problems, including transmission and durability issues.

Miles Electric Vehicle (Santa Monica, California USA)

The Los Angeles based manufacturer and distributor of all-electric vehicles manufactured in China. The

company already makes and sells two low-speed electric vehicles in the United States. All Miles vehicles offer its customers with steel chassis, steel impact-resistant frame, steel doors and DOT-approved glass.

Its most anticipated product, the MILES XS500 (picture below), is expected to be released in 2009. The highway-capable electric sedan provides all the standard features that a standard mid-size car would.



TH!NK Global (Aurskog, Norway) – Private

Think Global, a private company based in Norway, manufactures highway-certified electric cars. Its TH!NK City (see photo) is the world’s only crash tested and highway-certified electric car.



The car has a range of 126 miles and top speed of 65 mph. Its battery will be leased rather than sold to its customers. In the US, the expected price tag is between \$15,000 to \$17,000 and an additional fee of \$100-\$200 to lease the battery.

General Motors (United States, United Kingdom)

GM’s Chevy Volt is a plug-in hybrid vehicle that is expected to be launched in the third quarter of 2010. GM utilizes the internal combustion engine and electric motors in its design of the Chevy Volt. After being fully charged, the car will run on its electric battery up to 40 miles, and then it has to tap into the internal combustion engine fuel. On a single tank of fuel, the car has a range of 640 miles.



Aptera Motors (Carlsbad, California USA)

A California-based manufacturer of high-efficiency three wheeled vehicles. Aptera Typ-1 (see photo) is considered to be one of the most fuel-efficient cars in the world. It is a three-wheeler and comes in 2 configurations: all electric or hybrid. It has a driving range of 120 miles and fuel efficiency of 340 mpg.



REVA (Bangalore, India) – Private

Reva Electric Car Company was formed as a joint venture between the Maini Group of India and AEV LLC of California. It is intended be used as a city car and not for highway travel. It is not available in the United States because it is unsafe at high speed. The car has a range of 70 miles and top speed at 45 mph.



Why Phoenix Motorcars?

- First automaker to introduce the zero emission, all electric sport utility truck with highway travel capability in 2006.
- Extensive automotive industry experience with a mission to sell best-in-class EV's to the North American and world markets.
- Low risk entry strategy initially targeting the fleet market in California and abroad.
- Battery Agnostic battery technologies that enable the vehicles to be recharged in 10 minutes and drive over 100 miles.
- It can carry four people, haul a payload in the back and still maintain freeway speeds.
- Have "five star" crash test rating and provides the convenience of an SUV/SUT.
- Extensive customers list from utilities, cities, counties, ports, airports and others.
- Have more than 600 firm orders from fleets nationally.
- Projected EPA rating of 135 mpg.
- Cost-effective solution for today's economic realities:
Fully charged for around \$3.



President Bush Viewing Phoenix Motorcars' SUT
Source: Phoenix Motorcars