

Overcoming the Last Hurdle

Is the electric car ready to shock a few people?

By Paul Woods

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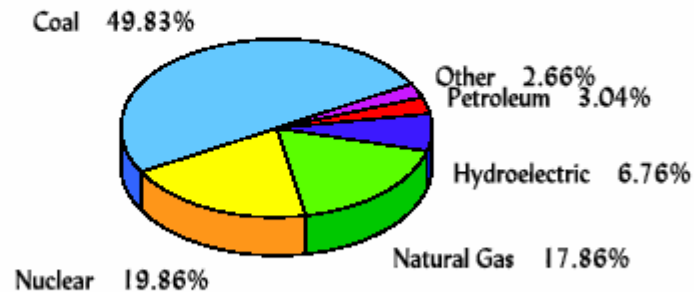
At the turn of the last century, cars came in steam, electric, and gasoline versions. When Thomas Edison was asked which he favored, without hesitating, his reply was electric cars. They didn't have the vibration, noise, and smell associated with gasoline cars or the long start up times and limited range of steam cars. Had someone listened to him at the time, we might not now be stuck with a classic 19th century technology and sending huge amounts of money to countries whose chief exports are petroleum and terrorists. For all its advancements, the internal combustion engine is still a noisy, heat-blasting, poison-spewing monster with too many moving parts.

The Conundrum

In spite of what the proponents of Proposition 87 promised in the last California election, putting a solar panel on your roof right now will have virtually no impact on the demand for foreign oil. Alternative energy technologies like solar and wind produce electricity only. The problem is that oil is overwhelmingly used to fuel our vehicles, with only about 3% being used to produce electricity. However, some amazing strides have been made recently in a technology developed in the 1830s, and there's now a light at the end of this tunnel.

Electricity Generation by Fuel Source

% of Total as of 2004



Source: Energy Information Administration

The Electric Car

The obvious solution to clean technologies that produce electricity and the need to fuel our vehicles is the electric car. Although these have been around since the 1830s, electric cars haven't exactly caught on so far. Some automakers had a brief fling with electrics in the 1990s in response to a program from the California Air Resources Board to produce a zero emissions vehicle. This program was subsequently modified after complaints by automakers that it made no sense to produce these cars because of the lack of consumer demand, and most of the electric cars produced at the time ended up in museums. This of course touched off conspiracy theories and charges of automaker incompetence. However, the real problem was probably that battery technology was in its infancy and electric cars were unable to provide the performance and range that would satisfy anyone but the most rabid environmentalist.

Raising the Bar

As a result, http://www.teslamotors.com/index.php?js_enabled=1 stunned a lot of people at a recent auto show. One observer summed it up by saying "until today, all electric cars have sucked." Martin Eberhard, the inventor of the Tesla Roadster says traditional carmakers have failed with electrics for two reasons. According to him, these were marketed as "penalty boxes" for environmental do-gooders and gas-mileage-obsessed penny-pinchers. Second, they just didn't

understand batteries. The Tesla's lithium ion battery pack gives it the power to hit 60 mph in four seconds, a top speed of 130 mph, and the ability to run 250 miles without a recharge. A one-hour charge is good for 80 miles, while it takes a 3.5-hour charge to go 250 miles. It even plugs into a wall socket at a roadside stop in a pinch.

Tesla's electric roadster is a big ticket item at \$90,000-\$100,000 depending upon options. Their strategy is to initially enter the high end of the market, where buyers are willing to pay a premium, in order to accumulate the funds necessary to broaden the product line. In 2008, Tesla expects to introduce a car designed to compete with BMW's 5 Series for about half the price of the roadster. Following that will come the development of a low cost family car. By the way, Tesla doubled their production target and is already sold out for 2007, which is bound to raise a few eyebrows in the auto industry.

Not There Yet

Although Tesla is claiming driving costs of around a penny per mile, that's the direct cost of electricity to charge the batteries. Tesla is also claiming a useful battery life of 100,000 miles. We're taking this with a few grains of salt, because with current lithium ion battery technology, that's pushing it.

The best thing about lithium ion batteries is their light weight and their ability to be formed into a variety of shapes and sizes. However, there are still some serious drawbacks. Even if never used, these batteries begin aging from the time of manufacture, so an older battery will not last as long as a new one. People living in Phoenix should note that these batteries also have the annoying habit of rupturing, igniting or exploding if subjected to high temperatures or direct sunlight.

Li-ion Battery Permanent Capacity Loss vs Storage Conditions

Storage Temperature	40% Charge	100% Charge
32 Degrees Farenheit	2% loss after 1 year	6% loss after 1 year
77 Degrees Farenheit	4% loss after 1 year	20% loss after 1 year
104 Degrees Farenheit	15% loss after 1 year	35% loss after 1 year

Source: Wikipedia

From the standpoint of someone considering an electric car, another problem is that lithium ion batteries lose storage capacity over time. The capacity loss is directly related to temperature and the amount of the charge when stored. If your garage is a carport in the desert, don't even think about buying a Tesla Roadster as your range could be less than 30 miles after 5 years. Higher temperatures reduce storage capacity more quickly, but keeping the charge low when the car isn't being used will prolong life. However, the risk here is driving too far with too low a charge, which may result in batteries that are irrecoverably dead and have to be replaced.

Let's assume that most people keep their electric cars fully charged and the batteries lose capacity at the rate of 20% per year. That means the range of a Tesla Roadster is 250 miles the first year, 200 miles in the second year, 160 miles in the third year, etc. Even if these batteries can be charged the usual 750 times, the constant erosion in the car's range may make it necessary to replace the batteries even if there are some charges left. The cost of replacement is still the wild card, but using conservative assumptions and assuming a big markup on Tesla's custom battery pack of 6,831 rechargeable batteries, this car is probably still more expensive to drive than a gasoline car once the cost of batteries is amortized.

Getting Over the Last Hurdle

It's possible that a small company in Reno, Nevada may have radically changed the economics in this equation. In February 2005, Altair NanoTechnologies <http://www.altairnano.com/> announced a prototype battery that has three times the power of existing batteries and can be fully charged in six minutes. In a recent test, the company claims their batteries went through 15,000 charge/discharge cycles while still retaining 85% of battery capacity. To accomplish this, the company removed the graphite from conventional lithium-ion batteries and replaced it with nanotitanate, a substance they developed. The batteries can operate from -50°C to over 75°C and appear to be safe even at extreme temperatures. They are currently being used in a new production electric truck made by Phoenix Motorcars <http://www.phoenixmotorcars.com/> in Ontario, California.

Phoenix Motorcars is planning to introduce a sport utility truck in early 2007, using the Altair battery. Its target market is fleet sales in California, 2% of which are required to be zero emission vehicles (ZEVs) by the California Air Resources Board. This truck carries a price tag of \$45,000 and has a relatively small battery in order to allow the truck to carry 5 passengers and a full payload. It has a range of around 130 miles, goes from zero to 60 mph in about 10 seconds, has a top speed of 95 mph, and recharges in less than 10 minutes.

Later in 2007, Phoenix plans to introduce a SUV with a similar price tag. It will be offered in two configurations, one with a range of 130 miles and the other with a range of 250 miles. It's a safe bet the one with the longer range will have less room for passengers and storage, but will also be faster with a higher top speed.

A Seismic Shift

It should be noted that the estimate for the number of charge cycles comes from Altair and has yet to be verified with independent tests. In addition, since the cars using these batteries are new, there's no history to compare against. Phoenix Motorcars is conservatively estimating a 12 year life on the Altair battery pack, so the batteries may outlive the rest of the vehicle. Not having to replace the batteries and pay only for the cost of recharging is the type of seismic shift that may finally tilt the economics away from combustion engines.

Laying the Groundwork

American and Japanese automakers are quietly laying the potential foundation for electric cars with hybrid vehicles. We're huge fans of gasoline/electric hybrids as they proved it was possible to save money on gasoline without sacrificing comfort or performance. Hybrids also give automakers experience with the necessary batteries and regenerative braking technology that captures the energy used in braking to recharge the batteries while driving. All that remains is to remove the antiquated combustion engine.

General Motors has recently reversed their reversal of the 1990s and again announced plans for an electric car. Several other U.S. and Japanese automakers are also jumping on this bandwagon. An all electric Prius may be possible within

18 months, although Toyota has made no announcements. Beyond that, a small selection of electric cars from major automakers is expected around 2010.

Reservations

As previously mentioned, the Altair battery technology is unproven, and it will take some time to see if it really works. To remove the last roadblock for electric cars, Altair's batteries will have to perform as promised and become more widely used. Range is also still an issue for electric cars. They now can probably cover most driving done by most people on most days. Folks may still need another car for longer trips, although Altair's batteries recharge in about the same amount of time that it takes to fill a gas tank, so the wider availability of the appropriate electrical outlets would mitigate this problem. It's also hard to be thrilled with the places chosen so far for assembly. The Tesla is being assembled in England while the basic truck from Phoenix Motorcars comes from Korea. Unfortunately, automakers in both countries are notorious for poor quality. Finally, the selection of electric cars needs to improve dramatically for these to become more widely accepted.

The Future?

An electric car that costs significantly less to drive than a gasoline powered car, that recharges in the time it takes to fill a gas tank, and has the comfort and performance to satisfy American drivers is one of the most potentially important and disruptive technologies of the decade. Imagine a one-time purchase of solar panels (subsidized by taxpayers) that not only eliminates your electricity bills but also provides a lifetime supply of fuel for your car. Imagine telling the lunatics that control world oil supplies to put their oil where the sun doesn't shine and finally giving the Middle East the lack of attention it deserves. Imagine having to figure out what to do with all the money you aren't spending on electricity and gasoline. Like Martin Luther King said, I have a dream.

For disclosure purposes, it should be noted that Odyssey Advisors LLC has an investment in Altair NanoTechnologies (ALTI) for a small number of clients willing to tolerate very high risk.

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