

**How far can a
battery take you?**

Energy Storage

Batteries

"Plug-in vehicles have the potential to make an immediate difference in reducing air pollution and curbing dependence on oil. Over the long term, plug-ins can play a critical role in the effort to stop global warming,

Texas gets about 37 percent of its electricity from coal-fired power plants. That's lower than the national average but still enough coal to contribute to smog in big cities.

Trouble is, power plants still pollute, just like gasoline engine tailpipes.

Based on data from the Environmental Protection Agency on Texas power plant emissions in 2008, an electric vehicle would be responsible for slightly more nitrogen oxides than a brand-new gasoline car.

[1] Power plants' coal smoke tarnishes halo of electric cars
<http://www.dallasnews.com/sharedcontent/dws/bus/stories/120509dnbusnuelectriccars.189e3e2.html>

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The Chevrolet Volt

Chevrolet's Volt, a plug-in hybrid due out in November, will draw 8 kilowatt-hours of electricity from the grid to go 40 miles. (The Volt also has a gasoline engine; hence, it's a hybrid.)

Plug in the Volt in Texas, and it will produce about 0.1 of a gram of nitrogen oxides per mile on electricity. The EPA recently tightened NO_x requirements for gasoline cars, so the average new car will emit only 0.07 of a gram of NO_x per mile.

Carbon dioxide emissions look better. A Volt would be responsible for 164 grams of carbon dioxide per mile traveled on the battery. A gasoline car emits 320 grams per mile.

Emissions issues for the rest of the country aren't any better. Some states, such as California, have cleaner power plants. Still, the average power plant in the U.S. creates more nitrogen oxides per kilowatt-hour of electricity than the average in Texas.

Health issues

Dan Greenbaum led a study for the National Research Council that found that plug-in vehicles in the U.S. would cause more health damage from pollution than other vehicle technologies.

Half of the country's power comes from coal plants, and it does take more energy to manufacture an electric vehicle, to manufacture the battery pack, etc., etc.said Greenbaum,

[1] Power plants' coal smoke tarnishes halo of electric cars
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Higher grid costs

Plug-in cars could also boost the cost of maintaining the electric grid for everybody. If drivers juice up in the late afternoon, during the hours of greatest power demand, Texas might need more power plants or lines to accommodate them.

Plugging in "during the day, you just exacerbate a problem," said Bob Shapard, chief executive of North Texas' power line company, Oncor.

"That's a big drain on our system," said Don Clevenger, vice president of external affairs for the company.

[1] Power plants' coal smoke tarnishes halo of electric cars

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If 1.2 million Texans were to buy Chevy Volts and plug them into the state's grid at the same time, late on a hot afternoon, Texas would need more power plants to accommodate them. That many vehicles would wipe out the extra reserve margin, or the cushion of excess power plant capacity. ERCOT aims to keep at least a 12.5 percent reserve margin to ensure reliability.

If 3.4 million Volt drivers in Texas plugged in simultaneously on the afternoon of the hottest day of the year, the grid could black out.

[1] Power plants' coal smoke tarnishes halo of electric cars

<http://www.dallasnews.com/sharedcontent/dws/bus/stories/120509dnbusnuelectriccars.189e3e2.html>

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Stricter rules

Environmental advocates say it's much easier to cut pollution at a few power plants than for millions of vehicles. The EPA is working on stricter nitrogen oxide regulations and has recently tightened rules for mercury emissions.

Recharging at 9:00 pm.

"There are some days in the summer when the wholesale rate for power can be 30, 40 cents per kilowatt-hour," he said. So power companies must build plants that sit idle for most of the year and fire up only occasionally, on the days of greatest demand.

[1] Power plants' coal smoke tarnishes halo of electric cars
<http://www.dallasnews.com/sharedcontent/dws/bus/stories/120509dnbusnuelectriccars.189e3e2.html>

Energy Storage

Hybrids are good for the environment when they run on the E-engine

Seven million barrels of gasoline are consumed by vehicles in the United States every day.

The Porsche 918 Spyder

Plugin hybrid

Tops any Lamborghini

Power: Total 716 PS

Petrol engine 516 PS

Electric engine 200 PS

The feeling of racing

The steering wheel with switching keys is detachable, like those of formula 1 cars.

Energy Storage

The Lithium-air battery [1]

Li-air batteries use a catalytic air cathode that supplies oxygen, an electrolyte and a lithium anode. The technology has the potential to store almost as much energy as a tank of gasoline, and will have a capacity for energy storage that is five to 10 times greater than that of Li-ion batteries, a bridge technology.

Life's quest for the technological holy grail takes on many different aspects. To fly... to eliminate polio...to go to the moon, some of these pursuits have been achieved. But people are never satisfied and the quest continues. Battery people, utilizing technology, have their moments to hope, dream and pursue greater energy densities. Having been brought up in the era of nuclear energy, the technologist envisions the day when a battery the size of a pack of chewing gum will power a computer for years. While batteries do make modest gains in energy stored, technologies such as cell phones expand to capture the dollar of the consumer by adding features which require greater power, but result in devices with micro-sized, dim displays to match almost unuseable, tiny keyboards.

Thinking beyond the device of today, some see an 'always-connected' person who has the combination of computer, cell phone, PDA and entertainment center in a single device ready to make the business deal, cure the illness and make the next hotel reservation while living in a virtual reality of a galaxy far, far away. Forgetting the electronic challenges of this magic module, the energy storage device necessary to provide this power, with small package size to satisfy the user, lies within this holy grail.

Energy Storage

A practical cell has from 15% to 40% of the energy density of the active material's theoretical maximum.

Here the Lithium perchloride (3620 Wh/kg) is shown, with 25% of the theoretical value.

http://www.batteriesdigest.com/lithium_air.htm

Energy Storage

Lithium metal, excluding oxygen, has the highest standard potential and electrochemical equivalence of all metals.

The specific capacity of a battery depends on the capacity of the lithium anode and the carbon cathode.

Adding transition metals increases the specific capacity of the cathode. Manganese presents the best results.

Energy Storage

URANIUM SHORTAGE

Uranium shortage in 2014 prices will double [1]

Sept. 22 2009 (Blomberg) -- Uranium demand will rise and exceed supply in 2014 as China and Russia add nuclear power stations, benefiting producers Paladin Energy Ltd. and Energy Resources of Australia Ltd., the Royal Bank of Scotland said.

The price of uranium will double to a peak of \$95 a pound in late 2011, from an average of about \$47 a pound this year. Supplies are “inconsistent” with “logistical, statutory and operating bottlenecks” in Canada, Namibia and Australia.

Demand will climb steadily, leading to “a deficit market from 2014 on,” The days of uranium prices below \$20 a pound “are history,” the RBS analysts said.

China: China has 26 reactors in the planning phase (with 12 to begin construction by the end of 2010) and a further 72 proposed.

An official at China’s National Energy Administration recently stated that the country would stockpile uranium and buy overseas deposits in order to avert domestic shortages. With such an aggressive nuclear power agenda, China clearly recognizes the need to secure future uranium supply.

[1] Bloomber: Uranium Shortage Looms in 2014, Benefiting Paladin, RBS Says
<http://www.bloomberg.com/apps/news?pid=20601081&sid=a7ro7rXqYCB0>

[2] Uranium shortage looming.
<http://www.resourceinvestor.com/News/2009/4/Pages/Uranium-shortage-looming--PDF-.aspx>

Energy Storage

Lithium shortage [1]

A project has applied for \$1.8 billion from the Department of Energy to build a seven-million-square-foot factory in Detroit to supply multiple automakers. With something like 14,000 employees, it wants to be able to supply batteries for five million hybrids or a half million plug-in EVs annually by 2013.

Meridian International Research does say in a 2006 report entitled "The Trouble With Lithium" that the world's supply is limited, and concentrated in China, Chile, Argentina and Bolivia. Total world reserves, according to William Tahil, director of research, is just 6.2 million metric tons. "Analysis shows that a world dependent on lithium for its vehicles could soon face even tighter resource constraints than we face today with oil," the report says.

[1] Will Hybrid and Electric Car Batteries Force a Global Lithium Shortage? The Daily Green. February 4, 2009

<http://www.thedailygreen.com/living-green/blogs/cars-transportation/lithium-batteries-electric-cars-460209#ixzz0eVVUrazi>

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Major obstacles exist for Lithium-air, especially in the area of temperature range. The present study looks at liquid electrolyte and the carbon black coated anode current collector. Over temperature ranges from -30 0C to +40 0C, the cells were discharged at constant currents from 0.05 to 0.5 mA/cm². Cells operated at +40 0C gave nominally 10 times more specific capacity than those at -30 0C.

The temperature affects the diffusion of oxygen through the electrolyte. It is anticipated that future work should separate the effects of oxygen solubility from oxygen diffusion. The reformulation of the electrolyte may be the way to improve low temperature operation.

Energy Storage

Lithium shortage [1]

Mitsubishi, which plans to release its own electric car soon, estimates that the demand for lithium will outstrip supply in less than 10 years unless new sources are found.

"The U.S. Geological Survey's mineral commodity specialist on lithium, Brian Jaskula, offers a more conservative estimate, forecasting that demand will begin to drive lithium prices up in the next 10 to 15 years. But the signs are clear: Lithium, which now costs less than a buck per kilogram, will not stay cheap for long.

There is not enough lithium carbonate and lithium chloride -- the two key salts used to formulate lithium metal for advanced batteries -- in the world to produce the necessary batteries to convert the world's gasoline and diesel fleet to HEV0 (conventional hybrids), PHEVs and battery electric vehicles or BEVs. And even if there were sufficient deposits, most of which are located above 3000 meters in the Bolivian, Chilean and Argentine Andes in ancient dry lake beds, at current rates of worldwide production it would take 75 years to build one billion 5kWh battery packs. [2]

[1] Could Lithium Shortages Impede Future Electric Car Deployment?

<http://www.treehugger.com/files/2009/01/lithium-shortage-electric-cars-batteries.php>

[2] The Coming Lithium Shortage

<http://priuschat.com/forums/prius-hybrid-news/27863-lithium-shortage.html>

Energy Storage

Lithium shortage [1]

In traditional rock-like form, it is obtained from open-pit mines in North Carolina, Zimbabwe, Manitoba, Canada and Western Australia. But this form is gradually being replaced with a brine-based product obtained from other sources, including Nevada, Chile and Bolivia.

According to the New York Times, Bolivia alone has as much as half the world's lithium reserves in remote salt deserts, and is contemplating nationalizing the industry. Bolivia could become the "Saudi Arabia of lithium" through its Salar de Uyuni deposit, the paper said. Extracting is not particularly eco-friendly -- the most cost-effective method is evaporating brine in special ponds lined with toxic PVC plastic. Lithium is corrosive, and breathing its dust can irritate nose and throats; in big doses, it can cause fluid buildup in the lungs. It also presents a fire hazard, one big headache for battery developers.

[1] <http://www.thedailygreen.com/living-green/blogs/cars-transportation/lithium-batteries-electric-cars-460209>

Energy Storage

Lithium shortage [1]

There are one billion cars running. To change to battery power giant amount of lithium will have to be provided. Absolut Asset Manager predicts a global demand of 85 000 tons of lithium in the 2020. Actual mining of lithium is 20 000 tons per year, which are mainly used for batteries of notebooks and mobiles. South America has two-thirds of lithium deposits. The United States Geological Survey says that the gobal deposit of lithium is 11 million tons.

Bolivia has the greatest deposit of all countries in the salt sea “Salar de Uyuni”. However, lithium extraction in the 1980s and 1990s by foreign companies met strong opposition of the local community. Despite being poor, locals believed that the money raised by the mining would not reach them. There is currently no mining plant at the site and the Bolivian government doesn't want to allow exploitation by foreign corporations. Instead it intends to build its own pilot plant with a modest annual production of 1,200 tonnes of lithium and to increase it to 30,000 tonnes tonnes by 2012.

Salar de Uyuni is estimated to contain 10 billion tonnes 11 billion tonnes of salt, of which less than 25,000 tonnes is extracted annually

Chile has a production of 8 000 tonnes of lithium per year. Its reserves are about three million tons in the Atacam salt sea.

[1] Bolivia holds key to electric car future. BBC. 2008-11-09.
<http://news.bbc.co.uk/2/hi/business/7707847.stm>

Energy Storage

03.02.2010: Electricity giant EWE calls for subsidies [1]

The German electricity corporation calls for heavy subsidies for the installation of charging stations and subsidies for the electric car, otherwise these cars would be build elsewhere.

Ewe stresses that France grants 5 000 Euro and tax reductions for every electric car which is sold. Great Britain, Denmark and Portugal similar high subsidies for electric cars.

To build 1,5 million charging stations the German government will have to invest up to 5 billion Euro, according to McKinsey. One recharging place will cost between 2 000 and 4 000 Euro. These cost must be paid by the electricity consumer and the connection with the grid might be paid by revenues of the delivered electricity.

The batteries double the car price. The range is too small. Electro cars are not friendly for the environment as they depend on fossil fuel power plants or nuclear power plants without nuclear waste storage solution.

The hydrogen car will be the future of the car industry.

- [1] Versorger verlangen Zuschüsse für Elektroautos. Handelsblatt. 03.02.2009.
<http://www.handelsblatt.com/unternehmen/industrie/subventionsforderung-versorger-verlangen-zuschuesse-fuer-elektroautos;2522835;0>

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Energy density [1]

The lithium-ion battery has a low energy density of 0,12 Wh/kg meanwhile Diesel oil has an energy density of 10 Wh/kg. The battery costs 20.000,00 Euro and offers a range of 100 to 250 km with a recharging time of 2,5 to 14 hours.

The [climate protection goals of the German government](#) foresee too have more that one million of electro-cars on German roads by 2020. [2]

Recharging Litium ion battery [3]

The Massachusetts Institute of Technology reports the development of batteries which can be recharged or discharger in seconds, rather than hours. Gerbrand Ceder and colleagues used a material which presents tunnels, permitting lithium to travel faster though the material.

[1] <http://www.landtag.nrw.de/portal/WWW/dokumentenarchiv/Dokument/MMST14-3135.pdf>

[2] TÜV SÜD: Zeit ist reif für E-Mobilität

http://www.tuev-sued.de/tuev_sued_konzern/presse/pressearchiv/tuev_sued_zeit_ist_reif_fuer_e-mobilitaet

[3] Re-engineered battery material could lead to rapid recharging of many devices. Beltway for electrical energy solves long-standing problem. Massaschusetts Institute of Technology.
<http://web.mit.edu/newsoffice/2009/battery-material-0311.html>

The End

Desert Energy Project