Short Circuit? Will Electric Cars Provide Energy and Environmental Salvation?

Jonathan A. Lesser

Many a young gentleman's first—and only—experience with an electric car was the "bumper car" ride at the local amusement park or state fair. The author himself fondly recalls the pleasure he derived as an eight-year-old in smashing into the whirling dervish of similarly excited boys in their cars. Of course, the forthcoming generation of electric cars is meant to replace the internal combustion engine, not satisfy the aggression of eight-year-olds. Therefore, the question is whether these cars will provide a *realistic* alternative, which I define as providing greater energy efficiency and reduced environmental impacts cost-effectively.

There is no doubt that these new electric cars can offer greater energy efficiency, even if claims by General Motors that its Chevy Volt will provide the average driver who recharges the car every night the equivalent of 230 miles a gallon of gas are silly.[1] Estimating the fuel efficiency of an electric car in terms of miles per gallon of gasoline is nonsense, unless the car's batteries happen to be charged by electricity from a gasoline-powered generator. A more useful measure is one that considers the total energy needed to move an electric car—or any car—a unit of distance.

In a 2006 article, Tesla Motors prepared a report comparing the energy efficiency of their car with those of gasoline and diesel power cars, hybrids, and even hydrogen power vehicles.[2] Based on a number of "best-case" assumptions, the authors of the Tesla report showed that the Tesla Roadster offered twice the "well-to-wheel" energy efficiency (measured in kilometers per megajoule) as a Toyota Prius hybrid.[3] Not surprisingly, the Tesla vehicle, being twice as energy-efficient, was also more environmentally friendly, with half the carbon emissions of the hybrid.

Jonathan A. Lesser, PhD, is president of Continental Economics, Inc., an economic and litigation consulting firm, with offices in Washington, DC, and Albuquerque, New Mexico. He can be reached at (202) 446-6062 or via e-mail at: jlesser@continentalecon.com.

CONSIDER THE REALITIES

Thus, it would seem that an electric car future does offer energy and environmental salvation, especially if powered by "free" energy from the sun and the wind. Nevertheless, before we all begin salivating over our extension cords, there are a few economic realities that ought to be considered. First, most electric car batteries will be charged from power produced by the grid using a mix of fossil-fuel and renewable technologies. If you are in the Midwest, for example, the majority of your electricity is likely generated by coal-fired power plants, which are far less fuel-efficient, but far cheaper, than a brand new state-of-the-art combined-cycle plant.

Second, one must consider the cost of the electricity needed to recharge the batteries. The Tesla's lithium-ion batteries means the car uses just over 0.2 kilowatt-hours a mile. If the typical residential electric customer pays 15 cents a kilowatt-hour, then the Tesla costs just three cents a mile for "fuel." Compared with a gasoline-powered vehicle getting 30 miles a gallon, that implies a cost of 90 cents a "gallon," far less than the average price of gasoline. Thus, from the standpoint of just fuel costs, electric cars look great.

However, recharging one's electric car, or millions of electric cars, will require more than extension cords. One must consider the cost of the recharging

DOI 10.1002/gas / © 2009 Wiley Periodicals, Inc.

infrastructure that will be needed to support millions of electric cars. For example, in August 2009, German lawmakers voted to spend €500 million (~$700 million) to develop battery technology and build a network of charging stations across Germany, in the hope of having one million electric cars on the road by the year 2020.[4] Germany is far smaller than the United States, having the area of Illinois, Indiana, and Ohio combined, and a far greater population density. Thus, the cost for the United States to establish a similar nationwide recharging infrastructure is almost certain to be far higher. Moreover, Germany may find that, like Great Britain, it must provide additional subsidies—akin to the United States' ill-conceived "cash-for-clunkers" program—to encourage people to buy hybrids and electric vehicles. Great Britain, for example, plans to offers subsidies of up to £5,000 (~$8,000) per vehicle.[5] Huge subsidies such as these indicate that electric cars, despite their potentially high energy efficiency, are not capable of competing with internal combustion vehicles until the cars' major stumbling block—batteries—becomes much less costly.[6]

A couple of other challenges also loom for electric cars. First, there is the already-strained U.S. transmission infrastructure. As the fury over the proposed Sunrise Power Link in California has shown,[7] even new transmission capacity that is designed to bring new wind, solar, and geothermal resources to market faces significant hurdles. And rooftop solar photovoltaics, while potentially viable with gas-fired peaking generation in the sunny Southwest,[8] will be of little use for consumers who charge their electric cars overnight. Second, there is the issue of power outages, such as those that invariably occur with major storms every year, as well as the catastrophic regionwide outages that, thankfully, occur less often. Although gasoline pumps require electricity, too, faced with an extended outage, most people can still drive their cars somewhere where there is power . . . and more gas.

At the end of 2007, the United States had about 250 million cars and light trucks registered. Even assuming that a million electric cars a year will be purchased by consumers, electric cars are unlikely to have a noticeable environmental impact. Moreover, despite existing for over a century, engineers continue to wring greater efficiencies from internal combustion engines and will almost certainly continue to do so, further lessening their environmental impact.

Thus, by all means, let us continue research on electric cars and, especially, improved battery technologies, which could be used not only for powering electric cars, but also for broader electric storage alternatives. As for the huge subsidies that will be needed to develop a recharging infrastructure and to induce all but the wealthiest consumers to buy the current generation of electric cars, perhaps that money can be better used elsewhere, especially given the current state of the U.S. economy. In the meantime, check out the bumper cars.

NOTES

1. See "Chevy Volt FAQs," http://gm-volt.com/chevy-volt-faqs/.
2. Eberhard, M., & Tarpenning, M. (2006). The twenty-first century electric car, Tesla Motors, Inc. Although the report is no longer available from Tesla Motors, a copy may be obtained from: http://www.stanford.edu/group/greendorm/participate/cee124/TeslaReading.pdf.
3. By "well-to-wheel" efficiency, the authors include the efficiency of extracting and processing fuel used to generate electricity, the efficiency of charging batteries, and the efficiency of the electric motor converting stored electricity into moving the vehicle. Similarly, for an internal combustion engine, the well-to-wheel efficiency includes the energy in extracting and refining gasoline and diesel fuel, and the efficiency of the engine itself. The methodology is based on the assumed efficiency of fossil fuel extraction and transport, refining, and so forth. Tesla, for example, assumed that all of the electricity used to charge its vehicle's batteries would be generated by a state-of-the-art, natural gas–fired, combined-cycle plant with a fuel efficiency of 60 percent, which implies a heat rate of less than 6,000 Btu's a kilowatt-hour.
4. (2009, August 21). Germany seeks leadership in electric cars, EurActiv.com. Available at: http://www.euractiv.com/en/transport/germany-seeks-leadership-electric-cars/article-184704.
5. Ibid.
6. Of course, research and development continues for new battery technologies that will replace the current state-of-the-art lithium ion batteries. These include lithium iron phosphate, lithium cobalt oxide, and lithium nickel manganese oxide. Unfortunately, at this juncture, the manufacturing costs of these batteries are too high to be commercially viable. Moreover, another concern about rapid increases in the number of electric cars is the world supply of lithium itself. See, e.g., Motavalli, J. (2009, August 25). Will hybrid and electric car batteries force a global lithium shortage? thedailygreen.com, http://www.thedailygreen.com/living-green/blogs/cars-transportation/lithium-batteries-electric-cars-460209?src=rss. See also Tahil, W. (2006, December). The trouble with lithium: Implications of future PHEV production for lithium demand. Meridian International. Available at: http://www.evworld.com/library/lithium_shortage.pdf.
7. I wrote about the Sunrise Power Link in a previous column. See Lesser, J. A. (2009, February). Renewables, becoming cheaper, are suddenly passé. *Natural Gas & Electricity*, 25(7), 30–32.
8. See Powers, B. (2009, August). CEC cancels gas-fired peaker, suggesting rooftop photovoltaic equally cost-effective. *Natural Gas & Electricity*, 26(1), 8–13.

 / DOI 10.1002/gas