Electric Cars and the Fixed Cost Conundrum

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Later this month, Tesla Motors plans to launch its initial public offering and sell about 12% of the company for $200 million. If the IPO is successful, Tesla's stock will trade on the Nasdaq Stock Market (TSLA) and its initial market capitalization will be roughly $1.5 billion. Since the IPO has spawned a series of analytical articles from better writers, I'll avoid the temptation to analyze the deal terms and focus on product issues instead. Like their cars, Tesla's IPO will undoubtedly attract vanity investors, the philosophically committed and the mathematically challenged. The more cautious element will probably stay on the sidelines.

Calling Tesla an automaker is like calling France's *très chic* Louis Vuitton, Möet Hennesy Group (LVMHF.PK) a beverage company. Tesla started with a $100,000 roadster in 2008 and has sold 1,063 cars to date. They plan to add a $50,000 family sedan in 2012 and have booked approximately 2,200 reservations over the last year. As a reference point, the star-crossed Delorean Motor Company sold about 9,000 stainless steel gull-wing sports cars for $25,000 (roughly $60,000 current dollars) in 1981 and 1982.

There will always be a market for vanity goods, particularly in the green space where eco-bling is hard to find. Moving down market will be a major challenge, however, because real consumers live in a world of paychecks, stressed budgets and overwhelming economic uncertainty. So while the eco-bling crowd will pay any price for the right status symbol, real consumers tend to think the green in their wallets is more important than the green in their cocktail party conversation. When people seriously consider their transportation needs and put pencil to paper, EVs will always fall short of the mark.

In a conventional car with an internal combustion engine, or ICE, the fixed cost of the fuel tank is insignificant and the variable cost of gasoline is high. In an electric car the dynamic is reversed. The fixed cost of the battery pack is immense and the variable cost of electricity is low.

At current US gasoline prices of $3 a gallon, an ICE that gets 30 mpg has a fuel cost of $0.10 per mile. At EU prices of roughly $6 a gallon, the fuel cost is $0.20 per mile. These numbers will move up and down with fuel prices and are certain to increase over time as oil prices climb, but they won't change because of an individual owner's driving habits.

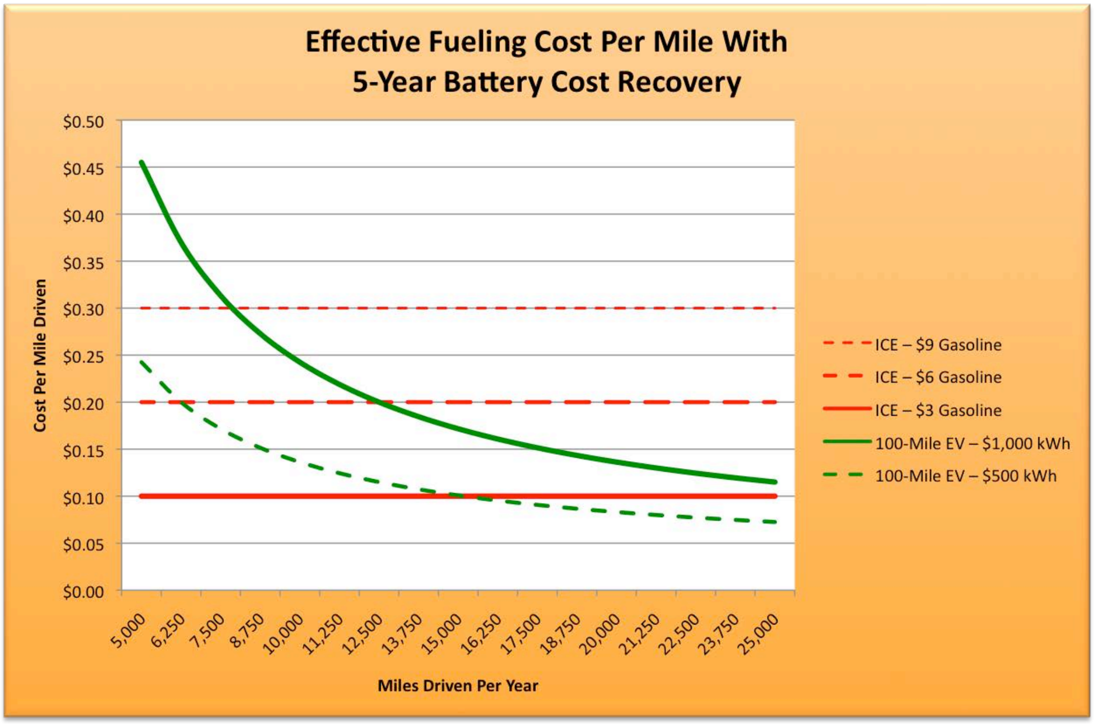
In an EV, the cost calculation is more complicated because there's a capital cost for the battery pack that must be recovered over a period of years and a variable cost for the electricity.

The appropriate cost recovery period is always a thorny issue with EV evangelists claiming that the goal should be breakeven over the life of the car and consumer surveys indicating that three years is the preferred breakeven period. Since no single number will please everyone, I'll default to IRS regulations that require businesses to depreciate cars and light trucks over a maximum of five years, and to new car loans, which commonly run for five years. Five years is probably not a perfect number, but it's more reasonable than either of the extremes.

The Wall Street Journal recently reported that Nissan's cost of making a 100-mile battery pack for the Leaf is about $18,000. By the time you add Nissan's normal 25% markup, the retail price should be about $24,000, or $1,000 per kWh. In spite of the facts, many readers believe $500 per kWh battery packs will be a reality within a couple years. Since I'm weary of arguing the reasonableness of those assumptions, I'll use both a $1,000 and a $500 per kWh pack price for this article.

I'll also use a number of other charitable assumptions including stable electric costs of $0.12 per kWh, no loss of battery capacity over time and no cycle-life limitations. While I cringe when reading discussions of second-life value because (a) nobody's demonstrated a 10-year first-life in the real world, and (b) I don't believe a buyer in 2020 will pay more than scrap value for a battery based on 2010 technology that's already logged a decade of service under unknown operating conditions, I'll assume a 15% second-life value to keep the peace.

The following graph presents alternative gas price scenarios of $3, $6 and $9 per gallon, and then overlays depreciation and charging cost curves for an EV with a 25 kWh battery pack priced at $1,000 and $500 per kWh. The solid bold lines show current gas and battery prices. The dashed lines show possible futures that are uncertain as to both timing and magnitude.



The most striking feature of this graph is the shape of the curves. Where prevailing mythology holds that EVs will be wonderful for urbanites with short commutes who don't need much range flexibility, the curves show that the best value will be derived by high-mileage drivers who presumably need far more range flexibility. The reason is simple. Spreading battery pack depreciation over 5,000 or even 10,000 miles a year results in a higher cost per mile than spreading that depreciation over 20,000 or 25,000 miles a year.

The bottom line is that EVs are only economical when you buy no more battery than you need and you use the battery pack heavily. That leads to a life and death struggle between range anxiety and affordability. When you factor in the other uncertainties, I believe plans to electrify passenger cars are doomed until gas prices increase substantially or battery costs fall substantially. While I think both are virtual certainties over the next decade, I don't believe either is likely in time to make Tesla a business success.