**Why Electric Cars Are Our Future**

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As the president of [Rochester Institute of Technology](http://www.rit.edu/), one of the nation's largest technical universities, I became interested in electric vehicles a few years ago because one of our major research centers was working on advanced battery and fuel cell research projects for major automotive companies. I was at first quite skeptical of electric vehicles because electricity must be generated from another source of energy, and that seemed to insert another inefficient step in the energy conversion process that would make such vehicles inherently less efficient than the current generation of gasoline-powered cars and trucks.

And I was not alone. In fact, first-generation electric vehicles such as the [Chevy Volt](http://www.chevrolet.com/volt-electric-car.html) and [Nissan Leaf](http://www.nissanusa.com/leaf-electric-car/index) have failed to gain significant market share in their first two years of availability, and many have concluded that they are not the future of personal transportation, either in the U.S. or elsewhere. Nevertheless, despite this widespread skepticism, other carmakers are rolling out new electric vehicles on a regular basis, including Ford, Tesla, Mitsubishi, Volvo, and BMW, among others.

Why? Because a careful analysis reveals that there are fundamental reasons that will drive manufacturers and consumers inevitably to electric vehicles in the years ahead, reasons that the public in general is unaware of. So here are a few of the reasons that I have learned that lead me to believe that within 50 years a majority of our cars will be equipped with electric drivetrains.

1. Electric vehicles are inherently more efficient at turning energy into miles driven. Most people do not realize this, but electric drivetrains are *much* more efficient than internal combustion engine (ICE) drivetrains (about 75% vs 25%, in fact). In fact, there is little hope that ICE drivetrains could ever compete with electric drivetrains in terms of efficiency. Why are ICE drivetrains so inefficient? There are many reasons, including heat losses and inertial losses of various kinds, but ICE's are also thermodynamic systems with efficiencies limited by the heat cycle they operate under. Engineers have done amazing work in improving the efficiency of gas-powered cars, but they are up against fundamental limits. In contrast, a Nissan Leaf or a Chevy Volt can go about 40 miles on 11 Kilowatt-hours (KWH) of electricity, the energy equivalent of a third of a gallon of gasoline. And since the national [average cost](http://www.teslamotors.com/financing) per KWH for electricity is only $0.11, this performance translates cost-wise into the equivalent of more than 120 miles per gallon.

2. Electric vehicles are greener than gasoline-powered cars. There are those who have tried to argue otherwise, but the most credible research has shown that most of a vehicle's carbon production comes during operation rather than production, and electric vehicles that consume only a third as much energy in operation are inherently greener no matter what fuel is used to generate the electricity they use. And electric vehicles powered by electricity from hydro, solar, wind, or nuclear sources produce no carbon in operation.

3. Electric vehicles can be powered by electricity produced from multiple energy sources. Electricity can come from wind, solar, hydro, nuclear, biofuel, and fossil fuel sources including natural gas, oil, and coal. All but one of those sources is produced almost entirely within the U.S. from local natural resources. So electric vehicles have the potential to support the U.S. economy and reduce our dependence on imported oil.

4. An efficient distribution network for electricity already exists in the U.S. This seems obvious, but compare this situation to that of other next-generation vehicle fuels such as natural gas and hydrogen. So in the future, electric drivetrains will probably dominate whatever the energy source. There's just no other way to get this kind of efficiency gain from an ICE drivetrain.

5. Range is less of an issue than most think. Most Americans drive [40 miles](http://www.bts.gov/programs/national_household_travel_survey/daily_travel.html) per day or less on the average, well within the range of almost all available electric cars, and future models will have 10 times this range or more. And for advanced designs like the Chevy Volt, driving distances are unlimited as long as one keeps filling the gas tank, because an onboard gasoline powered generator can provide electricity when the battery is depleted. In fact, statistics monitored daily at Voltstats.net on over 1700 Volts in operation indicate that the median Volt owner drives 80% of their miles using the stored energy in the battery, and consumes only one gallon of gas per 177 miles driven. So these drivers get the benefit of the greater efficiency of an electric vehicle and the unlimited range of a gasoline powered car.

6. Next generation technologies, such as fuel cell vehicles, will require electric drivetrains to propel the vehicles. Fuel cells can be efficient, portable sources of electricity running on a variety of fuels, but all cars and trucks using these energy sources will use electric drivetrains. In fact, there are new fuel cell technologies that use natural gas as a fuel to produce electricity, but in a chemical reaction rather than a combustion reaction. These advanced fuel cells produce sequesterable carbon that can be simply buried rather than being emitted into the atmosphere.