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Why Electric Cars Are Our Future

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Bill Destler, President, Rochester Institute of Technology

As the president of Rochester Institute of Technology, 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* (of cars) 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 and Nissan Leaf 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*** *(laminer)* **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** per KWH for electricity is only $0.11, this performance translates cost-wise* (judicious, relevant) 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.**

5. **Range*** (the distance covered, the scope) is less of an issue than most think. Most Americans drive **40 miles 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* (down, reduced). In fact, statistics monitored* (controled) daily at Voltstats.net on over 1700 Volts in operation indicate that the median Volt owner drives 80% of their miles using the stored* (added) energy in the battery, and consumes only one gallon* (US ~ 3,7 litres / GB ~ 4,5 litres) of gas per 177 miles driven. So these drivers get 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* (to make them function) 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* (that can be captured) Carbon that can be **simply buried rather than being emitted into the atmosphere**.

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.

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The debate : Can electric cars fix green credibility gap ?

http://www.huffingtonpost.com/michael-carmichael/plugin-2011-rising-tide-f_b_905791.html

Plug-In 2011: Rising Tide for Electric Cars

Posted: 07/21/11

Michael Carmichael, Visiting Scholar at Duke University

Concerned about global warming? Worried about environmental pollution?

Even in these days of global economic recession, billions of people still care deeply about the environment. Millions of people want to do something tangible -- right now -- to preserve the air we breathe, the water we drink, the food we eat, the land we cultivate and the natural world that restores and replenishes our fragile biosphere.

The electrification of the car and the transportation system provides an **intelligent technological response** to environmental degradation and global warming. Even in the midst of the worst recession **since the 1930s, the trend to electric cars and plug-in hybrids** (cars with both electric and small conventional motors) is growing stronger. While the market is not yet flooded* (invaded) with **plug-in electric cars**, manufacturers are accelerating their design, development and production. A new group of consumers, the Early Adopters, are plunking down (??) substantial sums to lead the green revolution by driving plug-in hybrids and electric cars. The cutting edge* (up-to-date) of the clean technology movement spearheads* (incentives) this burgeoning trend toward the plug-in electric car.

At the Raleigh Convention Center, Plug-In 2011 brought together hundreds of manufacturers, engineers, vendors, media and the general public to see many of the leading plug-in hybrids and pure electric cars. The day of plugging in your car instead of filling it was gasoline seems to be rapidly approaching. Organized by the Electric Power Research Institute, (EPRI) the annual Plug-In conference is one of the industry's major exhibitions that indicates the progress rapidly unfurling* (spreading) in the realm of the electric car.

The market leaders of plug-in hybrids, cars with both electric and conventional motors, are the highly successful Toyota Prius and its major US competitor, the Chevrolet Volt.

Both the Prius and the Volt combine electric motors with conventional engines to deliver seamless* (naturally) long-range capabilities for their owners. At forty miles on its electric motors alone, the Volt has a longer range than the Prius that has a pure electric range of thirteen miles. While both cars appear to be similar, they are actually quite different. The Prius uses a conventional engine to drive its front wheels just like the majority of cars in production today, but the Volt's wheels are constantly driven by electric motors. When the Volt's batteries need recharging, the conventional engine starts to charge the batteries while the car is on the go* (on the road) providing for journeys as long as 300 miles.

In the pure electric car category, the Mitsubishi I and the Nissan Leaf have more limited ranges of circa 60-100 miles before they need battery charges that can take four to eight hours. Ford exhibited their Focus Electric, but the packaging of the car on display at Plug-In

2011 made it clear that it was still a pre-production/prototype. Ford does produce a range of hybrids similar in engineering to the Toyota Prius, but none were on display at Plug-In 2011.

At Plug-In 2011, charging stations became the rage. The electric car industry is now experiencing a massive surge of growth in manufacturers of **plug-in charging stations**. Many manufacturers from GE to Siemans to Eaton exhibited convenient plug-in charging stations for the home, the office or the general public demonstrating just how swiftly* (quickly) the electric car is **moving toward majority acceptance.**

In fact, many attending Plug-In 2011 were impressed with the latest development of the plug-in concept: **hands free charging by wireless connection**. Plugless Power is **a start-up firm** that featured* (made) an exhibit with a Chevrolet Volt poised over* (ready for) a wireless charging station that permits drivers to park their cars over the charge point and walk away without dealing with heavy cables and multi-pronged plugs. One passerby muttered, "What will they think of next?"

The stand where the Chevrolet Volt was displayed was constantly **over-run with people attracted to the car** and its smart custom carport with solar panels in the roof and plug-in charging station. It struck me that manufacturers were **not only selling cars -- but also the charging stations to go with them**. This development seems like the beginning of the end for **the now outmoded gas station.**

Oddly* (strangely), two American manufacturers who have received **massive federal financial support**: Tesla and Fisker did not exhibit their wares* (goods to be sold) at Plug-In 2011. Tesla sent executives to serve as spokesmen, but Fisker was either totally absent or operating in full stealth* (furtive) mode. Tesla manufacturers a range of pure electric cars, while Fisker will manufacture luxurious plug-in hybrids led by the Fisker Karma.

The US market awareness of electric cars definitely seems to be crystallizing. While Tesla executives said that their initial high-end two-seat sports car sold, "**500-600 units per year**," their next model -- the Model S -- will be built in far higher quantities of **20,000 units beginning in early 2012.**

Both the pure electric Nissan Leaf and the hybrid Chevrolet Volt have sold **15-20,000 units** in their first year of commercial operations, and both manufacturers plan to expand production to more than **50,000 units in calendar 2012.**

Driving the electric car is a totally new automotive* (about cars) experience. Turn the key, push the button or move the lever into position and depress the accelerator to produce a silent and seamless surge of forward propulsion -- just like the Starship Enterprise. All the cars that I drove at Plug-In 2011 were **competent in urban traffic** around the Raleigh Convention Center. The Nissan Leaf is the clear leader in the pure electric category. The car is light, nimble* (agile) and fun to drive on city streets.

Mitsubishi and Nissan executives told me that they are developing more electric cars and plug-in hybrids. *I am looking forward to the plug-in electric equivalents* of the Mitsubishi Evo and the sumptuous Infiniti said to be rapidly approaching the horizon.

The Chevrolet Volt is a larger vehicle than the pure electrics with a longer range thanks to its on-board conventional power plant that serves as a generator to keep the batteries charged for 300-mile journeys.

Now in its fourteenth year of production, the Toyota Prius has sold amazingly well. Over one million Priuses have been sold globally with circa five hundred thousand in the US market alone.

Everywhere you turned at Plug-In 2011, someone was talking about the, "Ten Millionth Electric Car" -- a metaphor for the general acceptance of the electric car by the majority of consumers. Judging from the range of interest from the general public in Raleigh, North Carolina, the tide* (the trend) lifting the electric car is rolling in, and the surf is definitely rising.

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http://www.huffingtonpost.com/2012/11/19/professor-charles-perry-hybrid-converter_n_2158422.html

Eco Friendly Car / Green Technology

Professor Charles Perry Invents Kit To Turn Any Car Into A Hybrid

Posted: 11/19/2012

A team of students at Middle Tennessee State University have developed a kit that can turn any car into a fuel-efficient hybrid.

Dr. Charles Perry has lead the research since 2008, and his team used a 1994 Honda station wagon as their platform.
The retrofit is installed in the wheel well and only costs $3,000.

Plug-In Hybrid Retrofit Kit Could Greatly Improve Gas Millage For Only $3000

Posted: 08/02/2012

The bright minds of young college students and their mentors are at work again in the world of green technology. This time around the scene is Middle Tennessee State University (MTSU) and the item being developed is a plug-in hybrid retrofit kit said to work with almost any car.

Professor Charles Perry and a rotating group of MTSU students associated with the university's Department of Engineering Technology have, for the last few years, been developing a wheel hub, plug-in hybrid retrofit kit. This green car technology, currently in proof of concept stage, is now being shopped around to private investors for funding to demonstrate a manufacturing version of it.

Perry's wheel hub technology, according to MTSU, was recently outfitted on a 1994 Honda station wagon and helped this research vehicle to see a gas mileage increase anywhere from 50 to 100 percent. FuelEconomy.gov indicates, assuming this is the 1994 Honda Accord station wagon, that this car's original EPA rated combined MPG to be 23.

In a video which you can watch below, Perry describes how the technology works. In essence what is added to the two inner rear wheel brake structures are DC brushless motors. Tied to a lithium ion phosphate battery pack mounted in the rear of the vehicle, they supplement the traction provided by the car's regular gas engine, both reducing the amount of gas needed and also upping the MPG.

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The technology is designed for what would be around town usage. What's also pretty innovative here, according to Perry, is that the system is built with mostly off the shelf components. How they add the electric traction is what the secret sauce is.

"The whole point was to demonstrate the feasibility of adding the electrical motor to the rear wheel of the car without changing the brakes, bearings, suspension — anything mechanical," Perry said in a statement.

As for cost if it where to actually make it to market, it would likely price for around $3,000, which is considerably less then what you'd pay for buying a shiny new plug-in hybrid like the upcoming Ford Energi. Possible applications of this, besides in consumer vehicles, could also include companies with vehicle fleets.

And, as a side note, this isn't the only green tech innovation in the automotive space this university has been tinkering with. In January, for example, a converted Toyota Prius plug-in hybrid powered by solar, hydrogen and ethanol was set to make a cross country drive.

(Slideshow Available on Site)