



and

WisEnergyVASHON™

Take Action Tuesday

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DRIVE ELECTRIC

A GREAT IDEA REBORN

PRESENTED BY:

- Dave Barden - president
- Tag Gornall - vice president
- Joe Taskey - secretary
- Tony Furr - treasurer/web

TOPICS COVERED

- A new idea? Not really.
- Why go electric?
- Ten Myths of Electric Vehicles
- To convert or buy new?
- A Brief battery type comparison
- Resources and more Information

AN OLD IDEA REBORN

- EV's outnumbered gasoline vehicles until the advent of the electric starter
- There's nothing new under the sun...
- ...only refinement.



Porsche Semper Vivus - Series Hybrid 1900

AN OLD IDEA REBORN



Porsche 918 Spyder - Plug-in Hybrid 2010

WHY GO ELECTRIC?

- Reduce pollution and GHG
- Reduce maintenance
- Eliminate trips to the gas station
- Simplify your commute
- Quiet operation
- Reduce oil run-off from roadways
- Save money?
No. Not yet
- Save oil? Definitely!
Energy Independence
National Security
- Save electricity?

WHY GO ELECTRIC?

- Growing demand for the world's finite supply of petroleum. A US Military study (The Joint Operating Environment Report) warns that the surplus production capacity of the world's oil could disappear in two years. The price of oil has already topped \$100/barrel and by 2015 we could experience a 10million per day shortfall of oil.
- Of the country's light vehicle fleet (cars, SUVs, and pick-ups) 80% could be plugged in to charge overnight without impacting the current grid.

WHY GO ELECTRIC?

- An electric car even when charged from coal fired generators is still cleaner than a petrol burning car.
- In the future with a smart grid in place and V2G software (Vehicle to Grid) millions of plug-in vehicles plugged into the grid would be a win-win for consumer and utility by providing level loading charging at night and selling power back during peak hours. The consumer would buy low and sell high.

TEN MYTHS ABOUT EVS

THINK CEO **Richard Canny** is a motor industry veteran and a thought-leader in the EV space. He frequently contributes papers to academic institutions and media all over the world. Here are his top 10 EV myths, busted.



TEN MYTHS ABOUT EVS

I. “You are just moving the pollution out of the cities to the countryside”

Wrong: The electric motors of EVs are 3-5 times more efficient than fossil fuel vehicle engines. So although it's better to power EVs from renewable energy sources (which are growing quickly), the efficiency of EVs makes them far cleaner and lower carbon under any situation – even using coal-fired electricity. EV's will only get cleaner as we move to cleaner renewable energy sources.

TEN MYTHS ABOUT EVS

2. “Customers will never buy a car with less than 200 miles range”

Wrong: So-called "range anxiety" soon diminishes as people get used to driving EVs on a daily basis. Just like charging a cell phone overnight, plug in and in the morning it's ready to go. As more EVs hit the road, businesses and cities add charging points encouraging EV use. The availability of 15 minute fast charging helps cover those rare situations where EVs need to cover over 100 miles in a single day.

TEN MYTHS ABOUT EVS

3. “The battery won’t last”

Wrong: EV batteries are designed for 10 years and 100,000+ miles of lifetime range. THINK has cars on the road in Europe with batteries approaching 10 years and brings that experience to ensure modern Lithium ion batteries meet or exceed that target.

TEN MYTHS ABOUT EVS

4. “You’ll need to build a lot more power plants”

Wrong: Actually, there's enough off-peak electricity in the U.S. to power 79% of U.S. driving demand on a daily basis. As more EVs are deployed, it's important to ensure that the smart-charging (time-based charging management) and vehicle to grid connectivity is further developed at the same time. A connected network of thousands and then millions of micro energy storage devices – which EVs would become – potentially provides significant opportunities to improve the stability and performance of electric grids and help better balance peak demand.

TEN MYTHS ABOUT EVS

5. “We’re going to run out of Lithium – and isn’t it poisonous”

Wrong: Lithium carbonate today comes from dried salt lakes in South America (Chile, Argentina and Bolivia) and China. However there are also other huge sources for lithium, but these are more expensive to develop. Lithium can even be extracted from salt water and projects are under way to do this. The industry will not have a shortage of lithium for the next decade. It is also possible that new battery technologies will be based on other light metals like Zinc or Nickel. Lithium from used batteries will be recycled in dedicated recycling plants. The lithium batteries contains no poisonous heavy metals like lead in lead-acid batteries or cadmium in NiCd batteries. There are no other poisonous materials in the batteries, either.

TEN MYTHS ABOUT EVS

6. “The infrastructure has to come first”

Wrong: In our experience working with more than 20 cities across Europe, the best way to deploy EVs is to get cars on the road first, then add infrastructure. If there's no EVs to use those plugs and parking spots, people see it as wasteful. We think infrastructure is just a small part of good policy at a federal, regional and local level to support EV early adopters. Besides, the infrastructure does already exist in every home, business and facility that has an outlet!

TEN MYTHS ABOUT EVS

7. “They’re not safe”

Wrong: Highway-certified EVs like the THINK City meet all the same safety and crash test requirements as regular production cars – and some important extra ones. For example, new EU regulations require EVs to conform to the European CE electrical standards for plugged-in appliances, with the toughest electrical safety requirements. THINK City is the first vehicle to meet those requirements.

TEN MYTHS ABOUT EVS

8. “The technology is too complicated”

Wrong: A modern electric car has far fewer moving parts than a fossil fuel vehicle – about 5 main moving parts compared with up to 100s in an internal combustion engine. No oil changes, no filters – even brake pads last 2-3 times longer than in conventional cars because EVs like the THINK City use regenerative braking to recapture the energy that would otherwise be lost while braking. Your first trip to the dealership with an EV for scheduled maintenance is at 40,000 miles to check the brake pads.

TEN MYTHS ABOUT EVS

9. “Fast charging EV batteries in 15 minutes will wear them out quickly”

Wrong: Modern prismatic lithium batteries can be developed with fast-charging in mind – like the THINK EnerDel battery solution. The critical technology is in the cell design and managing battery temperature during charging. Limiting fast charging to the 0-80% range also protects battery life. THINK's view is the 95% or more of all EV miles will be driven on EVs charged in the overnight off-peak periods where electricity is cheaper and freely available. Fast charging locations provide reassurance and peace of mind for those occasional days where 100+ miles are required.

TEN MYTHS ABOUT EVS

10. “Plug in hybrids represent the best solution”

Wrong: Carrying around the extra weight and cost of two powertrains makes little sense. A "hybrid garage" (where one car is an EV and the other a high efficiency ICE like a diesel) is probably more economically efficient for most families. Pure EVs represent the end game of where vehicle electrification will take us – and this will occur in some vehicle usage segments faster than others. For a small urban commuter car an EV drive with relatively small battery size and low weight makes the best sense. As plug-in hybrids get bigger and heavier, they need more batteries and stronger ICE generators or engines – it becomes a "vicious circle" of more cost and more weight to achieve acceptable range and performance in both modes.

CONVERT OR BUY

- **Convert It!**

- Conversion removes the I.C.E. from the roads.
- Smaller carbon footprint than new-car manufacturing.
- Active enthusiast community allows meeting new, interesting, creative people.
- Gain intimate knowledge of your vehicle.
- Components can cost less than a new car... but not by much.
- Save a classic car that otherwise might otherwise never drive again.
- Provide self-satisfaction and keeps you out of trouble at the same time.

CONVERT OR BUY

- **Buy It!**

- Manufacturers provide complete warranties.
- Vehicle are rigorously tested by Safety Agencies.
- Many skilled engineers involved in designing factory vehicles.
- No time commitment.
- No safety concerns about designing and fabricating your own high voltage drive system...
- Cheaper. You'll never beat mass-production factory assembly at cost.

BATTERY TYPE COMPARISON



Lithium-Ion

VS.



Lead-Acid

BATTERY TYPE COMPARISON

Batteries in same vehicle

	Lead Acid Nissan	Li-Ion Nissan	Comments
Discrete Modules	20	48	Lead 3cells/module Li-Ion 1 cell/module
Cells	60	48	
Cost	\$3000	\$9600	BMS not included
Weight	22lbs/cell	12.4lbs/cell	
Total pack wt	1320lbs	595lbs	Less than 1/3 the weight
Voltage/Cell	2.25	3.2	nominal
AH	245	160	
KWH, total	29.4	24.57	
KWH useable	15 (50%)	22.1 (90%)	50% vs 90%
Total Cycles	400	2000	0% use left in Pb - 80% use left in Li-Ion
Kwh throughput	6000 kwh	44,226 kwh	Full charge Cycles x kwh
Watt-hrs/mile	400	300	Influenced by weight
Range (mi/chrq)	37.5	73	
Total miles	15,000	147,420	Over life of pack
Cost/KWH TP	\$0.50	\$0.22	TP = through put
Cost/mile	\$0.20	\$0.065	Capital cost of pack

FURTHER ADVANTAGES OF LI-ION OVER LEAD

- reduced, near zero, maintenance
- reduced terminal corrosion
- no risk of explosion from off-gassing hydrogen
- higher energy density, smaller space required
- constantly improving chemistry for replacement pack
- lighter weight improves efficiency
- lighter weight reduces wear and tear on tires, breaks, etc.
- higher capacity at end of EV life
- no sulfuric acid holes in clothing

EV MAINTENANCE ADVANTAGES ACCORDING TO **FORD**



2013 Ford Focus Electric (est. \$18k - \$23k)

EV MAINTENANCE

ADVANTAGES ACCORDING TO **FORD**

- Typical life expectancy of a vehicle on the road today is roughly 150,000 miles over 10 years.
- Over that lifetime Ford notes the difference in maintenance costs between its standard and electric Focuses will come in around \$1200, eliminating parts and service cost for oil changes, air filters, transmission and cooling systems maintenance, and spark plugs.
- EV Focus eliminates more than two dozen mechanical components that would normally require attention during the life of the vehicle.
- Fewer inconvenient scheduled services and fewer wear items like a new muffler, O2 sensors, or fuel/oil/air filters.

EV MAINTENANCE

ADVANTAGES ACCORDING TO **FORD**

- “When you have moving parts, such as the gears in a transmission or the pistons in an engine, you have maintenance,” -Sherif Marakby (Ford’s director of electrification)
- “With an electric drive, there are very few moving parts. And in the Focus Electric, the only moving parts are the motor and the wheels.” -Sherif Marakby
- EVs aren’t completely free of maintenance, though. Owners will likely want to check their windshield washer fluid level and should make sure to monitor tire pressures. Long-term wear items that are, unfortunately, unavoidable include brake pads, tires, and dampers.
- Costs less than \$2 per 100-mile charge.

FACTORY EV COMPONENTS



All-New Ford Focus Electric

The all-new Ford Focus Electric, which debuts in the U.S. in 2011 and in Europe in 2012, is one of five new hybrid and electric vehicles Ford will deliver over the next three years. Below are the components that will make up the zero-emissions, gas-free Focus Electric.

1 MOTOR CONTROLLER

Monitors the motor's position, speed, power consumption and temperature. It uses these inputs along with driver throttle input to enable an inverter to convert DC voltage from the battery into three precisely timed signals that drive the motor.

2 HIGH-VOLTAGE ELECTRIC HVAC COMPRESSOR

Is specifically designed for electric vehicle applications, drawing energy directly from the main battery pack.

3 ELECTRIC WATER PUMPS

Circulates coolant for the traction motor, inverters, battery and heater.

4 TRACTION MOTOR

Performs the conversion between electrical and mechanical power. Electric motors have efficiencies three times higher than that of a standard gasoline engine, minimizing energy loss and heat generation.

5 ELECTRIC POWER STEERING

Is tuned to deliver the same driving dynamics as the gasoline-powered Focus.

6 TRANSMISSION

Has the identical role as in a gasoline vehicle; however, it has different design considerations due to the higher rpm range available from the electric motor and increased emphasis on efficient and silent operation. The transmission is a single-speed unit.

7 MODULAR POWERTRAIN CRADLE

Enables the entire propulsion system to be inserted as one piece within the engine compartment and isolated from the vehicle body.

8 ELECTRIC VACUUM PUMP

Supplies vacuum to the brake system for power assist.

9 HIGH-VOLTAGE ELECTRIC COOLANT HEATER AND CONTROLLER

Specifically designed for electric vehicle applications, using energy-efficient technology to heat and circulate coolant. Heat also may be circulated to the battery to optimize performance.

10 VEHICLE CONTROL UNIT

Monitors and controls each vehicle system, and manages energy and mechanical power being delivered to the wheels to maximize range.

11 BATTERY PACK

Uses total of 23 kWh of power and liquid coolant for thermal management, and includes an electronic monitoring system that manages temperature and state of charge.

12 AC CHARGER

Converts the AC electricity from the power grid to DC voltage required by the battery, enabling full state of charge in a matter of hours when plugged in. The vehicle will accommodate both 120V and 240V power sources.

13 DC-DC CONVERTER

Allows the vehicle's main battery pack to charge the on-board 12V battery to power various vehicle accessories (headlights, etc.).



Image based on prototype, not production vehicle

FOCUS ELECTRIC FACTS

Final assembly location: Michigan Assembly Plant

Battery cell manufacturer: Compact Power Inc., Holland, Mich.

Battery system: Lithium-ion, liquid-cooled/heated, recyclable

Total battery capacity: 23kwh

Estimated cost to fully charge vehicle: \$2 to \$3 (based on nationwide average cost of \$0.10 per kWh)

Cost of 240v charging station: TBD

Tire size: 17-inch

0-60 acceleration: TBD, similar to gas-powered base model

Braking distance: TBD, similar to gas-powered base model

Passenger room and cargo room: TBD

Price range: TBD

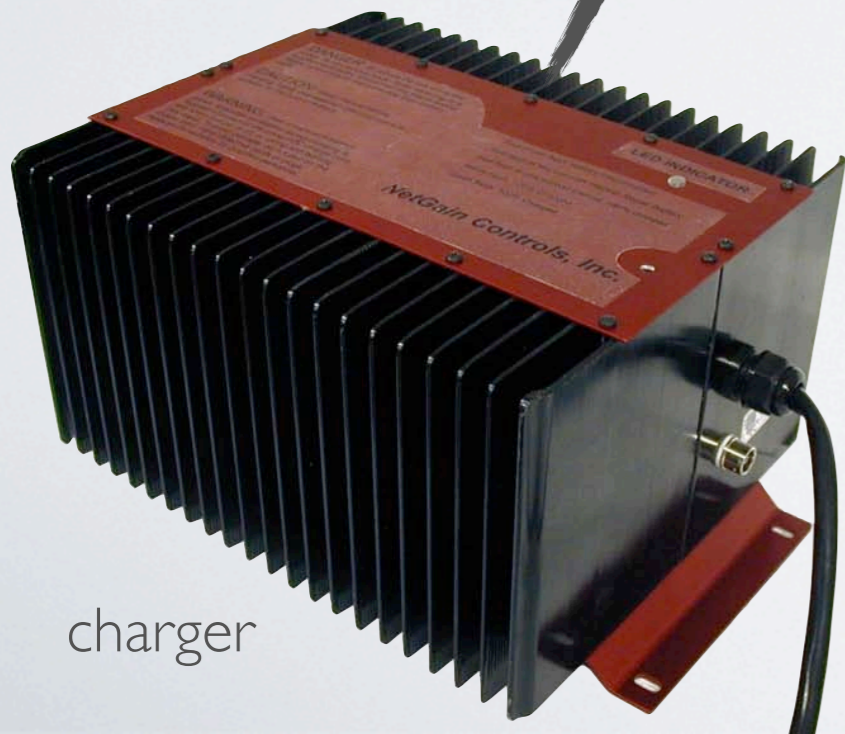
DIY EV COMPONENTS



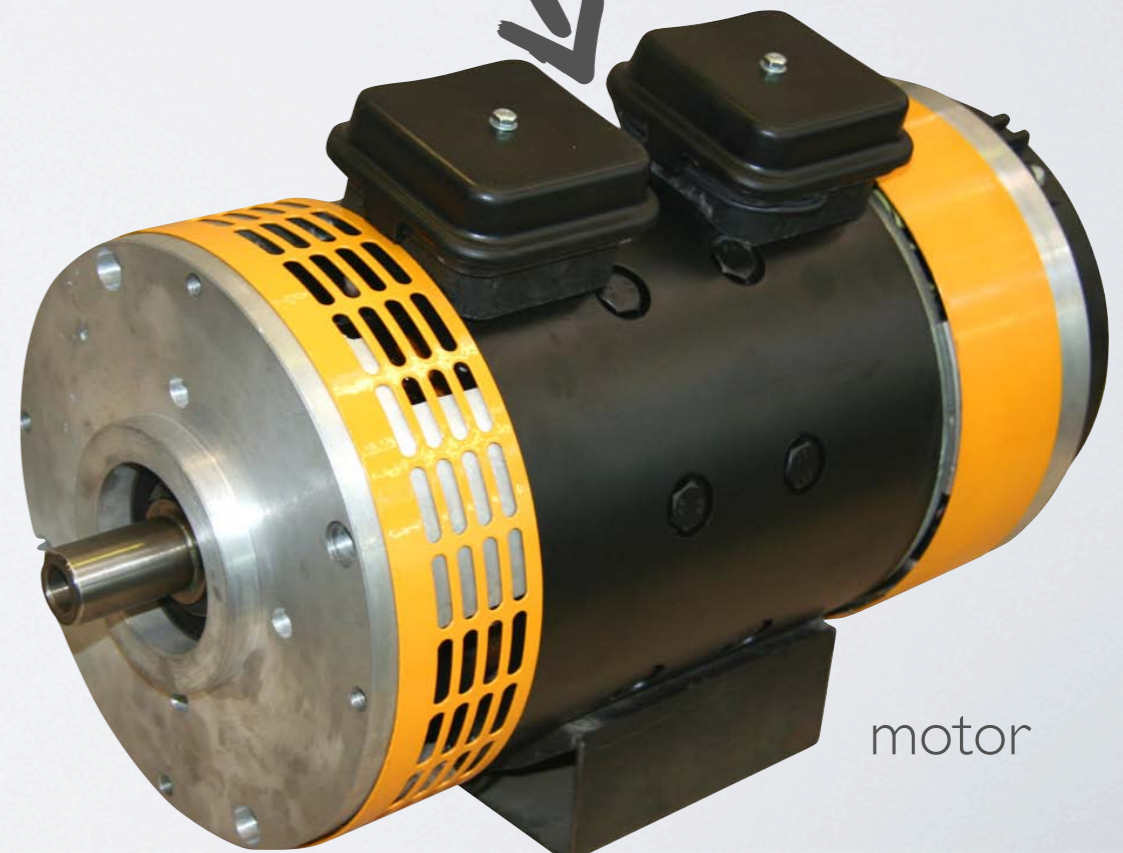
traction pack



controller



charger



motor

NINE THINGS TO KNOW BEFORE BUYING AN EV

THEDAILYGREEN.COM

1. There Are Two Kinds of Electric Cars:
all-electric cars (EV) and plug-in hybrids (PHEV).

All-electric cars are solely powered by large batteries charged from the grid; when they run out of juice they can't move anymore [i.e. Nissan Leaf]

Plug-in hybrids have a shorter all-electric driving range using a smaller battery pack. After the battery pack is drained, they can either revert to being a normal fuel-fed hybrid, or they can use fuel to run a generator and recharge the batteries on the fly [i.e. Chevy Volt]

NINE THINGS TO KNOW BEFORE BUYING AN EV

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2. There Are Lucrative Federal and State Incentives to Buy Now.

Though the sticker prices for electric cars tend to be higher, federal and state governments have offered some serious incentives to buyers.

All U.S. taxpayers are eligible for a \$7,500 federal tax credit — if you have a one-year tax liability that exceeds that amount or you can lease the car from the manufacturer using the entire \$7,500 to pay down the lease immediately. Nissan and Chevy both have relatively affordable \$350 per month lease deals. The federal tax credit remains in effect for a given manufacturer until it sells more than 200,000 EVs.

Many states have their own incentives. California has a \$5,000 credit, Oregon has a \$1,500 one and the State of Washington waves its usual 6.5% sales tax charge. Some states also provide special parking and carpool privileges.

NINE THINGS TO KNOW BEFORE BUYING AN EV

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3. There Are Three Ways to Charge Them

Manufacturers in the U.S. can provide three "levels" of charging support for their vehicles.

Level 1 charging happens off of a standard three-prong household outlet. Every electric car comes with a cable that supports this type of charging, but it's slow — only adding about 5 miles of driving range for every hour of charging.

Level 2 charging uses special wall- or pedestal-mounted equipment unique to electric cars. Similar to a standard household dryer outlet, Level 2 charging is faster, adding about 15-30 miles of driving range per hour of charging, depending on the vehicle.

DC fast charging uses industrially-rated, gas pump-sized stations to dump electrons into your car's battery like a firehose. Only some cars support this type of charging, and usually the option costs extra. DC fast charging can add about 80 miles of driving range in a half hour.

NINE THINGS TO KNOW BEFORE BUYING AN EV

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4. It's Easy To Install a Home Charging Station, But It Costs Extra (Don't Worry, There Are Incentives)

Although every electric car comes with support for Level 1 charging, most people will want to install their own Level 2 charging station at home so that they can fill up their car's battery overnight — but it's by no means a free endeavor.

Level 2 home charging stations will cost between \$1,500 and \$2,500 to install, depending on the manufacturer and the equipment chosen. If you have special circumstances, such as a long wiring run, the costs can be considerably more. Sounds like a lot, no? The federal government, again, has a pocketful of cash it's ready to dole out, providing a tax credit of 30% of the cost of purchase and installation, up to \$1,000.

NINE THINGS TO KNOW BEFORE BUYING AN EV

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5. Public Charging Stations Are Coming, But The Rollout Will Be Slow and Sporadic

If you're like 80% of Americans, a home charging station is good enough for most of your driving needs. However, public charging providing you the ability to extend your electric car's all-electric range substantially.

There is currently a huge push from the EV Project — a \$250 million joint federal-private program — to install nearly 15,000 public Level 2 charging stations in a handful of early deployment regions around the United States over the course of 2011. This includes areas of Oregon, California, Washington, Tennessee, Texas, Arizona and Washington, D.C. These regions you will have a relatively robust public charging infrastructure quickly.

NINE THINGS TO KNOW BEFORE BUYING AN EV

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6. All-Electric Cars Are for Daily Driving, Not Cross-Country Road Trips

If you buy a plug-in hybrid, you can ignore this because they are capable of taking long-distance trips. However, most of the initial crop of all-electric cars have a range of around 100 miles on a full charge. Some have up to 200 miles, but are quite a bit more expensive. If you have public charging where you live, or you return home and plug-in during the day, you can drive your EV more than 100 miles. Even so, you're not going to be taking them on long trips. Most people who buy an all-electric car will have a second car available for the occasional long trip.

NINE THINGS TO KNOW BEFORE BUYING AN EV

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7. You'll Spend Less On Maintenance, But...

All-electric cars ditch the thousands of moving parts of a combustion engine and associated transmission for a handful of moving parts in an electric motor. They also have no emissions equipment resulting in fewer maintenance costs — no more oil or transmission fluid changes or catastrophic mechanical repairs. And, although plug-in hybrids still have an engine and emissions equipment, they will need far less maintenance than a typical gasoline engine because they will operate as an electric car much of the time.

Even so, EVs have large, expensive batteries that may need to be replaced after 7-10 years. However, in this first crop of electric cars the manufacturers have provided long battery warranties. In the case of both the Nissan LEAF and the Chevy Volt, that warranty is 8 years or 100,000 miles. By then, the price of batteries will likely come down substantially.

NINE THINGS TO KNOW BEFORE BUYING AN EV

THEDAILYGREEN.COM

8. All-Electric Cars May Not Have Tailpipe Emissions, But They Aren't Emissions Free

"Zero emissions" is not entirely true. About half of the U.S.'s electricity comes from coal-fired power plants, so many drivers are filling up on a dirty fossil fuel. Depending on where you live, this ratio might be more or less — and in places like California or Washington, a large proportion of that electricity comes from natural gas and renewable energy sources, like wind, solar or hydro power.

According to Electric Power Research Institute, even if your electric car is powered by 50% coal it will pollute less than the average diesel or gas car.

NINE THINGS TO KNOW BEFORE BUYING AN EV

THEDAILYGREEN.COM

9. Electric Cars Are Really Cheap to Operate, But Expect Higher Utility Bills

Given the average cost of electricity in the United States of about 12 cents per kilowatt hour, you can drive an EV for around three to four cents per mile. At \$3.20 per gallon, a 30 mpg gas car costs about eleven cents per mile to drive — plus regular and unexpected maintenance that you likely won't have in an EV. If you drive your EV 50 miles every day, you can expect your electricity bill to increase by half.

RESOURCES

- <http://evalbum.com>
- <http://www.seattleeva.org>
- <http://www.vashoneva.org>
- <http://evdl.org>
- <http://www.pluginamerica.org>
- <http://setamericafree.org>
- <http://hybridconsortium.org>
- <http://nedra.com>
- <http://www.plasmaboyracing.com>
- <http://www.eaaev.org>
- <http://www.betterplace.com>
- <http://green.autoblog.com>

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