

Electric Vehicle Basics

Read this first if you are new to EVs like the Chevy Volt

What is an electric vehicle? An electric vehicle (EV) provides motion via an electric motor and an electric energy storage system like a battery, instead of an internal combustion engine and a gas tank.

Why now? Electric motors have been around for over a century, and indeed there were even some EVs a century ago. But now they can provide useful performance and reasonable convenience, because battery technologies have made huge improvements in recent years, driven by massive growth in portable consumer electronics (cell phones, cameras, laptops) -- big increases in battery power and capacity, with decreases in cost.

Electric motors are fundamentally more efficient. Electric motors are FAR more efficient at converting energy into motion than internal combustion engines (ICE) -- 95% thermodynamic efficiency compared to 15-20% for an ICE.

Electric motors have full torque at zero RPM. They don't have a *minimum* operating RPM (idle RPM) like ICE engines do. This ultimately means you don't need clutches or multiple gears -- no shifting! So there are less parasitic transmission losses, and there is no such thing as "idling".

Even with a dirty coal power plant, an EV is cleaner than an ICE. The most common misconception about EVs is that you are just transferring the point of emissions. But power plants are more efficient at converting fuel to power than a regular car's ICE could ever be -- 33-50% compared to 15-20%. The transmission efficiency of the electric grid is also around 95%. Look into "well to wheels efficiency" analyses.

Battery technology:

- Thermal Management System (TMS) matters!
- Tesla used off the shelf 18650 cells, rigorous TMS
- big carmakers using prismatic (flat) cells, rigorous TMS (mostly), now achieving decade-plus lifetimes

Check out this URL, or Google for "top 11 electric car myths".

<http://www.plugincars.com/top-11-electric-car-myths-86131.html>



Public charging infrastructure: (like gas stations, but for EVs) Started taking off in 2011; 3000+ stations nationwide, with dozens more every week. All use the same J1772 connector, shown above. DC Fast Charging coming too. Note that public charging is largely irrelevant to the Chevy Volt.

How to calculate efficiency? Miles per gallon when no gallons? This is a complicated question, that requires that you look at how you drive your car -- how many miles per day on *average* days?

EV creates choice in how you power your car. Right now you have no choice, it's oil or nothing. Electric power is cleaner, domestically produced, much cheaper than oil and will get cheaper and cleaner as more solar/wind capacity comes online.

The Volt is a transitional vehicle between an oil-based transportation sector and an electricity-based sector. By disconnecting the ICE from the wheels and having it serve as just a generator, future cars may actually swap in other fuel-burning generators instead. Diesel, turbines, fuel cells ...

We are witnessing the beginning of another technology revolution. This is like the 1993-1995 Internet wave -- this is disruptive technology. Think about the birth of digital photography in the late 90's. Who still uses a film camera? CRT vs. LCD ...

Status of specific models:

Chevrolet Volt: pure electric for first 35 miles, then unlimited range via gas engine / generator, available now. See reverse side for more Volt info.

Nissan Leaf: pure electric, 100 miles range, simpler battery system, cheaper, available now

Ford Focus EV: pure electric, 100 miles range, advanced battery system, available late 2012

Chevrolet Volt

Items of interest for EV enthusiasts (i.e. those who already understand EVs in general)

35 miles nominal “All Electric Range” (AER); pure electric vehicle with full performance for first 35 miles. No gas is used for the first 35 miles every day – including at highway speeds.

Transition to gas engine generator is barely noticeable at first, although you can certainly hear it in stop and go traffic; pure EV experience is definitely more fun; gets 37 MPG in gas mode; 300+ mile range between gas station stops.

120V charge takes 10 hours using portable EVSE cordset that comes with car; car is compatible with any J1772 EVSE and can charge as fast as 3.5 hours at 240V (limited by Volt onboard 3.3 kW rectifier)

120V EVSE offers 8 Amp mode for circuits that are already carrying some load; 14 hour charge.

0-60 in 8.5 secs, feels faster due to early torque; top speed limited to 101 MPH; agile due to low CG

Three techniques to deal with stale gas:
- premium gas required; higher octane goes stale slower (also better gas engine efficiency)
- fuel tank is pressurized
- after one year on same tank of gas, engine will run to burn up remaining gas, forcing you to replace it

Battery is Lithium Ion, 288 prismatic cells, 400 pound package in center of car; 16 kWh capacity of which 10.5 kWh is used (65%), to improve battery life; electrodes are manganese spinel, for durability.

Battery thermal management system (TMS) is quite complex, with both heating and cooling capability, multiple temperature thresholds. Design temperature range is -13 °F to 122 °F; beyond those extremes, the TMS will pull the temperature in before operating. Note these are battery pack core temps, not ambient temps.

Battery has 8 year / 100,000 miles warranty; GM has said they engineered it to last 15 years.



Cold weather observations: AER is affected a bit – about 25 miles daily range in winter. Cabin heating is somewhat anemic. Heated car seats are fantastic. Remote start (cabin preheating) is addictive.

L mode on shifter adds more regen braking when lifting off accelerator – great for stop and go traffic.

Drive mode = Sport : changes “accelerator pedal mapping”; it just changes how the “sensitive” the pedal is, does not affect total power available.

Drive mode = Mountain : intended for use on very long uphill grades (like 20 mile climbs!) when in gas mode; increases low SOC threshold from 20% to 40% (est.); commanded *before* you get to the climb, so that when you get there you have the battery to dip into. Volt drivers are “gaming Mountain mode” to force gas engine on early to preserve some battery at the end of a long drive to a demo event. That way we still have charge to demo the Volt’s pure EV mode!

Options: OnStar includes smartphone remote monitoring and control; most buyers are opting for the leather seats which include seat heaters; nice stereo available, useful for such a quiet car!

Built in Detroit (Hamtramck plant); battery cells supplied by LG Chem (Michigan factory soon), packs assembled in USA; gas engine built in Austria (Michigan soon). Detroit factory can produce high volumes, 7,000 units on road by end of 2011, can ramp up to 60,000 units in 2012.

Local rollout: deliveries to Georgia started in early Sept 2011, lots of very happy owners all over the state, see www.VoltStats.net for cool usage data!

Launches in Europe as Opel Ampera in mid 2012.

Chris Campbell

www.FirstVoltInGeorgia.com

(I don’t work for GM – I’m just an EVangelist!)