



TECHNOLOGY - INFRASTRUCTURE

November 30, 2010

Kristin Zimmerman

Manager, Advanced Technology Infrastructure – Chevy Volt Program
General Motors



Technology Highlights

- **How it Works**

- Volt is an electric vehicle with extended-range capability, powered by a propulsion system that primarily uses electricity
- When the Volt battery runs out of charge, it uses a small amount of gas in its onboard generator to create enough electricity to keep going for hundreds of miles



- **Battery Mode (25-50 miles)**

- In Battery mode, Volt will not use gasoline or produce tailpipe emissions
- During this primary mode, Volt is powered by electrical energy stored in its lithium-ion battery.

- **Extended-Range Mode (~300 miles)**

- Once the initial electric charge is depleted, the range-extending gas engine will turn on to seamlessly generate enough energy to continue to power the car for hundreds additional miles
- The engine-generator eliminates “range anxiety,” giving peace of mind that the driver will not be stranded by a depleted battery



Technology Highlights (cond.)

- **Battery (16kwh)**

- *The Volt is powered by a lithium-ion battery pack; the Li-ion battery holds its charge efficiently and has no memory effect (it doesn't have to be run down completely before recharging)*

- **Charging (level 1 or 2)**

- *Volt can be plugged into a standard 120-volt household outlet or a 240-volt charging station can be installed*
- *Most efficient when plugged in regularly, but will operate fine without being plugged in for days, weeks or even months*

- **Performance (no compromise)**

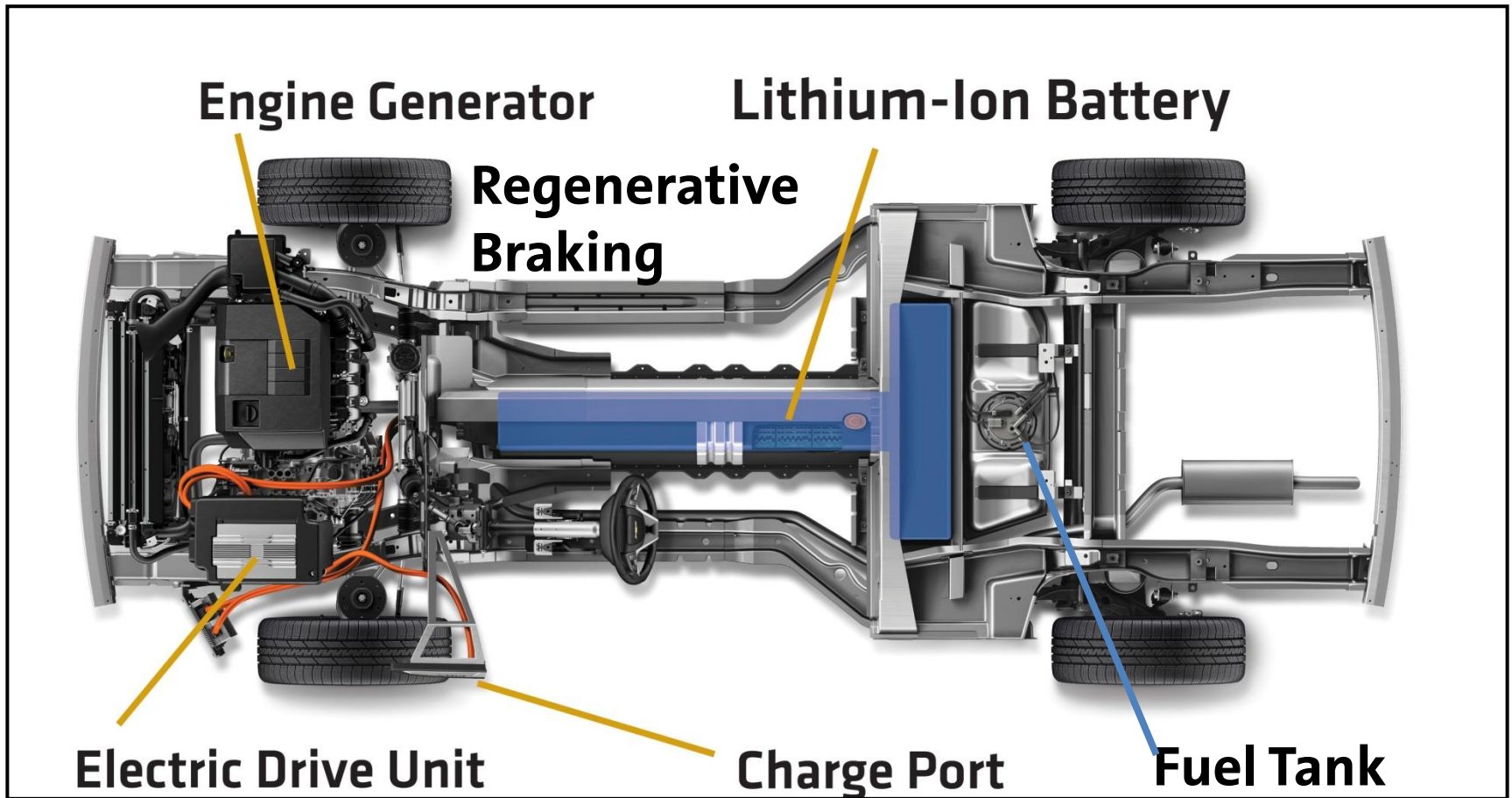
- *Functional, efficient and fun to drive with quick acceleration*
- *0-60 in under 9 seconds*
- *Delivers 273 lb-ft of torque, the equivalent of 150 hp and a top speed of 100 mph*



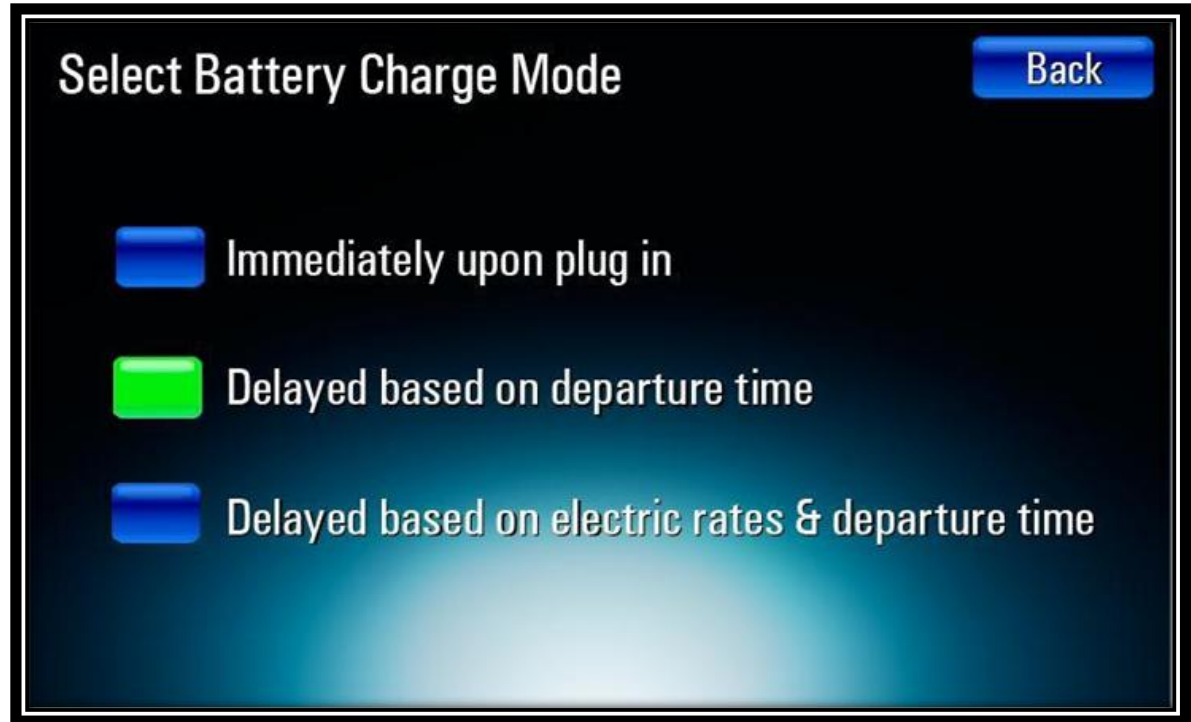


Description and Operation

Propulsion In Vehicle



Smart Charging Functionality



Volt charging options move customers away from peak charging, result in a “stagger” that prevents a new evening peak, and includes manual programmable features that anticipate the more automatic "smart grid" features to come.

How Does a Chevrolet Volt Compare?

Annual Energy Usage – Electrical Appliances

Home Heating System 3,524 kWh

Central Air Conditioning 2,796 kWh

Refrigerator/Freezer 2,610 kWh

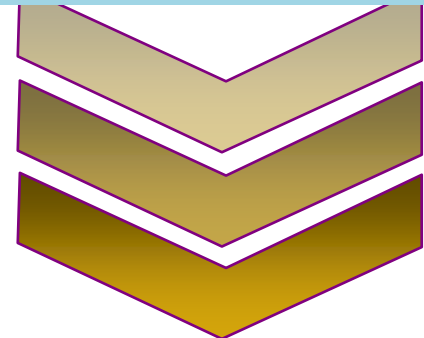
Water Heater 2,552 kWh

 **2,520 kWh**

Clothes Dryer 1,079 kWh

Lighting 940 kWh

1 Computer & monitor operating ALL day




1 **CHEVY**

for annual energy usage

MPGe: The EPA Sticker

EPA Fuel Economy and Environmental Comparisons

 **Dual Fuel Vehicle:
Electricity-Gasoline**

Charge Time



4 hours
@ 240V

All Electric

When battery is fully charged, first **35** miles only.

 **93** **MPG equivalent**
36 kWh per 100 miles
combined city/hwy

\$601 cost per year if always run in All Electric

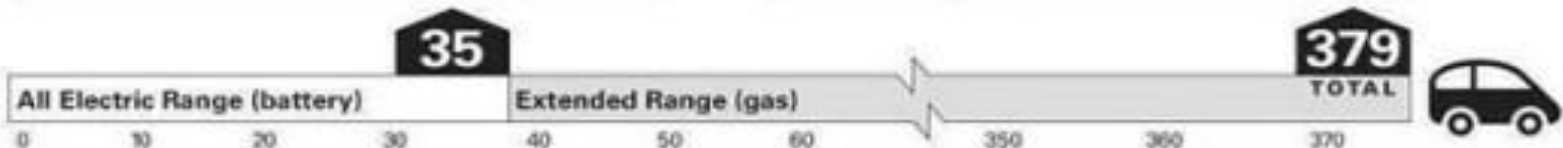
Gas Only

When electricity is used up, runs on gas for another **344** miles.

 **37** **MPG**
2.7 gallons per 100 miles
combined city/hwy

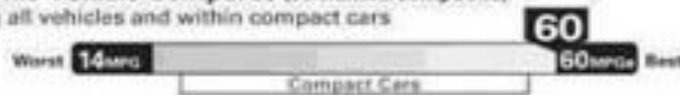
\$1,302 cost per year if always run in Gas Only mode

Range (Miles)



How This Vehicle Compares (combined composite)

Among all vehicles and within compact cars



Greenhouse Gases (CO₂ g/mile, tailpipe only)



Other Air Pollutants



Examples: Charging Routines

Miles driven between full charge	Fuel Economy MPG	Electricity Consumed	Electricity + Fuel Energy Cost
30	NA	10.9 kWh	4c / mi
45	168	12.9 kWh	5c / mi
60	89	12.9 kWh	6c / mi
75	69	12.9 kWh	7c / mi
Never Charge	37 35 city / 40 hwy	N/A	9c / mi

Your actual mileage and costs will vary with fuel cost, temperature, driving conditions, and how you drive and maintain your vehicle. Cost estimates are based on 15,000 miles per year at \$3.20 per gallon and 11 cents per kW-hr. MPG equivalent: 33.7 kW-hrs = 1 gallon gasoline energy.

Visit www.fueleconomy.gov to download the Fuel Economy Guide (also available at dealers).



Chevrolet Volt's Value Proposition

Battery Size/Warranty/Lifetime:

- **16kwh (only using 10kwh)**
- **8 year/100,000 mile warranty**
- **Secondary battery use: Energy Storage Focused (10 + years)**
 - **CES, Distributed Renewable Storage, V2G – Frequency Modulation**

Fuel Costs: See EPA Sticker

Fleet Advantages:

- **Cost savings: Fuel, M&R, Insurance??**
- **Displace petroleum & reduce CO2 (sustainability goals)**

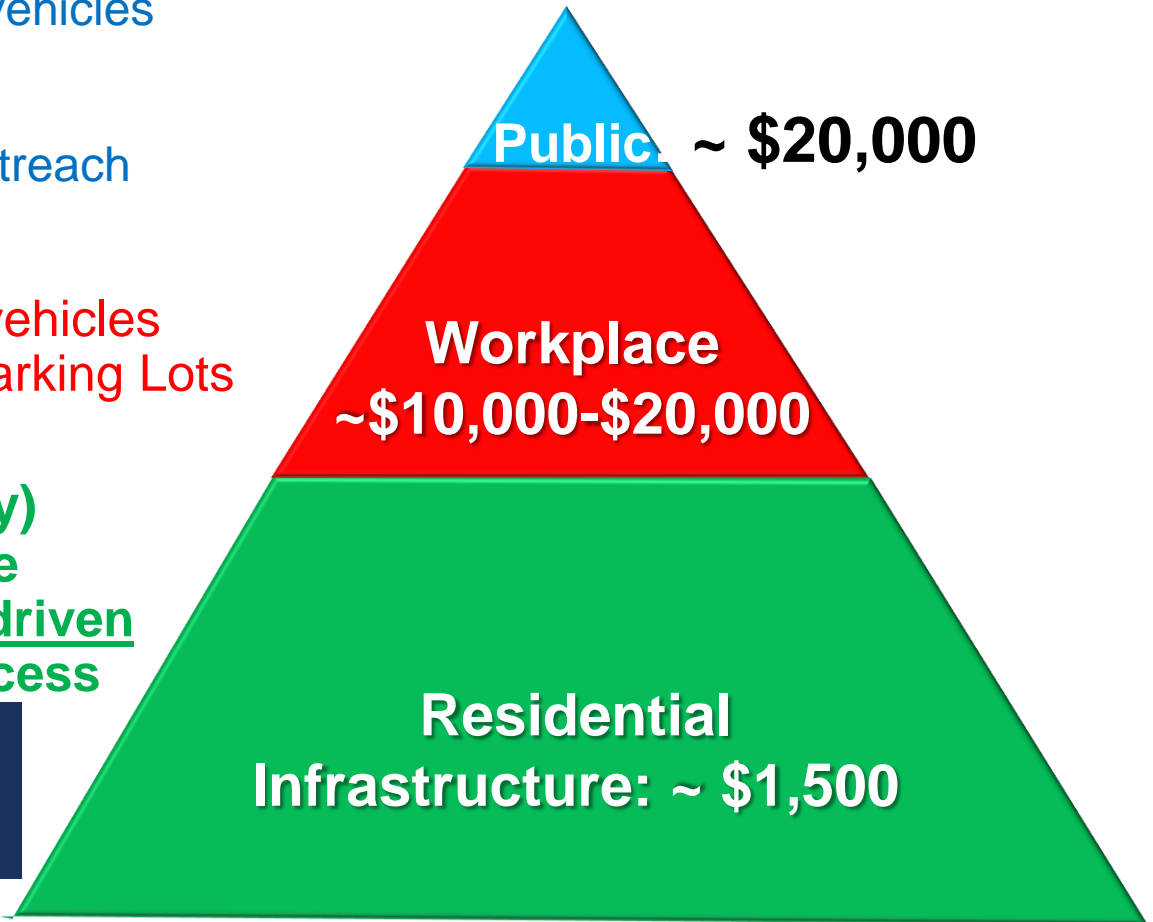
EV Readiness - Infrastructure

Residential/Workplace/Public Charging and Customer Outreach



Charging Infrastructure

- Public
 - 1 station per 1,000 plus vehicles
 - High Visibility
 - Commercial/Retail
 - Public Education and Outreach
- **Workplace**
 - 1 station per 10-1,000 vehicles
 - Corporate, Municipal Parking Lots
- **Residential (majority)**
 - 1 station per residence
 - Satisfying consumer-driven home installation process
 - Permits, electricians, inspections, meters, rates (22-38 days??)



Infrastructure Goal - Ensure a Positive Customer Experience

Residential: Home Charging Installations

- Utilities to provide favorable EV/TOU rates
- **Utility support of EVSE install Demo programs**
- Utility website to inform customer of best rates for their household
- Utilities 1-800 call center for customer care
- **Streamline the EVSE installation process by: (cost saving to customer)**
 - **NEC code modifications**
 - **Sponsor workshops to education of electricians and inspectors**
- Leverage grants dollars for Vehicle and EVSE purchase

Example Action – Residential

Change to Residential Building Code to simplify installation of EVSE.

E3501.6.4 Electrical Vehicle Charging System Service Disconnect.

A separate service disconnect for electrical vehicle charging systems shall be permitted. The disconnect shall be located immediately adjacent to the outdoor meter cabinet. A permanent plaque or directory shall be installed at each service disconnect location denoting the other services, feeders, and branch circuits supplying a building or structure and area served by each service, feeder, and branch circuit. The disconnect shall not be required to be grouped with the service disconnects for the structure.

Purpose - Reduction in cost of installation of up 30 to 40 percent.

Infrastructure Goal - Ensure a Positive Customer Experience

Commercial/Workplace: EV infrastructure roll-out

- Support businesses working with local utilities
- Support working with local jurisdictions and city planners
- **Support business case development for secondary battery use**
- **Utility support of EVSE install Demo programs**

Public: EV infrastructure roll-out

- **Support coordination for Park and Ride locations with Businesses**
- Support preferential and/or free parking
- Leverage Other MPSC Grants , etc.
- **Utility support of EVSE install Demo programs**

Infrastructure Actions

Workplace/Public Charging

Require working with the local utility, electrical contractors and inspectors ...

- **Curbside Charging –DOT, Light Posts, Parking Meters**
- **Parking Garage Charging – Placement of Stations**
- **Open Parking Lot Charging - Park and Ride/Business**
- **Airport, Theaters, Malls, Stadiums...**

Avoid deploying too much hardware – error on the side of deploying too much conduit...

Example Action – Workplace/Public

Deploying Charging at Large Box Stores - *Meijer*

This is a very exciting step for Meijer as we continue to look for ways to expand our sustainability initiatives,” said Julie Croll, Meijer senior vice president of properties and real estate. “The key to our success through the years has been innovation, and we look at sustainability the same way. Whether we are providing our customers with re-usable bags, placing rooftop wind turbines on stores or offering charging stations for the electric vehicles, we are committed to searching for [innovative](#) ways to be green.”

Purpose – Sustainability - Charging convenience (free charging)

Charging Power Levels

120V (1.2 kW) Charging (20 amp rec)

- Plugs into standard household outlet
- Full charge in about 8-10 hours
- No additional equipment or installation typically required
- Charge cord standard with the vehicle in NA



120V Cordset

240V (3.3 kW) Charging (40 amp rec)

- Full charge in about 3-4 hours
- Efficient and enables more opportunity to drive electrically
- Requires a one-time investment to upgrade garage with dedicated 240V circuit



240V Charge Station



**J1772
Connector
and Vehicle
Plug**

Coordinated Customer Outreach

Outreach/Training: *Infrastructure*

- **Utility (Customer, Dealers)**
- **Electrical Contractors/Inspectors**
- **Resources:**
 - Chevy.com
 - EDTA/NPVI website information (Charging, First Responder Training, etc)
 - GoElectricDrive.com
- **Local Clean Cities Coalitions**

Key Take Aways...

Smart Charging is on-board...

...and should stay there

The Role of Secondary Battery Use?

We Need to get Residential Charging 100% correct or the customer will respond negatively...this means that we need to coordinate our efforts (Auto OEM, Utility, Charging Station OEM, Electrical Contractors, Inspectors)

Workplace/public charging should not get in the way of streamlining the processes for residential installations...it should inform workplace/public charging...and it should always comprehend :

- Maintenance and repair;*
- Technology upgrades; and*
- Take back at end of life*



Go to www.getmyvolt.com to order one today



THANK YOU!

