How It Works?
- Electric and gasoline motor power drivetrain
- Ability to run on only electric power for specified range
  - Range dependent on battery size
- Battery charged in two ways:
  - Regenerative Braking
  - Plugging into 120 V outlet
- Different than hybrid vehicle (HEV) because of ability to charge battery from source other than braking

Components of a PHEV
The above diagram shows the components of a PHEV, the major components that effect production emissions are the electric and gasoline motor, as well as the battery pack which is larger than those included in HEV’s because of the ability to operate solely on battery power for a substantial range.

Pros
- Reduced fuel consumption
  - Save money on operation-Electric prices about $1/GGE
  - 40-60% reduction in petroleum energy consumption
  - 30-60% reduction in greenhouse gas emissions
- Reduced dependency on foreign oil

Cons
- Large charging time- 1 to 4 hours using 240 volt charger
- Emissions linked to source of power generation
  - Environmental impact strong function of carbon intensity
- Battery technology not fully evolved
  - Lithium ion batteries expensive and do not have large range
  - Batteries may need to be replaced in lifetime of vehicle
  - Increased human toxicity from battery components

Electricity Constraints
The main constraint on emissions gains of PHEV’s is the source of electrical power. This is dependent on the location, time of day, climate, and seasonal load variations. All of these factor into the graphic on the right which shows the equivalent MGP of a PHEV in the various electrical producing areas.

Why Buy a PHEV?
- Higher initial cost compared to HEV and ICE vehicles
- Lower initial cost than EV
  - No range issue because of tandem gas engine
- Chart on bottom right shows greater environmental impact than ownership of HEV
- Pay off period for ownership 13 years, will be reduced by:
  - Innovations in battery technology
  - Fluctuations in oil prices
  - Increases in production of PHEV’s
  - High initial cost offset by federal tax credit

Comparative Vehicle Emissions
The figure to the right shows the percent reduction in emissions compared to ICE vehicles
- Trends show that all combustion gasses are reduced more in order of gas consumption
- PHEV’s and EV’s produce more PM10 and SOx because of electrical power generation

Emissions Comparison to Traditional Internal Combustion Engine Cars (ICE)
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<td>Aguirre, K., Eisenhardt, L., Lim, C., &amp; Nelson, B. (2012). Lifecycle analysis comparison of a battery electric vehicle and a conventional gasoline vehicle. <em>California Air Resources Board,</em></td>
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