= Chevrolet Volt =

The Chevrolet Volt is a plug @-@ in hybrid manufactured by General Motors , also marketed in rebadged variants as the Holden Volt in Australia and New Zealand , and with a different fascia as the Vauxhall Ampera in the United Kingdom and as the Opel Ampera in the remainder of Europe .

Sales of the 2011 Volt began in the U.S. in mid @-@ December 2010 followed by various European countries and other international markets in 2011 . Global combined Volt / Ampera family sales totaled over 110 @,@ 000 unit by the end of March 2016 , with the U.S. as the leading market with over 96 @,@ 600 Volts delivered through May 2016 . Canada is the world 's second largest market with almost 6 @,@ 400 Volts sold through May 2016 . About 10 @,@ 000 Opel / Vauxhall Ampera cars had been sold in Europe as of December 2015 , with the Netherlands leading the European region with almost 5 @,@ 000 Amperas and over 1 @,@ 000 Volts registered . The Volt / Ampera family of vehicles is the world 's all @-@ time best @-@ selling plug @-@ in hybrid vehicle as of March 2016 .

The Volt operates as a pure battery electric vehicle until its battery capacity drops to a predetermined threshold from full charge . From there its internal combustion engine powers an electric generator to extend the vehicle 's range as needed . When the engine is running it may be periodically mechanically linked (by a clutch) to a planetary gear set , and hence the output drive axle , to improve energy efficiency . The Volt 's regenerative braking also contributes to the on @-@ board electricity generation . Under the United States Environmental Protection Agency (EPA) cycle , the 2013 / 15 model year Volt all @-@ electric range is 38 mi (61 km) , with a combined electric mode / gasoline @-@ only rating of 62 mpg @-@ US (3 @.@ 8 L / 100 km ; 74 mpg @-@ imp) equivalent (MPG @-@ equivalent) .

The second generation Volt improved battery system and drivetrain increased the all @-@ electric range to 53 miles (85 km) , its EPA rated fuel economy in charge @-@ sustaining mode to 42 mpg @-@ US (5 @.@ 6 L / 100 km ; 50 mpg @-@ imp) , and the combined city / highway fuel economy in all @-@ electric mode to 106 MPG @-@ e , up from 98 MPG @-@ e . Deliveries to retail customers in the U.S. and Canada began in October 2015 as a 2016 model year .

The Volt has won several awards , including the 2009 Green Car Vision Award , 2011 Green Car of the Year , 2011 North American Car of the Year , 2011 World Green Car , 2012 European Car of the Year , and 2016 Green Car of the Year . Controversies regarding the Volt include the extent to which the U.S. federal government may have participated in the Volt ? s development , which continued through General Motors ' 2009 government @-@ led bankruptcy , and concerns about the battery pack fire risk following a crash test that the National Highway Traffic Safety Administration (NHTSA) performed on a Volt in 2011 . At the completion of its investigation NHTSA concluded that no discernible defect trend exists .

= = Terminology = =

The Society of Automotive Engineers ' (SAE) definition of a hybrid vehicle states that the vehicle shall have " two or more energy storage systems both of which must provide propulsion power , either together or independently . " General Motors has avoided the use of the term " hybrid " when describing its Voltec designs , even after the carmaker revealed that in some cases the combustion engine provided some assist at high speeds or to improve performance . Instead General Motors describes the Volt as an electric vehicle equipped with a " range extending " gasoline powered internal combustion engine (ICE) as a genset and therefore dubbed the Volt an " Extended Range Electric Vehicle " or E @-@ REV . In a January 2011 interview , the Chevy Volt 's Global Chief Engineer , Pamela Fletcher , referred to the Volt as " an electric car with extended range . "

According to the Society of Automotive Engineers (SAE) definitions , the Volt is a plug @-@ in hybrid vehicle , due to the combination of an internal combustion engine and two electric motors , along with a battery that can accept off @-@ board energy . The Volt operates as a purely electric vehicle for the first 25 to 50 miles (40 to 80 km) in charge @-@ depleting mode . When the battery capacity drops below a pre @-@ established threshold from full charge , the vehicle enters charge

@-@ sustaining mode , and the Volt 's control system will select the most optimally efficient drive mode to improve performance and boost high @-@ speed efficiency .

= = History = =

= = = Concept vehicle = = =

The Chevrolet Volt concept car debuted at the January 2007 North American International Auto Show , becoming the first @-@ ever series plug @-@ in hybrid concept car shown by a major car manufacturer . The Volt concept vehicle had four doors with a rear liftgate and seating for four passengers . This was a significant change in design when compared to the General Motors EV1 of the 1990s , which only seated two to reduce weight and to make the necessary room for the lead @-@ acid battery pack . The top speed was also increased on the Volt , from the electronically limited 80 miles per hour (130 km / h) to 100 miles per hour (160 km / h) . The battery pack size was reduced , from about 10 @.@ 6 cu ft (300 L) in volume in the EV1 , to 3 @.@ 5 cu ft (100 L) in the Volt .

General Motors ' then @-@ Vice @-@ Chairman Robert Lutz said the two @-@ seater sports car being developed by Tesla , the Tesla Roadster , and the rapid advancement of lithium @-@ ion battery technology inspired him to push the carmaker to develop the Volt after the 2006 Detroit Auto Show . Lutz 's initial idea was to develop an all @-@ electric car , but Jon Lauckner , General Motors Vice President for Global Vehicle Development , convinced him that to avoid an expensive battery , range anxiety concerns , and lack of public charging infrastructure , they could use a smaller battery pack with a small gasoline engine driving a generator acting as a backup to extend the range , but without a mechanical connection between the gasoline engine and the drive wheels , so it would be a pure electrically driven vehicle without many of the limitations General Motors learned from the EV1 experience .

Most of the Volt initial design parameters defined for the development of the concept car , then referred as the " iCar " in homage to the iPod , were kept throughout the process up to the final production version . A key design parameter was a target of 40 miles (64 km) for the all @-@ electric range , selected to keep the battery size small and lower costs , and mainly because research showed that in the U.S. 78 percent of daily commuters travel 40 miles or less . This target range would allow most travel to be accomplished electrically driven and the assumption was made that charging will take place at home overnight . This requirement translated using a lithium @-@ ion battery pack with an energy storage capacity of 16 kWh considering that the battery would be used until the state of charge (SOC) of the battery reached 30 % . This limit to the SOC was necessary in order to maintain operational performance under a wide range of environments , and to minimize the battery degradation to allow at least a ten @-@ year life span . The initial target range for the gasoline engine / generator was set between 250 to 300 miles (400 to 480 km) and the vehicle had to be family size for four or five passengers .

Another key design decision was to develop the concept car based on a new family of common powertrain components for electric propulsion , which initially was called the E @-@ Flex Systems , ? E ? stands for electric drive and ? Flex ? for the different sources of electricity , but later was renamed Voltec drive system . The E @-@ Flex or Voltec powertrain is an attempt to standardize many components of possible future electrically propelled vehicles , and to allow multiple interchangeable electricity @-@ generating systems . The E @-@ Flex powertrain has the potential to adapt the vehicles to pure battery electric , to fuel cell @-@ powered or to several other sources of energy to create electricity on board , such as engine @-@ generator sets (genset) fueled by gasoline , diesel , biodiesel , ethanol fuel (E100) , or flex @-@ fuel (E85) . Regenerative braking would also contribute to the on @-@ board electricity generation . On October 2006 the E @-@ flex powertrain was selected for the new propulsion architecture and the name Volt was chosen by General Motors .

The Volt concept car became the first application of the E @-@ Flex (Voltec) drive system with a

combination of an electric motor , the same used in the Chevrolet Equinox Fuel Cell , a 16 kW · h (58 MJ) lithium @-@ ion battery pack with 136 kW of peak power , and a genset consisting of a small 1 @.@ 0 L , 3 @-@ cylinder turbocharged flex @-@ fuel capable engine linked to a 53 kW (71 hp) generator . General Motors called this genset an electric vehicle (EV) range extender . The vehicle was propelled by an electric motor with a peak output of 120 kW (160 hp) delivering 236 lb ft (320 Nm) of motoring torque . The concept car featured several advanced materials from GE Automotive Plastics which allowed GM to reduce the vehicle weight up to 50 percent .

The Volt concept featured a 12 US gal (45 L ; 10 @.@ 0 imp gal) fuel capacity providing the vehicle a total driving range of around 640 mi (1 @,@ 030 km) , which considered a gasoline fuel efficiency of about 50 mpg @-@ US (4 @.@ 7 L / 100 km ; 60 mpg @-@ imp) and a 40 mi (64 km) all @-@ electric range . According to General Motors estimates , a daily drive of 60 mi (97 km) , combined with an overnight recharge to support the first 40 all @-@ electric miles , would yield an effective gasoline fuel economy of 150 mpg @-@ US (1 @.@ 6 L / 100 km ; 180 mpg @-@ imp) . General Motors also emphasized that the Volt would further reduce dependence on imported oil if E85 ethanol was used instead of gasoline to power the on @-@ board generator engine . Robert Lutz added that if the driver used E85 , " the fuel economy figure became 525 miles per (equivalent) petroleum gallon " , as only 15 % of gasoline is used in this blend . General Motors also noted that actual production of the Volt depended on further battery development , because the required rechargeable batteries needed to make the Volt a viable vehicle did not exist in the market and had yet to be developed . The concept car was actually powered by two 12 @-@ volt conventional car batteries , just enough power to allow the vehicle to move at low speeds in the stand .

= = First generation (2010 ? 2015) = =

= = = Production model = = =

The production design model officially unveiled on September 16 , 2008 , as part of General Motors centennial celebration at the Wintergarden headquarters in Detroit . The production model differed greatly in design from the original concept car . The carmaker cited necessary aerodynamic changes needed to reduce the concept car 's high drag coefficient of Cd = 0 @.@ 43 down to a more efficient Cd = 0 @.@ 28 , though still somewhat higher than the Toyota Prius Cd = 0 @.@ 25 . Another reason was the use of General Motors ' new global compact vehicle platform Delta II to keep costs reasonable , and shared with the 2010 model year Chevrolet Cruze . Another significant difference from the concept car is the seating , as the production Volt seats four rather than five passengers . This change was due to the higher @-@ than @-@ usual central tunnel that runs from the front console to the rear seat that houses the car 's T @-@ shaped battery pack .

After the concept was put into the pipeline for production , General Motors began looking for a partner to develop the Volt 's lithium @-@ ion battery pack . The carmaker evaluated about twenty @-@ five different battery cell chemistries and constructions from around two dozen lithium @-@ ion battery makers around the world . Due to their more promising cell technologies , two companies were selected in June 2007 , Compact Power (CPI) , which uses a lithium manganese oxide (LiMn2O4) cell made by its parent company , LG Chemical ; and Continental Automotive Systems , which uses lithium iron phosphate based cylindrical cells made by A123Systems . By the end of October 2007 CPI (LG Chem) delivered their finished battery pack prototypes , and A123 delivered theirs by January 2008 . General Motors testing process was conducted at the laboratory the carmaker had created for the GM EV1 program . The battery packs included monitoring systems designed to keep the batteries cool and operating at optimum capacity despite a wide range of ambient temperatures . In order to make sure the battery pack would last ten years and 150 @,@ 000 miles (240 @,@ 000 km) expected for the battery warranty , the Volt team decided to use only half of the 16 kWh capacity to reduce the rate of capacity degradation , limiting the state of charge (SOC) up to 80 % of capacity and never depleting the battery below 30 % . General Motors also was expecting the battery could withstand 5 @,@ 000 full discharges without losing more than 10 % of

its charge capacity .

In April 2008 General Motors started extensive battery testing . In two years the carmaker put the battery packs to the equivalent of 150 @,@ 000 real @-@ world miles (240 @,@ 000 km) and ten years of use . The durability of the battery pack was tested for a broad range of extreme ambient conditions including a shaker table to simulate potholes and a thermal chamber , to simulate temperatures varying from 116 ° F (47 ° C) , typical of the Southwest deserts , to ? 40 ° F (? 40 ° C) typical of the Alaska tundra . In April 2008 the lithium @-@ ion battery pack was placed in Chevrolet Malibus fitted with the Volt powertrain to be used as test mules for further real @-@ world testing . In October 2008 General Motors chose CPI (LG Chemical) to provide the battery systems for the first production version of the Volt . In July 2008 General Motors confirmed that a non @-@ turbocharged , 1 @.@ 4 L 4 @-@ cylinder engine would be used as the range extender , and that the intention was to build it in Flint , Michigan . In April 2009 , General Motors allowed journalists to test the Volt powertrain in the body of Chevrolet Cruze sedans used as test mules which lacked the range @-@ extending generator at the GM Technical Center in Warren , Michigan .

The first pre @-@ production test car based on the final Volt design was built in June 2009 , in Warren , Michigan , and by October 2009 , 80 Volts had been built and were tested under various conditions . On March 31 , 2010 , the first factory @-@ built Volt was produced at the Detroit Hamtramck Assembly Plant in order to test the production line and for quality control purposes , both of the tooling and the pre @-@ production vehicles produced before regular production began .

Tony Posawatz was the Volt Vehicle Line Director from 2006 to 2012 , and he was known as employee # 1 and led the team from concept to production .

Official introduction

General Motors held a ceremony at its Detroit Hamtramck Assembly Plant on November 30 , 2010 , to introduce the first Chevrolet Volt off the assembly line . The first Volt built for retail sale was earmarked for display at General Motors ' Heritage Center museum in Sterling Heights , Michigan . The second unit was offered at a public auction , with an opening bid of US $ 50 @,@ 000 and it was won by Rick Hendrick who paid US $ 225 @,@ 000 . The proceeds went to fund math and sciences education in Detroit through the Detroit Public Schools Foundation . Deliveries to retail customers in the United States began in mid December 2010 . Volt deliveries began in Canada in September 2011 . The first deliveries of the Chevrolet Volt in Europe took place in November 2011 . The European version of the Volt , the Opel Ampera , was released to retail customers in Europe in February 2012 . Deliveries of the right @-@ hand drive Vauxhall Ampera in the UK began in May 2012 . The Holden Volt was released in Australia in December 2012 .

= = = Specifications = = =

= = = = Drivetrain = = = =

The 2011 Chevrolet Volt has a 16 kWh / 45 A · h (10 @.@ 4 kWh usable) lithium @-@ ion battery pack that can be charged by plugging the car into a 120 @-@ 240 VAC residential electrical outlet using the provided SAE J1772 @-@ compliant charging cord . No external charging station is required . The Volt is propelled by an electric motor with a peak output of 111 kW (149 hp) delivering 273 lb · ft (370 N · m) of torque . Capacity of the battery pack was increased to 16 @.@ 5 kWh (10 @.@ 9 kWh usable) for 2013 models , which increased the all @-@ electric range from 35 to 38 mi (56 to 61 km) . Other specifications remained the same . The battery pack capacity was increased to 17 @.@ 1 kWh for 2015 models . This incremental upgrade is likely to reflect in an improvement in range over previous model years , but as of July 2014 , the 2015 Volt has not been re @-@ certified with the EPA .

While driving , after the Volt battery has dropped to a predetermined threshold from full charge , a small naturally aspirated 1 @.@ 4 L 4 @-@ cylinder gasoline fueled internal combustion engine (Opel 's Family 0) with approximately 80 hp (60 kW) , powers a 55 kW generator to extend the Volt 's range . The vehicle also has a regenerative braking system . The electrical power from the

generator is sent primarily to the electric motor , with the excess going to the batteries , depending on the state of charge (SOC) of the battery pack and the power demanded at the wheels .

The Volt requires premium gasoline with a minimum 91 or octane rating because the higher octane rating fuel permits the 10 @.@ 5 : 1 compression ratio engine to utilize more ignition timing advance in order to maximize its fuel efficiency by 5 to 10 % as compared to regular gasoline . For users who drive mostly in electric mode and to avoid maintenance problems caused by storing the same gasoline in the tank for months , the 2011 Volt has a sealed and pressurized fuel tank to avoid evaporation , and as a result , the fuel filler has to be depressurized before opening the tank . Also the engine management system monitors the time between engine running and it is programmed to prompt the driver to run past the 40 @-@ mile (64 km) all @-@ electric range before recharging in order to consume some gasoline . If the driver does not run on gasoline , the system will automatically run the maintenance mode which starts the engine to consume some of the aging fuel and circulate the fluids within the engine . A configuration with an E85 flex @-@ fuel capable engine is under development and was expected to be available in 2013 .

Operating and driving modes

The Voltec drivetrain has three power converting elements :

Primary traction electric motor / generator , provides good acceleration for driving at lower speeds and regeneration for braking , its maximum output of 111 kW setting the maximum output of the whole system .

Secondary electric motor / generator , works primarily as generator capable of producing 55 kW or when necessary acts as a motor assisting the primary electric motor .

Internal combustion engine of 63 kW power , engaged when the batteries reach the predetermined threshold .

These units are connected via a planetary gear and three electrically controlled hydraulic clutches to provide power output for propulsion in any of four programmed operating modes :

Single motor electric ? The primary motor runs solely on battery power , maximum propulsion power is 111 kW .

Dual motor electric ? At higher vehicle speeds the secondary motor engages over the planetary gear such that it reduces the speed of the primary motor . This facilitates higher efficiency and better mileage for the combined system , without increasing the maximum power .

Single motor extended ? The battery reaches its minimum charge which triggers the combustion engine . The engine drives the secondary motor which now works as a generator , via the charging electronics , to keep the minimum battery charge level . The primary motor can still provide its 111 kW for short acceleration , albeit not sustained .

Dual motor extended ? The electric motors are used again in dual configuration with increased efficiency at higher speeds . Additionally the gasoline engine contributes propulsion power via the planetary gear . While power is drained from the battery the amount is less than in mode 2 for the same propulsion power , thus extending the range .

The drivetrain permits the Volt to operate as a pure battery electric vehicle until its battery capacity has been depleted to a defined level , at which time it commences to operate as a series hybrid design where the gasoline engine drives the generator , which keeps the battery at minimum level charge and provides power to the electric motors . The full charge of the battery is replenished only by loading it on the electrical grid .

While in this series mode at higher speeds and loads , (typically above 30 miles per hour (48 km / h) at light to moderate loads) the gasoline engine can engage mechanically to the output from the transmission and assist both electric motors in driving the wheels , in which case the Volt operates as a power @-@ split or series @-@ parallel hybrid . After its all @-@ electric range has been depleted , at speeds between 30 to 70 miles per hour (48 to 113 km / h) , the Volt is programmed to select the most efficient drive mode , which improves performance and boosts high @-@ speed efficiency by 10 to 15 percent .

While operating modes are switched automatically the Volt allows the driver to choose from three drive modes : normal , sport and mountain . The mountain mode , which is expected to be required only under unusual power demand conditions , increases minimum battery state of charge (SOC)

to around 45 % , thus maintaining performance on steep and long grades . The driver will hear more engine noise due to the higher rate of power generation required to maintain this mode . The sport mode causes the engine to rev higher , and the response to the throttle pedal is quicker . The Ampera has an additional option , the " City Mode " or " battery hold " , allowing the driver to save the energy currently stored in the battery for use when traveling in urban areas or restricted zones . The 2013 model year Volt includes a " Hold " option to provide the same choice .

= = = = Battery = = = =

The 2011 Volt 's lithium @-@ ion battery (Li @-@ ion) battery pack weighs 435 lb (197 kg) and " consists of 288 individual cells arranged into nine modules . Plastic frames hold pairs of lithium @-@ ion cells that sandwich an aluminum cooling fin . The design and construction of that aluminum plate was critical to ensuring an even temperature distribution with no hot or cool spots across the flat , rectangular cell . The battery pack has its own cooling circuit that is similar to , but independent from , the engine cooling system . "

For the 2011 / 2012 model years , the battery pack stores 16 kWh of energy but it is controlled or buffered via the energy management system to use only 10 @.@ 3 kWh of this capacity to maximize the life of the pack . For this reason the battery pack never fully charges or depletes , as the software only allows the battery to operate within a state of charge (SOC) window of 65 % , after which the engine kicks in and maintains the charge near the lower level . The minimum SOC varies depending on operating conditions . When more power is required , such as mountain mode , the lower limit of the SOC will rise to 45 % to ensure there is enough power available . The battery capacity was increased to 16 @.@ 5 kWh for the 2013 model year , the SOC window will be increased to use 10 @.@ 8 kWh of the total battery energy , and the buffer to ensure battery life will not be reduced . These changes will increase the Volt 's all @-@ electric range but charging will take slightly longer . The improved battery performance and durability were achieved through minor changes to the material composition of the battery cell chemistry .

Despite containing near identical energy (+ / - 0 @.@ 5 kWh) , the Volt 's battery pack is over 70 % lighter than the EV1 's original 1 @,@ 310 lb (590 kg) , 16 @.@ 5 kWh AC Delco lead @-@ acid battery pack , mainly because the Volt uses higher specific energy Li @-@ ion batteries . Li @-@ ion batteries are expected to become less expensive as economies of scale take effect .

Because batteries are sensitive to temperature changes , the Volt has a thermal management system to monitor and maintain the battery cell temperature for optimum performance and durability . The Volt 's battery pack provides reliable operation , when plugged in , at cell temperatures as low as ? 13 ° F (? 25 ° C) and as high as 122 ° F (50 ° C) . The Volt features a battery pack that can be both warmed or cooled . In cold weather the battery coolant is electrically heated during charging or operation in order to provide full power capability ; in hot weather the battery coolant can be chilled utilizing the vehicle 's air @-@ conditioning system preventing over @-@ temperature damage .

The Volt 's battery is guaranteed by General Motors for eight years or 100 @,@ 000 miles (160 @,@ 000 km) , and will cover all 161 battery components . GM estimates that the Volt batteries will degrade by 10 to 30 % after 8 years or 100 @,@ 000 miles . GM has applied for a patent that may allow technicians to quickly and cheaply recover some of the performance of degraded battery packs . The Volt ? s battery management system runs more than 500 diagnostics at 10 times per second , allowing it to keep track of the Volt ? s battery pack in real @-@ time , 85 % of which ensure the battery pack is operating safely and 15 % monitor battery performance and life .

The Volt uses a plug specification published in 2009 , SAE J1772 @-@ 2009 , that is considered a standard for electric cars in North America . Depending on in @-@ car settings a full charge will take approximately 10 hours (12A setting) to as much as 14 hours (8A setting) from a standard North American 120 V , 15 A outlet and about 4 hours from a 240 VAC source and suitable 240V EVSE . The Volt comes with a 20 ft (6 @.@ 1 m) charging cord suitable for the standard household power outlet in its country of sale . If plugged in , recharging can be controlled remotely through a smartphone application .

= = = = Others = = = =

In order to save energy , the Volt will sometimes heat the seats instead of blowing heated air through HVAC system , as heating the vehicle 's cabin draws significant power , and can even exceed what is needed to move the vehicle on occasions . A power @-@ saving stereo system uses amplifiers that switch on and off rapidly to save power . It uses 50 percent less energy . The system is also lighter because the use of high grade neodymium magnets .

= = = Performance = = =

The Volt has a top speed of 100 mph (160 km / h) . According to Edmunds.com road tests , the Volt 's 0 to 60 mph (0 ? 97 km / h) acceleration time is 9 @.@ 2 seconds running on electric @-@ only mode , and 9 @.@ 0 seconds with the gasoline engine assisting propulsion . Motor Trend reports the Volt 's quarter mile (402 m) time is 16 @.@ 9 sec @ 84 @.@ 3 mph (135 @.@ 7 km / h) , while Edmunds reports a quarter mile (402 m) time of 16 @.@ 8 sec @ 81 @.@ 5 mph (131 @.@ 2 km / h) in electric @-@ only operation , and 16 @.@ 6 sec @ 85 @.@ 5 mph (137 @.@ 6 km / h) with the gasoline engine assisting . Motor Trend reports a 60 to 0 mph (97 to 0 km / h) braking distance of 112 ft (34 m) and Edmunds.com of 124 ft (38 m) .

= = = = Range = = = =

= = = = = United States = = = = =

2011 ? 2012 model years

According to General Motors the Volt 's all @-@ electric range with fully charged batteries varies from 25 to 50 miles (40 to 80 km) depending on terrain , driving technique , and temperature . The Environmental Protection Agency (EPA) official all @-@ electric range is 35 miles (56 km) with an energy consumption of 36 kWh per 100 miles (810 kJ / km) . This range is based on the agency 's five @-@ cycle tests using varying driving conditions and climate controls . The total range with a full tank of gasoline and a fully charged battery is 379 miles (609 @.@ 9 km) according to EPA tests .

The Volt 's nominal usable battery capacity is 10 @.@ 3 kWh . The Volt 's fuel tank capacity is 9 @.@ 3 US gallons (35 L ; 7 @.@ 7 imp gal) . Aside from charge sustaining modes of operation , the battery capacity is completely used first , and then the fuel is consumed . In the event that the car is operated until it runs out of gasoline , the gasoline @-@ powered generator shuts down , and the Volt continues to operate , tapping into a reserve portion of the battery capacity which is below the regular minimum state @-@ of @-@ charge . The reserve battery capacity provides an extra 3 to 4 mi (4 @.@ 8 to 6 @.@ 4 km) . If this reserve battery capacity is also exhausted , the Volt slows to a stop .

2013 ? 2015 model years

As a result of its improved battery chemistry , the 2013 model year Volt increased its EPA 's rated all @-@ electric range to 38 miles (61 km) with an energy consumption of 35 kWh per 100 miles (788 kJ / km) , down from 36 kWh (810 kJ / km) in the 2012 model . The total range with a full tank of gasoline and a fully charged battery is 380 miles (611 @.@ 6 km) . The 2014 and 2015 Volt have the same EPA ratings .

= = = = = Europe = = = = =

The Opel Ampera official all @-@ electric range under the EU @-@ approved UN ECE R101 standard for plug @-@ in hybrids is 83 km (52 mi) . Opel prefers to state that the Ampera 's EV ranges is 40 to 80 kilometres (25 to 50 mi) which is confirmed in tests carried out by ADAC

Motorwelt . The Vauxhall Ampera is reported to have a total range of 310 mi (500 km) .

= = = = Fuel economy = = = =

United States

The U.S. Environmental Protection Agency (EPA) officially rated the 2011 model year Volt 's combined city / highway fuel economy in all @-@ electric mode at 93 miles per gallon gasoline equivalent (MPG @-@ e) (2 @.@ 5 L gasoline equivalent / 100 km ; 112 mpg @-@ imp gasoline equivalent) and 94 MPG @-@ e for the 2012 model year . This rating considers a conversion factor of 33 @.@ 7 kWh of electricity being the energy equivalent of a gallon of gasoline . The EPA rating in gasoline @-@ only mode is 37 mpg @-@ US (6 @.@ 4 L / 100 km ; 44 mpg @-@ imp) . The overall combined city / highway gasoline @-@ electricity fuel economy rating for the 2011 Volt is 60 mpg @-@ US (3 @.@ 9 L / 100 km ; 72 mpg @-@ imp) equivalent (MPG @-@ e) , The EPA also included in the 2011 Volt 's fuel economy label a table showing fuel economy and electricity consumed for five different scenarios : 30 , 45 , 60 and 75 miles (121 km) driven between a full charge , and a never charge scenario . This information was included in order to make the consumers aware of the variability of the fuel economy outcome depending on miles driven between charges . Under the gasoline @-@ only scenario (never charge) , the 37 mpg @-@ US (6 @.@ 4 L / 100 km ; 44 mpg @-@ imp) figure results from 35 mpg @-@ US (6 @.@ 7 L / 100 km ; 42 mpg @-@ imp) city driving and 40 mpg @-@ US (5 @.@ 9 L / 100 km ; 48 mpg @-@ imp) on the highway .

For the 2012 model year , EPA revised the Volt 's fuel economy ratings , increasing the combined city / highway rating in all @-@ electric mode from 93 MPG @-@ e to 94 MPG @-@ e , and the highway rating was increased from 90 MPG @-@ e to 93 MPG @-@ e . As a result of its improved battery pack , the 2013 model year EPA rating climbed to a combined city / highway fuel economy of 98 miles per gallon gasoline equivalent (2 @.@ 4 L gasoline equivalent / 100 km ; 118 mpg @-@ imp gasoline equivalent) . The EPA rating in gasoline @-@ only mode is the same 37 mpg @-@ US (6 @.@ 4 L / 100 km ; 44 mpg @-@ imp) as the previous models . The combined gasoline @-@ electricity fuel economy rating of the 2013 / 2014 model year Volt is 62 mpg @-@ US (3 @.@ 8 L / 100 km ; 74 mpg @-@ imp) equivalent , 63 MPG @-@ e in city driving and 61 MPG @-@ e in highway .

When introduced in December 2010 , the 2011 Volt was the most fuel efficient car sold in the American market in the compact class , with a combined gasoline @-@ electricity fuel economy of 60 mpg @-@ US (3 @.@ 9 L / 100 km ; 72 mpg @-@ imp) equivalent (MPG @-@ e) , until it was surpassed by the 2012 Ford Focus Electric in February 2012 . The all @-@ electric Focus has a combined fuel economy of 105 mpg @-@ US (2 @.@ 2 L / 100 km ; 126 mpg @-@ imp) equivalent (MPG @-@ e) . Nevertheless , the Volt remained as the most fuel efficient car with an internal combustion engine available in the United States until May 2014 , when the BMW i3 REx replaced the Volt as the most efficient EPA @-@ certified current year vehicle with a gasoline engine , with a combined gasoline @-@ electricity fuel economy of 88 mpg @-@ US (2 @.@ 7 L / 100 km ; 106 mpg @-@ imp) equivalent (MPG @-@ e) .

In December 2012 General Motors reported , based on data collected through its OnStar telematics system since Volt deliveries began , that Volt owners drive around 900 mi (1 @,@ 400 km) , or a month and a half , between fill @-@ ups . By mid June 2014 , GM reported that among Volt owners who charge regularly , they typically drive more than 970 mi (1 @,@ 560 km) between fill @-@ ups and visit the gasoline station less than once a month . In early October 2014 , based on General Motors ' real time tally of miles driven by Volt owners in North America , the company reported they have accumulated a total of 1 billion miles (1 @.@ 6 billion km) traveled , of which , about 62 @.@ 5 % were driven in all @-@ electric mode .

A 2014 analysis conducted by the Idaho National Laboratory using a sample of 21 @,@ 600 all @-@ electric cars and plug @-@ in hybrids , found that Volt owners traveled on average 9 @,@ 112 miles in all @-@ electric mode (e @-@ miles) per year , while Leaf owners traveled 9 @,@ 697 e @-@ miles per year , despite the Volt 's shorter all @-@ electric range , about half of the Leaf

's . The 2015 edition of the EPA 's annual report " Light @-@ Duty Automotive Technology , Carbon Dioxide Emissions , and Fuel Economy Trends " estimates the following utility factors for 2015 model year plug @-@ in hybrids to represent the percentage of miles that will be driven using electricity by an average driver , whether in electric only or blended modes , The Volt has a utility factor of 66 % , compared with 83 % for the BMW i3 REx , 45 % for the Ford Energi models , 43 % for the McLaren P1 , 37 % for the BMW i8 , and 29 % for the Toyota Prius PHV .

Europe

The Opel Ampera official equivalent fuel consumption under the EU @-@ approved UN ECE R101 standard for plug @-@ in hybrids is 1 @.@ 2 L / 100 km (196 @.@ 0 mpg @-@ US ; 235 @.@ 4 mpg @-@ imp) (83 @.@ 3 km / L) . However , a leading Opel engineer prefers saying 169 Wh / km while battery @-@ powered , and then 20 km / L petrol @-@ powered . The ECE R101 standard weights charge @-@ depleting mode as 76 % and gasoline @-@ only driving as 24 % .

= = = Operating cost and payback period = = =

According to Consumer Reports in December 2011 , the Chevrolet Volt fuel cost in electric mode was 3 @.@ 8 ¢ / mile , while the Nissan Leaf had a cost of 3 @.@ 5 ¢ / mi . The Volt 's higher cost per mile was attributed to its heavier weight . Their estimates used the U.S. national average electricity rate of 11 ¢ / (kWh) and energy consumption rates as measured on their own , unofficial tests . When comparing the Volt in range @-@ extended mode with the four most fuel efficient gasoline @-@ powered cars as tested by the magazine , the plug @-@ in hybrid had a cost of 12 @.@ 5 ¢ / mi (using premium gasoline) while the Toyota Prius had a cost of 8 @.@ 6 ¢ / mi . , the Honda Civic Hybrid 9 @.@ 5 ¢ / mi . , the Toyota Corolla 11 @.@ 9 ¢ / mi . , and the Hyundai Elantra 13 @.@ 1 ¢ / mi . The analysis also found that , on trips up to 100 mi (160 km) , the Volt was cheaper to drive than the other four cars because the Volt was able to drive 35 mi (56 km) using less expensive electric power . Consumer Reports found that , using their proprietary testing , the Volt overall fuel efficiency was 99 mpg @-@ US (2 @.@ 4 L / 100 km ; 119 mpg @-@ imp) equivalent (MPG @-@ e) , and using only range @-@ extended mode the overall fuel economy was 32 mpg @-@ US (7 @.@ 4 L / 100 km ; 38 mpg @-@ imp) and equivalent to the Toyota Corolla . The report noted that , as of 2011 , plug @-@ in electric cars are more expensive to buy , and the previous operating costs do not include maintenance , depreciation or other costs .

According to Edmunds.com , the price premium paid for the Volt in 2012 , after discounting the US $ 7 @,@ 500 U.S. federal tax credit , takes a long time for consumers to recover in fuel savings , often longer than the normal ownership time period . Edmunds compared the Volt (priced at US $ 31 @,@ 712) with the same @-@ size gasoline @-@ powered Chevrolet Cruze (priced at US $ 19 @,@ 656) and found that the payback period for the plug @-@ in hybrid is 15 years for gasoline prices at US $ 3 per gallon , 12 years at US $ 4 per gallon , and drops to 9 years with gasoline prices at US $ 5 per gallon . At February 2012 prices , the break even period is 14 years . These estimates assume an average of 15 @,@ 000 miles (24 @,@ 000 km) annual driving and vehicle prices correspond to Edmunds.com 's true market value estimates .

In a similar comparison carried out by TrueCar in April 2012 for The New York Times , the analysis found that the payback period for the Volt takes 26 @.@ 6 years versus a Chevrolet Cruze Eco , assuming it was regularly driven farther than its battery @-@ only range allows , and with gasoline priced at US $ 3 @.@ 85 per gallon . The analysis assumes an average of 15 @,@ 000 miles (24 @,@ 000 km) driven a year , a fuel economy of 34 @.@ 3 mpg @-@ US (6 @.@ 86 L / 100 km ; 41 @.@ 2 mpg @-@ imp) for the Cruze Eco , priced at US $ 19 @,@ 925 , and a Volt price of US $ 31 @,@ 767 , after discounting the US $ 7 @,@ 500 federal tax . TrueCar also found that with gasoline priced at US $ 5 per gallon , the payback time could drop to about 8 years if the Volt were to be operated exclusively on battery power . The newspaper also reported that according to the March 2012 Lundberg Survey , gasoline prices would need to reach US $ 12 @.@ 50 a gallon for the Volt to break even , while the Nissan Leaf would be competitive with a similar gasoline @-@ powered compact car at US $ 8 @.@ 53 a gallon .

Since the Edmunds and The New York Times pieces however , numerous rebuttal articles have

surfaced that have identified various flaws in the methodologies and calculations used by Edmunds and TrueCar in their estimation of the Volt 's pay @-@ back period . Namely both sources strict use of the Volt 's " gasoline engine only " EPA fuel economy rating of 37 mpg , when in fact when operated as intended any real @-@ world use will most typically include an initial 38 miles of all @-@ electric power during which zero gasoline would be consumed . Thus resulting in significantly higher total fuel economy that admittedly will be entirely dependent on how often and how far the car is driven . Many of these articles further suggest that the usage model used by TrueCar of 114 trips of 131 mi (211 km) per trip was not typical of the majority of American daily driving patterns , and their use of a projected cost US $ 3 @.@ 85 per gallon as the cost of gasoline throughout the entire payback period quite unrealistic . An article from the online automotive publication The Truth About Cars indicates that when the Volt is charged and driven daily exclusively on its available electric power for its EPA rated 38 miles of all @-@ electric range (13 @,@ 780 mi (22 @,@ 180 km) annually) the payback period for the Volt would be much lower and similar to that of other plug @-@ in electric @-@ cars such as the Nissan Leaf or approximately 8 @.@ 7 years (as indicated by TrueCar) .

= = = Tailpipe emissions = = =

While operating in all @-@ electric mode the Volt produces no tailpipe emissions . However , the clean air benefit is mostly local because , depending on the source of the electricity used to recharge the batteries , air pollutant emissions are shifted to the location of the electricity generation plants . The amount of carbon dioxide emitted depends on the emission intensity of the power source used to charge the vehicle . When the Volt 's battery is depleted and the gasoline @-@ powered engine engages , the plug @-@ in emissions are similar to other internal combustion engine vehicles . The amount of total local emissions depends on how much the Volt is driven in all @-@ electric mode and how much in charge @-@ sustaining mode .

United States

The California Air Resources Board (CARB) classified the Volt as Ultra Low Emission Vehicle (ULEV) , as CARB tests do not account for the Volt electric range . With all tests conducted under conditions where the engine is running the CARB rated the Volt 's carbon monoxide (CO) emissions at 1 @.@ 3 g / mile (0 @.@ 81 g / km) , missing the limit for SULEV classification by 0 @.@ 3 g / mile (0 @.@ 19 g / km) .

The EPA rating for the model year 2011 Volt 's tailpipe emissions is 84 grams of CO2 per mile , (52 @.@ 5 CO2 g / km) . Tailpipe emissions for the improved model year 2014 / 15 Volt fell to 81 grams of CO2 per mile , (50 @.@ 6 CO2 g / km) . CO2 emissions are produced by the internal combustion engine in extended @-@ range mode , and only after the Volt 's primary battery charge has been depleted . In the other air pollutants category , the Volt rates six out of ten , with ten being best .

The EPA also estimated the upstream CO2 emissions associated with the production and distribution of electricity required to charge the vehicle . Since electricity production in the United States varies significantly from region to region , the EPA considered three scenarios / ranges with the low end of the range corresponding to the California powerplant emissions factor , the middle of the range represented by the national average powerplant emissions factor , and the upper end of the range corresponding to the powerplant emissions factor for the Rockies . The following table shows the Volt tailpipe emission plus total upstream CO2 emissions for the three scenarios , compared with other four popular plug @-@ in hybrids and the average gasoline @-@ powered car :

Europe

The Ampera 's official EU @-@ approved UN ECE R101 carbon dioxide emission rating is 27g / km .

= = = Safety = = =

The 2011 Chevrolet Volt standard features include 4 @-@ wheel anti @-@ lock brakes with traction control ; StabiliTrak electronic stability control system with brake assist ; tire @-@ pressure monitoring system ; and 8 total airbags : dual @-@ stage frontal , side @-@ impact and knee for driver and front passenger , and roof @-@ rail side @-@ impact for front and rear outboard seating positions , with a passenger sensing system . There is also available an optional emergency assistance system . A safety cage , built with high @-@ strength and ultra high @-@ strength steel , surrounds the passenger compartment to keep the space intact in the event of a crash . Crush zones framing the trunk and the engine crumple to absorb crash energy before it reaches occupants . Door hinges and latches in harmony with door structure and its steel reinforcements to keep doors closed during an impact . The 2011 Chevrolet Volt was named " Top Safety Pick " by the Insurance Institute for Highway Safety . The Volt received the top ratings of " Good " for front , side , and rear impact crash tests , and also on rollover protection . All injury measurements except one were rated good , indicating a low risk of significant injuries in crashes according to the scale of severity employed in the IIHS ? s testing . The Volt 's lower rating of " Acceptable " was for torso injuries .

The Volt received a five @-@ star overall crash safety rating from the National Highway Traffic Safety Administration (NHTSA) , the highest @-@ possible score . This rating was obtained with NHTSA 's New Car Assessment Program which is used for 2011 model year vehicles .

Accident and rescue handling

In August 2010 , General Motors began a training program for first responders when performing rescue duties involving the Chevrolet Volt . The program began at the 2010 Fire @-@ Rescue International in Chicago , using a pre @-@ production Volt for a live extrication exercise . Chicago firefighters demonstrated the sequence of tasks required to safely disable the vehicle ? s powertrain and its 12 @-@ volt electrical system , which controls its high @-@ voltage components , and then proceed to extricate injured occupants . As of January 2011 , additional training workshops had taken place in several other cities corresponding to the Volt 's initial launch markets . An Emergency Response Guide for the 2011 Volt was made available at its Service Technical College for use by emergency responders . The guide also describes methods of disabling the high voltage system and identifies cut zone information .

GM recommends that a Volt battery fire be fought with water rather than dry chemicals , and rates the Volt battery as having no explosion or electrocution hazard as the result of a collision . The high @-@ voltage system is designed to shut down automatically in the event of an airbag deployment , and to detect a loss of communication from an airbag control module . During the Volt development the lithium @-@ ion battery pack was subjected to a wide range of tests , including overcharge , discharge , vibration , excessive heat and cold , short circuit , humidity , fire , crush , water immersion , salt water immersion , and nail penetration .

Warning sounds

Due to significant noise reduction typical of vehicles traveling in all @-@ electric mode at low speeds , the Volt is fitted with a manually activated electronic warning sound system called Pedestrian @-@ Friendly Alert System for use when the car is operating at low speeds to alert pedestrians to the car 's presence .

= = = Other features = = =

Connectivity

The Volt features OnStar Mobile application for owners to access vehicle information without being in or near the car . This smartphone application features the ability to check fuel efficiency as well as the vehicle 's current electric range . It also helps monitor the charging , giving owners key information about the current charge level and the amount of time it will take until it is fully charged . The application also is able to control features such as locking / unlocking doors , and acts as a remote starter . A five @-@ year OnStar Directions and Connections service was bundled into the 2011 Volt 's base price , which was reduced to three years for the 2012 model year .

2011 model year

The 2011 Chevrolet Volt comes standard with cruise control ; remote vehicle start @-@ up system ;

17 @-@ inch 5 @-@ spoke forged painted aluminum wheels ; Bluetooth wireless technology for select phones ; audio and navigation system with a center console capacitive touch panel and DVD and MP3 playback , with voice recognition ; OnStar with five years of service ; BOSE premium speaker system , with six speakers and sub @-@ woofer ; 30 GB hard drive for audio data storage ; USB port ; three auxiliary , 12 @-@ volt , power outlets ; power door locks and windows ; power adjustable mirrors ; programmable time of day charge control ; and a 110 @-@ volt charge cord .

Available options include ; 17 @-@ inch 5 @-@ spoke forged polished @-@ aluminum wheels ; rearview camera system , parking assist package ; leather @-@ wrapped steering wheel ; and heated leather front seats with selectable automatic activation .

2012 model year

The 2012 Volt standard features include a remote keyless access with passive locking allowing the car to automatically lock and unlock with the key fob in close proximity of vehicle ; OnStar turn @-@ by @-@ turn navigation for three years , and available in @-@ dash navigation system ; and Chevrolet MyLink including Bluetooth streaming audio for music and select phones . The 2012 Volt has seven option packages while the 2011 model had only three .

2013 model year

The low @-@ emission package standard available on later 2012 Volts destined for the California market is included in the 2013 Volts sold in New York state to allow their owners access to high @-@ occupancy lanes . The liftgate and roof of the 2013 model is body @-@ colored rather than black , and a new interior color " Pebble Beige " is available in both cloth upholstery and leather seats with suede inserts . A removable rear @-@ seat center armrest is included in the premium trim package . Other changes include an improved audio system with GPS @-@ based navigation ; a comfort package that includes heated driver and front passenger cloth seats and leather @-@ wrapped steering wheel ; and there are a pair of available safety packages .

2014 model year

Minor changes for the 2014 model year include a manual release for the charge port door in place of the electronically activated door found on previous models , and the addition of two new paint colors . A leather wrapped steering wheel becomes standard .

= = Second generation (2015 ?) = =

The second generation Chevrolet Volt was officially unveiled at the January 2015 North American International Auto Show . Retail deliveries began in the United States and Canada in October 2015 as a 2016 model year , with 1 @,@ 324 units delivered in the U.S. that month . Availability in the American market was limited to California and the other 10 states that follow California ? s zero emission vehicle regulations . GM scheduled the second generation as a 2017 model year to be released in the 39 remaining states by early 2016 . Manufacturing of the 2017 MY Volt began in February 2016 , and the first units arrived at dealerships at the end of February 2016 . The 2017 model complies with stricter Tier 3 emissions requirements and it will be available nationwide .

The second generation Volt has an upgraded powertrain with a 1 @.@ 5 @-@ liter engine that uses regular gasoline ; the 18 @.@ 4 kWh battery pack has new chemistry that stores 20 % more electrical energy and uses fewer cells , 192 compared with 288 on the 2014 Volt ; it uses a new power controller that is integrated with the motor housing ; the electric motors weigh 100 lb (45 kg) less and use smaller amounts of rare earth metals . GM engineers explained that the second generation Volt was developed using extensive input from Volt owners .

These improvements allow the 2016 Volt to deliver better EPA ratings than the first generation model . The all @-@ electric range was officially rated at 53 mi (85 km) , up from 38 mi (61 km) attained by the 2015 Volt . The gains in efficiency allow the second generation Volt to improve its combined fuel economy in gasoline @-@ only (charge @-@ sustaining) mode to 42 mpg @-@ US (5 @.@ 6 L / 100 km ; 50 mpg @-@ imp) , up from 37 mpg @-@ US (6 @.@ 4 L / 100 km ; 44 mpg @-@ imp) for the previous model . The official second generation Volt 's rating for combined city / highway fuel economy in all @-@ electric mode is 106 miles per gallon gasoline equivalent (MPG @-@ e) , up from 98 MPG @-@ e for the 2015 first generation model . The combined

gasoline @-@ electricity fuel economy rating of the 2016 model year Volt is 77 mpg @-@ US (3 @.@ 1 L / 100 km ; 92 mpg @-@ imp) equivalent , 82 MPG @-@ e in city driving and 72 MPG @-@ e in highway . Both the all @-@ electric range and fuel economy ratings are the same for the 2017 model year Volt .

In April 2013 , CEO Daniel Akerson announced that GM expects the second generation Volt to be priced on the order of US $ 7 @,@ 000 to US $ 10 @,@ 000 lower than the 2013 model year with the same features . The 2016 Volt pricing will start at US $ 33 @,@ 170 before any available government incentives , plus US $ 825 for destination . The starting price is US $ 1 @,@ 175 lower than the 2015 Volt . In California , order books for the second generation Volt were opened on May 28 , 2015 .

In July 2014 , Opel announced that due to the slowdown in sales , the Ampera would be discontinued after the launch of second generation Volt , and between 2014 and 2018 , Opel planned to introduce in Europe a successor product in the electric vehicle segment . General Motors announced in February 2016 that the all @-@ electrc Opel Ampera @-@ e hatchback will go into production in 2017 . This is the European version of the Chevrolet Bolt EV .

In April 2015 , General Motors confirmed that it will not build the second generation Volt in right @-@ hand @-@ drive configuration . Due to low sales , only 246 units had been sold in Australia by mid @-@ April 2015 , the Holden Volt will be discontinued once the remaining stock is sold out .

= = Production , price and sales = =

= = = North America = = =

Assembly of the Volt was assigned to Detroit / Hamtramck Assembly plant following the conclusion of the 2007 UAW @-@ GM contract talks . For initial production the gasoline engine is being imported from the Opel engine plant in Aspern , Austria . In November 2010 , General Motors began investing US $ 138 @.@ 3 million at its engine operations plant in Flint , Michigan to support increased production of the Ecotec 1 @.@ 4 L engine that is used in the Chevrolet Cruze , the upcoming 2012 Chevrolet Sonic , and the variant used in the Chevrolet Volt . The Flint plant was expected to start production of 400 engines a day in early 2011 , ramp up daily production to 800 engines in late 2011 , and to increase its capacity to 1 @,@ 200 a day by late 2012 . In May 2011 , General Motors decided to invest an additional US $ 84 million at the Flint plant to further increase 1 @.@ 4 L engine production capacity .

In 2010 , General Motors planned an initial production for calendar year 2011 of 10 @,@ 000 Volts and 45 @,@ 000 units for 2012 , up from the 30 @,@ 000 units initially announced . In May 2011 , the carmaker again raised its production targets , as Volt and Ampera production capacity was increased to 16 @,@ 000 units in 2011 , including 3 @,@ 500 units for exports and 2 @,@ 500 demonstration units destined to U.S. dealerships , and the rest for U.S. sales . However , in November 2011 GM 's sales chief announced that they would not meet its sales goal of 10 @,@ 000 vehicles in 2011 .

Out of the 2012 production , General Motors expected to produce 10 @,@ 000 Amperas for sale in Europe , 6 @,@ 000 destined for Opel and 4 @,@ 000 for Vauxhall in the UK . In addition , 2 @,@ 000 Volts will be made available for the region . By early 2012 GM abandoned its sales target to deliver 45 @,@ 000 Volts in the U.S and instead announced that production in 2012 will depend on demand . By March 2012 the Volt plant has a global production capacity of 60 @,@ 000 vehicles per year .

The Volt 's battery cells are produced by LG Chem in South Korea and then shipped to the US , where the battery packs are assembled at a purpose @-@ built facility in Brownstown Charter Township , Michigan owned and operated by General Motors . Compact Power , the North American subsidiary of LG Chem , is building a battery plant in Holland , Michigan to manufacture the advanced battery cells for the Volt and other carmakers , with capacity to produce enough cells for 50 @,@ 000 to 200 @,@ 000 battery packs per year . The US $ 303 million Holland plant was

funded by 50 % U.S. Department of Energy matching stimulus funds and is planned to open by mid @-@ 2012 .

The 2011 Chevrolet Volt was officially launched on November 30 , 2010 at a ceremony at the Hamtramck plant , where the first production unit for retail sale came off the assembly line . The first retail vehicle was delivered to a customer in Denville , New Jersey on December 15 , 2010 . GM reported it had built 12 @,@ 400 Volts in total through December 2011 . This includes dealers ' demo vehicles in North America and Amperas in dealerships in Europe , crash test vehicles and other unavailable Volts owned by GM .

GM halted production for about one month at the Detroit / Hamtramck Assembly plant by mid June 2011 to complete some upgrades , including the installation of new tooling , equipment and overhead conveyor systems throughout the facility . These upgrades allowed GM to triple the rate of Volt production and prepared the plant for 2012 Volt and Ampera production . After the plant retooling , the production rate reached 150 units per day four days a week by August 2011 . The Volt plant was also down during January 2012 in preparation for building the California lower @-@ emission version . A four @-@ week shutdown due to slow sales took place between March and April 2012 . GM said it had around 3 @,@ 600 Volts in inventory and needed to reduce dealer inventories as production is expected to meet market demand . GM also extended the traditional two @-@ week summer vacation by an extra week at the Hamtramck plant . GM closed its Detroit @-@ Hamtramck plant from September 17 until October 15 , 2012 , affecting roughly 1 @,@ 500 workers on downtime while the plant was retooled to assemble the all @-@ new 2014 Chevrolet Impala alongside the 2013 Volt . This was the second time in 2012 that GM has halted Volt production .

Production of the 2013 model year Volt began in July 2012 and customer deliveries began during the same month . In October 2012 , GM announced that the Cadillac ELR extended @-@ range luxury coupe will be built at the Detroit @-@ Hamtramck Assembly plant , together with he Chevrolet Volt , Opel Ampera , and Holden Volt . The addition of the ELR to the plant represents an additional US $ 35 million investment , bringing the total product investment to US $ 561 million since December 2009 . The first 2014 ELRs rolled off the production line in late May 2013 . These were pre @-@ production units destined for testing purposes before production for retail customers began at the end of 2013 . Deliveries of the 2014 model year Volt began in August 2013 . Volt sales in the U.S. reached the 50 @,@ 000 unit milestone in October 2013 , with over 60 @,@ 000 vehicles of the Volt / Ampera family sold worldwide . Production of the 2015 model year Volt ended in mid @-@ May 2015 , while manufacturing of pre @-@ production units of the second generation began in March 2015 .

= = = = United States = = = =

Sales of the 2011 Chevrolet Volt began in selected markets due to limited initial production , as General Motors ' original target for 2011 was 10 @,@ 000 units . The first cars were delivered in Washington D.C. , the New York City metropolitan region , California , and Austin , Texas . By May 2011 the Volt had been launched also in Connecticut , Maryland , Michigan , New Jersey , and Virginia . Deliveries in Delaware , Florida , Georgia , Hawaii , North Carolina , Oregon , Pennsylvania , South Carolina , and Washington began in the third quarter of 2011 . In June 2011 , Chevrolet dealers nationwide began taking orders for the 2012 Volt , and deliveries in all 50 states began in November 2011 .

The suggested retail price (MSRP) for the 2011 Chevrolet Volt in the U.S. started at US $ 40 @,@ 280 which excluded destination freight charge , tax , title , license , dealer fees and optional equipment and before any savings due to factory incentives , tax deductions , or other available subsidies for qualifying buyers . The MSRP for the 2012 Volt starts at US $ 39 @,@ 995 including a US $ 850 destination freight charge and excludes tax , title and license fees , or other available government subsidies . The base price is US $ 1 @,@ 005 less than the 2011 model year , and General Motors explained that this price reduction is possible because of a " wider range of options and configurations that come with the expansion of Volt production for sale nationally . " The price will drop to US $ 34 @,@ 995 including destination charges for the 2014 model year .

Due to the capacity of the Volt 's battery pack it qualifies for the maximum US $ 7 @,@ 500 federal tax credit as specified in the Emergency Economic Stabilization Act of 2008 . The federal tax credit phases out over a one @-@ year period after the manufacturer has sold at least 200 @,@ 000 vehicles in the U.S. Several states also have additional incentives or rebates available for plug @-@ in electric vehicles for qualifying buyers . The 2011 Volt price including all available regular production and premium options is US $ 44 @,@ 600 , including destination charges and before tax credits or any subsidies . For the 2012 model year the price of the Volt with all available options is US $ 46 @,@ 265 before tax credits or any subsidies available .

Although the Volt 's retail price is higher than its main competitor , the 2011 Nissan Leaf , the lease payment for the Volt is almost the same as its competitor , except that the Leaf has a lower initial payment . General Motors explained that " the apparent disparity between the Volt 's sticker and lease prices is a reflection of the company 's calculation that the vehicle will maintain a very high residual value after three years ? significantly higher than that of the LEAF . "

The price for the home charging units is US $ 490 plus installation costs . The Voltec is a home @-@ charging unit built by SPX for Volt owners . It is a 240 @-@ volt (Level II) charger , and , according to General Motors , can replenish the Volt 's batteries in about four hours . Consumer Reports has advised buyers to budget up to US $ 2 @,@ 000 , as many older homes may need a substantial electrical upgrade because the U.S. National Electrical Code requires that the charger have its own dedicated 220 @-@ volt , 30 @-@ amp circuit . Early buyers can benefit from the federal tax credit available for charging equipment .

The 2011 Volt was not submitted for application to the California Air Resources Board 's (CARB) Clean Vehicle Rebate Project rebate and therefore was not required to meet the 10 @-@ year 150 @,@ 000 @-@ mile (240 @,@ 000 km) battery warranty requirement for enhanced advanced technology partial zero @-@ emissions vehicles (enhAT @-@ PZEV) . The Volt team explained that for the launch General Motors decided to go with a common national package which includes an 8 @-@ year 100 @,@ 000 @-@ mile (160 @,@ 000 km) battery warranty . For this reason owners of the 2011 Volt did not qualify for California 's rebates and free access to use carpool lanes even when traveling solo . A third package , scheduled for 2013 , is under development with an E85 flex @-@ fuel engine . General Motors engineering team commented that " introducing two or three packages of an entirely new technology set and platform at the same time wasn 't an option . "

In February 2012 General Motors began deliveries of a low emission version destined for California that features a new low emissions package that allows the 2012 Chevrolet Volt to qualify as an enhanced , advanced technology ? partial zero emissions vehicle (enhAT @-@ PZEV) and have access to California ? s high @-@ occupancy vehicle lanes (HOV) . The new standard California version of the Volt features a modified engine and exhaust components . The catalytic converter was modified to add a secondary air @-@ injection pump that " streams ambient air into the exhaust stream to increase its ability to remove pollutants . " Owners of a 2012 Volt with the low emissions package are eligible to apply for one of 40 @,@ 000 available HOV lane stickers issued to vehicles that qualify as a California AT @-@ PZEV . The permits are handed out on a first @-@ apply , first @-@ served basis . Additionally , the new low emissions package makes the 2012 Volt eligible for owners to receive up to US $ 1 @,@ 500 in state rebates through the state ? s Clean Vehicle Rebate Project (CVRP) . This incentive is in addition to the federal government ? s US $ 7 @,@ 500 tax credit . Only the 2012 Volts manufactured after February 6 , 2012 , are fitted with the low emission package and sold as standard models in California . Other states where the Volt has solo driving access to HOV lanes are Florida , Georgia , New York and Virginia .

U.S. sales

Since sales began in December 2010 , a total of 98 @,@ 558 Volts have been sold in the country through June 2016 . The Volt ranked as the all @-@ time top selling plug @-@ in electric car in the United States until February 2015 , when it was surpassed by the all @-@ electric Nissan Leaf in March 2015 . Cumulative Volt sales passed Leaf sales in March 2016 , and became once again the best selling plug @-@ in car in the American market .

The top 10 selling states during the first quarter of 2012 were California , Michigan , Florida , Illinois , Texas , New York , Minnesota , Ohio , North Carolina and Maryland . California is the leading

market and accounted for almost 23 % of Volt sales during this quarter , followed by Michigan with 6 @.@ 3 % of national sales . In California the leading regional markets are San Francisco , Los Angeles , and San Diego , all metropolitan areas notorious for their high congestion levels and where free access to high @-@ occupancy lanes for solo drivers has been a strong incentive to boost Volt sales in the state .

Resale value

In May 2011 Kelley Blue Book (KBB) projected the 2011 Chevrolet Volt resale value at just over US $ 17 @,@ 000 after 36 months , the length of a typical lease , which represents 42 % of the car 's US $ 41 @,@ 000 suggested retail price (MSRP) . KBB explains that even though the residual value seems low , the projection considers that the first 200 @,@ 000 Volts sold will qualify for a US $ 7 @,@ 500 federal tax credit , which effectively reduces the MSRP to US $ 33 @,@ 500 , making the US $ 17,000represent 51 % of its original value after the tax credit . In comparison , KBB notes , the 2011 Toyota Prius has a projected residual of 46 % after 36 months . KBB 's estimate assumed gasoline price will be around US $ 4 per gallon in 2014 . For 2012 , Kelley Blue Book expected the Volt to retain 42 % of its original value after 3 years and 27 % after 5 years . Based on these figures , in November 2011 KBB awarded the Volt with the 2012 Best Resale Value Awards in the plug @-@ in electric car category . KBB explains that the residual value for the Volt is lower than the market 35 @.@ 5 % average due to the US $ 7 @,@ 500 federal tax credit , which lowers the transaction price and pushes down the residual value .

Consumer Reports ' analysis show that many Chevrolets lose about half of their purchase price after three years of ownership , and if the Volt depreciates the same , US $ 17 @,@ 000 seems a reasonable estimate . However , Consumer Reports have noted that fuel @-@ efficient hybrids and diesel models often depreciate far less than most vehicles , which might increase the Volt 's resale value after three years above the US $ 17 @,@ 000 estimate . Additionally , if gasoline prices continue to rise or if the tax credits expire , the demand for used Chevrolet Volts could quickly increase , raising their market value . On the other hand , if the next @-@ generation Volt ? s battery has twice the capacity and cost less , as General Motors has claimed , the first generation Volts will be obsolete when the new ones come out in 2015 . Considering these assumptions , Consumer Reports considers that " at this point we believe it ? s still unclear how the Volt will fare . "

Pecan Street demonstration project

General Motors is sponsoring the Pecan Street demonstration project at the Mueller neighborhood in Austin , Texas . The project objective is to learn the charging patterns of plug @-@ in electric car owners , and to study how a residential fleet of electric vehicles might strain the electric grid if all owners try to charge them at the same , which is what the preliminary monitoring found when the plug @-@ in cars return home in the evening . As of June 2013 , the community has nearly 60 Chevrolet Volt owners alone thanks to GM 's commitment to match the federal government 's US $ 7 @,@ 500 rebate incentive , which halves the purchase price of the Volt .

= = = = Canada = = = =

Chevrolet began taking orders in May 2011 and deliveries began in September 2011 in major cities only . During 2012 the Volt was the best selling plug @-@ in car in Canada , outselling all other PEVs combined . Despite a 24 % reduction from 2012 sales , the Volt continued as the top selling PEV in the Canadian market in 2013 , and again in 2014 with 1 @,@ 521 units . As of December 2015 , the Volt continued to rank as the top selling plug @-@ in electric car in Canada . Since September 2011 , a total of 6 @,@ 387 Volts have been delivered in Canada through May 2016 . The monthly sales record was set in May 2016 with 270 deliveries .

The suggested retail price (MSRP) for the 2012 Chevrolet Volt starts at CA $ 41 @,@ 545 (US $ 42 @,@ 423 in June 2011) which excludes any charges , fees , and optional equipment and before any available subsidies or incentives for qualifying buyers . In the Canadian market , the Volt is offered in one standard trim level with two option packages , a Premium Trim Package and a Rear Camera and Park Assist Package . Some provinces are offering Government incentives including

Ontario , Quebec (both at CA $ 8 @,@ 500 US $ 8 @,@ 680) and British Columbia has announced their new LiveSmart BC program in which the Chevrolet Volt qualifies for a CA $ 5 @,@ 000 incentive / rebate as well as CA $ 500 towards charging equipment .

= = = Europe = = =

The European version of the Volt , the Opel Ampera (known as the Vauxhall Ampera in the United Kingdom) , was unveiled at the Geneva Auto Show in March 2009 and also was exhibited at the 2009 Frankfurt Auto Show . Opel developed the battery control modules for the Ampera at the Opel Alternative Propulsion Center Europe in Mainz @-@ Kastel , Germany . The production version of the Ampera was unveiled at the 2011 Geneva Motor Show . The Ampera is assembled at the Detroit / Hamtramck Assembly plant , Michigan .

The main differences between the Volt and the Ampera are in their styling . The Ampera has a distinctive front and rear fascia , with a large cut @-@ out in the rear bumper . The Opel Ampera features more stylized alloy wheels as standard , and the side skirts are body @-@ colored rather than black . In the inside there are only minor differences and both versions share the same exact powertrain and battery pack . A key operational difference was that the Ampera has four drive modes , one more than the 2011 / 12 model year Volt . The additional option is " City Mode " , which adapts battery management to the needs of commuter travel . City mode or " battery hold " engages the range @-@ extender immediately , allowing to save the energy currently stored in the battery , and when switched off , the range @-@ extender stops and the Ampera is then able to use the energy saved in the battery for pure electric driving , for example for traveling urban areas or restricted zones , such as the European low emission zones or to allow the Ampera to qualify for an exemption of the London congestion charge The 2013 model year Volt included the " Hold Drive " button to allow drivers to conserve battery @-@ pack energy for use at a particular time of their choice .

Sales

General Motors production target for 2012 was to manufacture 10 @,@ 000 Amperas for sale in Europe , 6 @,@ 000 destined for Opel and 4 @,@ 000 for Vauxhall in the UK , plus an additional 2 @,@ 000 Volts were to be made available for the region . The carmaker targeted the Ampera for business fleet market and local government agencies , where Opel has a strong customer base , while the Volt is aimed at retail customers . According to Opel , by June 2011 around 5 @,@ 000 customers across Europe had reserved an Ampera , with fleet or business customers representing 60 % of reservations , and a total of 7 @,@ 000 orders were received by March 2012 , with Benelux , Germany and the United Kingdom as the top markets in terms of orders .

The first deliveries of the Chevrolet Volt in Europe took place on November 30 , 2011 , to the U.S. Embassy in France . Distribution of the Opel Ampera to dealerships began in December 2011 , but deliveries to customers were delayed until February 2012 because Opel decided to wait until the NHTSA completed its investigation of the Volt 's battery fire risk after a crash . Since May 2012 the Vauxhall Ampera is available through the Zipcar carsharing club in London , Bristol , Cambridge and Oxford .

The Opel / Vauxhall Ampera was Europe 's top selling plug @-@ in electric car in 2012 with 5 @,@ 268 units and captured a 21 @.@ 5 % market share of the region 's plug @-@ in electric passenger car segment . As of October 2013 , the Ampera held a market share of almost 10 % of European registration of plug @-@ in electric cars since 2011 . The market share in the Netherlands was 40 % and 10 % in Germany . Ampera sales fell 40 % in 2013 to 3 @,@ 184 cars , and within the plug @-@ in hybrid segment , the Ampera was surpassed in 2013 by the Mitsubishi Outlander P @-@ HEV (8 @,@ 197) , Volvo V60 plug @-@ in (7 @,@ 437) , and the Prius plug @-@ in (4 @,@ 314) . In 2013 the Ampera ranked eighth among Europe 's top selling plug @-@ in electric vehicles , and its market share fell to about 5 % . During the first five months of 2014 , only 332 units had been sold , down 67 % from the same period in 2013 . In July 2014 , Opel announced that due to the slowdown in sales , the Ampera will be discontinued after the launch of second generation Volt , and between 2014 and 2018 , Opel plans to introduce in Europe a successor product in the electric

vehicle segment . Ampera sales totaled 939 units in 2014 , and only 215 units during the first nine months of 2015 .

As of December 2015 , Opel / Vauxhall Ampera sales totaled almost 10 @,@ 000 units since 2011 , with the Netherlands as the leading market with 5 @,@ 031 Amperas registered , followed by Germany with 1 @,@ 542 units , and the UK with 1 @,@ 250 units registered by the end of June 2015 . The Netherlands is also the top selling Volt market in Europe with 1 @,@ 062 units registered through December 2014 , > out of about 1 @,@ 750 Volts sold through 2014 .

Pricing

In February 2011 Opel announced that the Ampera was to be offered for a uniform price throughout the Eurozone at ? 42 @,@ 900 (US $ 56 @,@ 920 in May 2012) including VAT , but prices by country may vary due to the trim levels that will be offered in each market . The Chevrolet Volt also has a uniform price that starts at ? 41 @,@ 950 (US $ 55 @,@ 660 in May 2012) including VAT . The Opel Ampera is eligible to several subsidies and tax breaks available for plug @-@ in electric vehicles in several European countries .

In the UK , the Vauxhall Ampera starts at GB £ 37 @,@ 250 (US $ 60 @,@ 400 in May 2012) before discounting the GB £ 5 @,@ 000 Plug @-@ in Car Grant The Chevrolet Volt will also be available in the UK at a cost of GB £ 33 @,@ 545 (US $ 54 @,@ 400 in May 2012) before the government grant . All Volts in the UK will come standard with leather interior .

= = = China = = =

General Motors unveiled the Chevrolet Volt in Shanghai under its Chinese name of ??? (Wo Lan Da) in September 2010 . The first Volts , out of the 10 @-@ vehicle demonstration fleet , arrived in China by late December 2011 . The demonstration program is taking place in Beijing , Tianjin and Shanghai .

The Volt went on sale in China by late 2011 with pricing starting at CN ¥ 498 @,@ 000 (around US $ 78 @,@ 300 as of August 2012) and sales are limited to eight Chinese cities : Beijing , Shanghai , Hangzhou , Suzhou , Wuxi , Guangzhou , Shenzhen and Foshan . GM explained that 13 dealerships were selected in the eight cities , and they were chosen because these " cities have more elites who are inclined to try new technologies and lead the fashion tide . "

However , according to General Motors , in a move illegal under WTO rules the Chinese government refused the allow Chevrolet Volt owners access to up to US $ 19 @,@ 300 in government subsidies available for plug @-@ in vehicles unless GM had agreed to transfer intellectual property to a joint venture with a Chinese automaker for at least one of the Volt ? s three core technologies : electric motors , complex electronic controls , and power storage devices , whether batteries or a fuel cell . General Motors negotiated with the Chinese government to let the Volt qualify for the subsidies without the technology transfer , but as of November 2011 , the subsidies were available only for electric cars made by Chinese automakers . As a result of the high import duties , General Motors reported in August 2012 that sales are minimal , those of a very low @-@ volume car . According to LMC Automotive , a total of 18 Volts have been sold in China through June 2012 .

In March 2012 , General Motors announced that an agreement was signed with the China Automotive Technology and Research Center (CATARC) to manage the Volt demonstration fleet in Beijing and to gather feedback from the fleet usage for one year . The demonstration Volts were scheduled to be delivered in April 2012 .

= = = Other markets = = =

Australia

Deliveries of the Holden Volt in the Australian market began in December 2012 , and the first Volt was delivered to the U.S. Ambassador in Canberra . Pricing starts at A $ 59 @,@ 990 (around US $ 62 @,@ 598) . In November 2011 the first Holden Volt arrived in Australia for a series of evaluation tests . Holden has announced that the Volt underwent numerous modifications to better

suit it to Australian roads , although the test vehicles are left @-@ hand drive .

The Holden Volt is available to purchase through 49 select Holden dealerships throughout metropolitan and rural Australia , with 18 in Victoria , 11 in New South Wales , 9 in Queensland , 7 in Western Australia and 4 in South Australia . A total of 80 Holden Volts were sold during 2012 , and 101 units in 2013 . A total of 246 Holden Volts had been sold in the country by mid April 2015 , with the stock of the first generation almost empty . General Motors announced that it will not build the second generation Volt in right @-@ hand @-@ drive configuration , so the Volt will be discontinued in the country when the remaining stock is sold out .

Brazil

General Motors do Brasil announced that it will import from five to ten Volts to Brazil during the first semester of 2011 as part of a demonstration and also to lobby the federal government to enact financial incentives for green cars . If successful , General Motors would adapt the Volt to operate on ethanol fuel , as most new Brazilian cars are flex @-@ fuel .

Japan

In December 2010 , General Motors announced plans to introduce the Volt in limited numbers into Japan in 2011 for technology and market test purposes . Exports for retail sales will depend on the results of this trial .

Mexico

The second generation Volt was released for retail customers in December 2015 . Pricing starts at 638 @,@ 000 pesos (~ US $ 36 @,@ 880) , and it is available in Mexico City , Monterrey , Guadalajara , Querétaro , and Puebla .

New Zealand

The Holden Volt will be released in New Zealand through three dealerships , with one in Auckland , Christchurch and Wellington . Deliveries are scheduled to begin by late 2012 and pricing starts at NZ $ 85 @,@ 000 (around US $ 71 @,@ 930) .

= = = Global sales = = =

Combined global Volt / Ampera sales passed the 100 @,@ 000 unit milestone in October 2015 . The Volt family of vehicles ranks as the world 's all @-@ time top selling plug @-@ in hybrid , and it is also the second best selling plug @-@ in electric car ever , after the Nissan Leaf , which has sold 200 @,@ 000 units worldwide by early December 2015 . The Volt / Ampera family was the world 's best selling plug @-@ in electric car in 2012 with 31 @,@ 400 units sold . The Opel / Vauxhall Ampera was Europe 's top selling plug @-@ in electric car in 2012 with 5 @,@ 268 units , representing a market share of 21 @.@ 5 % of the region 's plug @-@ in electric passenger car segment . However , during 2013 Ampera sales fell 40 % , and the declining trend continued during 2014 and 2015 .

As of March 2016 , global Volt / Ampera family sales totaled over 110 @,@ 000 units since its inception in December 2010 , including almost 10 @,@ 000 Opel / Vauxhall Amperas sold in Europe up to December 2015 . As of May 2016 , Chevrolet Volt sales are led by the United States with 96 @,@ 621 units delivered , followed by Canada with 6 @,@ 387 units , and the Netherlands with 1 @,@ 062 Volts registered through December 2015 , together representing 99 % of global Volt sales . Out of the 9 @.@ 989 Opel / Vauxhall Amperas sold in Europe through December 2015 , 5 @,@ 031 were registered in the Netherlands , 1 @,@ 542 in Germany , and 1 @,@ 279 in the UK by the end of September 2015 , together representing 78 % of Ampera sales .

The following tables present retail sales of the Volt and Ampera variants through December 2015 for the top selling national markets by year since deliveries began in December 2010 . Demonstration vehicles allocated to dealerships are not included in retail sales reports while they are used for test drives .

= = Related concept cars = =

Cadillac Converj

The Cadillac Converj is a plug @-@ in hybrid concept car first unveiled at the 2009 North American International Auto Show which incorporated the propulsion system from the Chevrolet Volt , including the Voltec powertrain . In August 2011 , General Motors announced its decision to produce the Converj as the Cadillac ELR . The first 2014 ELRs rolled off the production line in late May 2013 . These were pre @-@ production units destined for testing purposes and production for retail customers started at the end of 2013 . The ELR was released to retail customers in the U.S. in December 2013 .

Volt MPV5

At the 2010 Auto China show General Motors unveiled the Chevrolet Volt MPV5 Concept . The Volt MPV5 is a plug @-@ in crossover hybrid and has a top speed of 100 mph (160 km / h) and an electric range of 32 miles (51 km) . The MPV5 integrates design elements from the Volt , with a body style very similar to the Chevrolet Orlando and four inches larger than its predecessor , Chevrolet HHR .

Opel Monza Concept

The Opel Monza Concept is a four @-@ seat coupe plug @-@ in hybrid concept car with gullwing door unveiled at the 2013 Frankfurt Motor Show . The concept shares the same basic plug @-@ in hybrid setup as the Chevrolet Volt and Opel Ampera , but using a turbocharged 1 L 3 @-@ cylinder natural gas @-@ powered engine as its range extender instead of General Motors ? current 1 @.@ 4 L gasoline engine . According to Opel , this concept is the role @-@ model for the next generation of Opel cars , and because of its modular chassis design , future cars based on it would be able to accommodate gasoline , diesel or electric power .

= = Controversies and criticism = =

= = = EPA fuel economy testing = = =

In 2008 , General Motors was concerned about how the United States Environmental Protection Agency (EPA) would test the Volt to determine its official fuel economy rating . The controversy centered on whether , by including a gasoline engine , the Volt should be classified as a hybrid rather than an electric car as claimed by General Motors . If tested with the same EPA tests used by other hybrids , the Volt 's EPA fuel economy rating would be around 48 mpg @-@ US (4 @.@ 9 L / 100 km ; 58 mpg @-@ imp) due to the current EPA test for hybrids disallowing vehicles from boosting their mpg rating using stored battery power . General Motors stated that the Volt is an entirely new type of vehicle which the EPA 's current fuel economy tests were not suited to rate and that a new test should be devised for this emerging class of hybrid @-@ electrics . General Motors also advocated for a more simplified mpg calculation method to take into account the range of a plug @-@ in hybrid while running solely on electricity . Because the Volt can travel 40 miles (64 km) on batteries alone , GM argued that most drivers with a daily commute of less than that distance would drive only in electric mode , so long as they recharged their vehicle at work or at home overnight .

The EPA official rating issued in November 2010 included separate fuel economy ratings for all @-@ electric mode and gasoline @-@ only mode , with an overall combined city / highway gasoline @-@ electricity fuel economy rating of 60 mpg @-@ US (3 @.@ 9 L / 100 km ; 72 mpg @-@ imp) equivalent (MPG @-@ e) . To address the variability of the fuel economy outcome depending on miles driven between charges , EPA also included in the Volt 's fuel economy label a table showing fuel economy and electricity consumed for five different scenarios driven between a full charge , and a never @-@ charge scenario . According to this table the Volt 's fuel economy goes up to 168 mpg @-@ US (1 @.@ 40 L / 100 km ; 202 mpg @-@ imp) equivalent (MPG @-@ e) if driven 45 miles (72 km) between full charges . Also , in recognition of the multiple operating modes that a plug @-@ in hybrid can be built with (all @-@ electric , blended , and gasoline @-@ only) , for the new fuel economy and environment label that will be mandatory in the U.S. beginning in model year 2013 , EPA and the National Highway Traffic Safety Administration (NHTSA) issued two separate

fuel economy labels for plug @-@ in hybrids . One label is for extended @-@ range electric vehicles , like the Chevy Volt , with two modes : all @-@ electric and gasoline @-@ only ; and a second label for blended mode that includes a combination of all @-@ electric , gasoline and electric operation , and gasoline only , like a conventional hybrid vehicle .

= = = EPA fuel economy rating = = =

In August 2009 , General Motors released its estimated city fuel economy rating for the Volt of 230 mpg @-@ US (1 @.@ 0 L / 100 km ; 280 mpg @-@ imp) of gasoline plus 25 kWh / 100 mi (560 kJ / km) of electricity using the EPA 's proposed method for evaluating plug @-@ in hybrids . The U.S. Environmental Protection Agency (EPA) issued a statement clarifying that the " EPA has not tested a Chevy Volt and therefore cannot confirm the fuel economy values claimed by GM . " In July 2010 , GM explained that their estimate was based on a formula that had not been officially approved and that they had been awaiting the EPA 's decision on how the equivalent fuel economy of plug @-@ in hybrids would be estimated .

The official EPA rating was issued in November 2010 and became the agency 's first fuel economy label for a plug @-@ in hybrids . The EPA rated the 2011 Volt combined fuel economy at 93 miles per gallon gasoline equivalent (MPG @-@ e) in all @-@ electric mode , and 37 mpg @-@ US (6 @.@ 4 L / 100 km ; 44 mpg @-@ imp) in gasoline @-@ only mode , for an overall combined fuel economy rating of 60 mpg @-@ US (3 @.@ 9 L / 100 km ; 72 mpg @-@ imp) equivalent (MPG @-@ e) . The label also shows the combined city @-@ highway fuel economy in all @-@ electric mode expressed in traditional energy consumption units , rating the Volt at 36 kWh per 100 miles (160 km) .

= = = Production cost and sales price = = =

In 2009 , the Presidential Task Force on the Auto Industry said that " GM is at least one generation behind Toyota on advanced , ? green ? powertrain development . In an attempt to leapfrog Toyota , GM has devoted significant resources to the Chevy Volt . " and that " while the Chevy Volt holds promise , it is currently projected to be much more expensive than its gasoline @-@ fueled peers and will likely need substantial reductions in manufacturing cost in order to become commercially viable . " A 2009 Carnegie Mellon University study found that a PHEV @-@ 40 will be less cost effective than a HEV or a PHEV @-@ 7 in all of the scenarios considered , due to the cost and weight of the battery . Jon Lauckner , a Vice President at General Motors , responded that the study did not consider the inconvenience of a 7 miles (11 km) electric range and that the study 's cost estimate of US $ 1 @,@ 000 per kWh for the Volt 's battery pack was " many hundreds of dollars per kilowatt hour higher " than what it costs to make today . "

In early 2010 , it was reported that General Motors would lose money on the Volt for at least the first couple of generations , but it hoped the car would create a green image that could rival the Prius .

After the Volt 's sales price was announced in July 2010 , there was concern expressed of the launch price of the Volt and its affordability and resulting popularity , especially when the federal subsidies of US $ 2 @.@ 4 billion were taken into account in the development of the car .

General Motors CEO Edward Whitacre Jr. rejected as " ridiculous " criticism that the Volt 's price is too expensive . He said that " I think it 's a very fair price . It 's the only car that will go coast to coast on electricity without plugging it in , and nobody else can come close . " Despite the federal government being the major GM shareholder due to the 2009 government @-@ led bankruptcy of the automaker , during a press briefing at the White House a Treasury official clarified that the federal government did not have any input on the pricing of the 2011 Chevrolet Volt .

There have also been complaints regarding price markups due to the initial limited availability in 2010 of between US $ 5 @,@ 000 to US $ 12 @,@ 000 above the recommended price , and at least in one case a US $ 20 @,@ 000 mark up in California . Even though the carmaker cannot dictate vehicle pricing to its dealers , GM said that it had requested its dealers to keep prices in line

with the company ? s suggested retail price .

In May 2011 the National Legal and Policy Center announced that some Chevrolet dealers were selling Volts to other dealers and claiming the US $ 7 @,@ 500 federal tax credit for themselves . Then the dealers who bought the Volts sell them as used cars with low mileage to private buyers , who no longer qualify for the credit . General Motors acknowledged that 10 dealer @-@ to @-@ dealer Volt sales had taken place among Chevrolet dealers , but the carmaker said they do not encourage such practice .

In September 2012 , Reuters published an opinion / editorial article where it claimed that General Motors , nearly two years after the introduction of the car , was losing US $ 49 @,@ 000 on each Volt it built . The article concluded that the Volt is " over @-@ engineered and over @-@ priced " and that its technological complexity has put off many prospective buyers , due to fears the car may be unreliable . GM executives replied that Reuters ' estimates were significantly flawed as they also allocated the vehicle 's research and development program costs only against the number of Volts sold in the United States (as of August 2012) , instead of spreading the total costs over the entire lifetime of the model , as well as including those units sold in Europe and other countries . GM explained that the investments will pay off once the innovative technologies of the Volt are applied across multiple current and future products .

= = = Battery pack fire risk = = =

In June 2011 a Volt that had been subjected by the National Highway Traffic Safety Administration (NHTSA) to a 20 mph (32 km / h) side pole impact crash test followed by a post @-@ impact rollover , caught fire three weeks later in the test center parking lot , burning nearby vehicles . The battery was found to be the source of the fire . After the fire , both Chevrolet and the NHTSA independently replicated the crash test and a subsequent vehicle rotation procedure to test for any fluid leakage , but in their first attempt they could not reproduce the conditions under which the battery pack ignited . The NHTSA said it had " concluded that the crash test damaged the Volt ? s lithium @-@ ion battery and that the damage led to a vehicle fire that took several weeks to develop . " In further testing of the Volt 's batteries carried out by NHTSA in November 2011 , two of the three tests resulted in thermal events . One battery pack was rotated 180 degrees within hours after it was impacted and began to smoke and emit sparks after rotation . In the other case , the battery pack that was crashed @-@ tested one week earlier and that had been monitored since the test caught fire . The NHTSA then took an uncommon step on November 25 , 2011 and opened a formal safety defect investigation " without any data from real @-@ world incidents " to examine the potential risks involved from intrusion damage to the battery pack in the Chevrolet Volt . After the initial Volt fire , the NHTSA examined the Nissan Leaf and other plug @-@ in electric vehicles and said its testing ? has not raised safety concerns about vehicles other than the Chevy Volt . ?

As a result of this investigation , GM announced that it would offer any new GM car in exchange to any Volt owner who has concerns while the federal investigation was taking place . In December 2011 , the company said that if necessary they were prepared to recall all the vehicles and repair them upon determination of the cause of the fires , and also announced they would buy back the car if the owner was too afraid of the potential for a fire . GM 's CEO also said that it may be necessary to redesign or make changes to the battery pack depending on the recommendations from federal officials . As of December 1 , 33 Volt owners in the U.S. and 3 in Canada had requested a loaner car . As of December 5 , General Motors reported that a couple dozen Volt owners had requested the carmaker to buy back their cars , and the company had already agreed to repurchase about a dozen . Before the carmaker agrees to buy back each vehicle , other options are explored as GM primarily wants to provide loaner cars , but " if the only way we can make them happy is to repurchase it , then we will , " a GM spokesman said . General Motors explained that the buy back price includes the Volt purchase price , plus taxes and fees , less a usage fee based on how many miles the car has been run . As of January 5 , 2012 , GM reported that around 250 Volt owners had requested either a loaner vehicle or a potential buyback .

The NHTSA also said it was working with all automakers to develop postcrash procedures to keep

occupants of electric vehicles and emergency personnel who respond to crash scenes safe . Additionally , NHTSA advised to be aware that fires may occur a considerable amount of time after a crash . General Motors said the first fire would have been avoided if GM 's protocols for deactivating the battery after the crash had been followed . These protocols had been used by GM since July 2011 but were not shared with the NHTSA until November 2011 . In another statement the carmaker stated that they ? are working with other vehicle manufacturers , first responders , tow truck operators , and salvage associations with the goal of implementing industrywide protocols . ?

Customer deliveries of the Opel Ampera in Europe were delayed until the NHTSA completed its investigation of the Volt 's battery fire risk to make sure the vehicle is safe . However , deliveries of the first Chevrolet Volts in Europe began in France in November 2011 . Deliveries of the Vauxhall Ampera in the UK continued as scheduled for May 2012 . Opel Ampera deliveries began in February 2012 .

Battery enhancements

On January 5 , 2012 , General Motors announced that it would offer a customer @-@ satisfaction program to provide modifications to the Chevrolet Volt to reduce the chance that the battery pack could catch fire days or weeks after a severe accident . The carmaker described the modifications as voluntary enhancements and stated that neither the car nor the battery was being recalled . General Motors determined the June fire was the result of a minor intrusion from a portion of the vehicle into a side section of the battery pack . This intrusion resulted in a small coolant leak inside the battery of approximately 50 mL (1 @.@ 8 imp fl oz ; 1 @.@ 7 US fl oz) . When the vehicle was put through a slow roll , where it was rotated at 90 @-@ degree increments , holding in each position for about five minutes , an additional 1 liter (0 @.@ 22 imp gal ; 0 @.@ 26 U.S. gal) of coolant leaked . With the vehicle in the 180 degrees position (upside down) , the coolant came in contact with the printed circuit board electronics at the top of the battery pack and later crystallized . Three weeks later this condition , in combination with a charged battery , led to a short circuit that resulted in the post @-@ crash fire .

General Motors explained the modifications will enhance the vehicle structure that surround the battery and the battery coolant system to improve battery protection after a severe crash . The safety enhancements consist of strengthening an existing portion of the Volt ? s vehicle safety structure to further protect the battery pack in a severe side collision ; add a sensor in the reservoir of the battery coolant system to monitor coolant levels ; and add a tamper @-@ resistant bracket to the top of the battery coolant reservoir to help prevent potential coolant overfill . The additional side safety structural pieces have a total weight of 2 to 3 lb (0 @.@ 91 to 1 @.@ 36 kg) , and their function is to spread the load of a severe side impact away from the battery pack , reducing the possibility of intrusion into the pack .

During December 2011 , GM conducted four crash tests of Volts with the reinforced steel and upgraded cooling system , resulting in no intrusion to the battery and no coolant leakage . On December 22 , 2011 , the NHTSA also subjected a modified Volt to the same test that led to the original fire , with no signs of the damage that is believed to have been the cause . The NHTSA said ? the preliminary results of the crash test indicate the remedy proposed by General Motors today should address the issue of battery intrusion ? though its investigation remained open . General Motors declined to say how much the modifications would cost .

All 12 @,@ 400 Chevrolet Volts produced until December 2011 , including all Amperas in stock at European dealerships , were scheduled to receive the safety enhancements . Since production was halted during the holidays , the enhancements were in place when production resumed in early 2012 . Sales continued , and dealers modified the Volts they had in stock . General Motors sent a letter to Volt owners indicating that they could schedule the service appointment to protect their batteries beginning in the last week of March 2012 . General Motors also decided to replace the 120 @-@ volt charging cords in most of the nearly 10 @,@ 000 Volts sold since late 2010 . The new cords were enhanced to add durability , and some of the chargers built after February 5 have the new cords .

NHTSA findings

On January 20 , 2012 , the National Highway Traffic Safety Administration closed the Volt 's safety

defect investigation related to post @-@ crash fire risk . The agency concluded that " no discernible defect trend exists " and also found that the modifications recently developed by General Motors are sufficient to reduce the potential for battery intrusion resulting from side impacts . The NHTSA also said that " based on the available data , NHTSA does not believe that Chevy Volts or other electric vehicles pose a greater risk of fire than gasoline @-@ powered vehicles . " The agency also announced it has developed interim guidance to increase awareness and identify appropriate safety measures regarding electric vehicles for the emergency response community , law enforcement officers , tow truck operators , storage facilities and consumers .

House of Representatives hearing

The chairman of the Subcommittee on Regulatory Affairs , Stimulus Oversight and Government Spending , U.S. Representative Jim Jordan held hearings on January 25 , 2012 , to investigate why the NHTSA opened a formal investigation only five months after the first postcrash battery fire occurred in June . The subcommittee of the House Committee on Oversight and Government Reform wanted to determine if government officials , including from NHTSA , purposely held back information on the Volt fire for political reasons . Both Daniel Akerson , General Motors CEO , and David L. Strickland , NHTSA administrator , denied any wrongdoing .

= = Reception = =

= = = Awards and recognition = = =

The Volt has received awards from multiple organizations :

U.S. organizations

2009 Green Car Vision Award by the Green Car Journal at the Washington Auto Show for " a bold and far @-@ reaching approach that promises to bring an exceptionally fuel efficient model to consumers at reasonable cost . "

2011 Car and Driver Ten Best Cars . For the first time ever Car and Driver magazine included an electrically powered car among its 10 best .

2011 Motor Trend Car of the Year . The magazine commented that " In the 61 @-@ year history of the Car of the Year award , there have been few contenders as hyped ? or as controversial ? as the Chevrolet Volt . "

2011 Green Car of the Year by Green Car Journal . The magazine editors explained that " This award welcomes a new genre of mass @-@ production electric vehicles to the consumer market , with the Volt as the first @-@ ever electric vehicle to take top prize . "

2011 Automobile of the Year by Automobile Magazine . The editors commented that the Volt " ... is genuinely an all @-@ new car , in the most simplistic sense as well as in the greater notion that the Volt is unlike any vehicle we have ever driven . "

2011 North American Car of the Year announced at the 2011 North American International Auto Show . Forty @-@ nine American and Canadian automobile writers chose the Volt . The nominees were judged based on " innovation , design , safety , handling , driver satisfaction and value " .

Listed among the 2011 Greenest Vehicles of the Year by the American Council for an Energy @-@ Efficient Economy .

Listed among the 2011 Best Green Cars by Mother Earth News .

2011 Edison Award - Gold in the Transportation Category , Personal Transportation Segment .

2012 Best Resale Value Award in the category of electric cars by Kelley Blue Book .

2011 The Volt ranked first in Consumer Reports ' list of owner @-@ satisfaction based on its 2011 Annual Auto Survey , with 93 % respondents who owned the Volt saying they definitely would purchase that same vehicle again . The magazine noted that the Volt had been on sale for just a few months at the time of the survey , and also clarified that the survey took place before the National Highway Traffic Safety Administration investigation regarding the Volt 's battery fire risk .

2012 Total Cost of Ownership Award in the electric car category , granted by Kelley Blue Book for the lowest projected costs during initial five @-@ year ownership period in its category .

2012 The Volt ranked first , for a second year in a row , in Consumer Reports ' list of owner @-@ satisfaction based on its 2012 Annual Auto Survey , with 92 % respondents who owned the Volt saying they definitely would purchase that same vehicle again .

2016 Green Car of the Year by Green Car Journal (awarded to the second generation Volt) . The Chevrolet Volt is the first model to receive this award more than once .

International organizations

2009 Festival Automobile International awarded the Grand Prize for Environment to the Volt .

2011 World Green Car announced at the 2011 New York Auto Show .

2012 International Engine of the Year Award in the category of Green Engine , shared by the Opel Ampera and the Chevrolet Volt for their 1 @.@ 4 L engine @-@ based extended @-@ range electric powertrain .

European organizations

2011 Overall Winner of What Car ? Green Awards , granted by the UK magazine to the Vauxhall Ampera .

2011 Top Gear 's " Green Car of the Year 2011 " to the Vauxhall Ampera .

2012 Car of the Year in Denmark . In October 2011 , 18 Danish motor journalists chose the Opel Ampera as " Car of the Year 2012 " by a wide margin , despite being more expensive than the family cars the award usually goes to .

2012 European Car of the Year , shared by the Chevrolet Volt and the Opel / Vauxhall . The Ampera / Volt became the first car developed in the U.S. to win this European award .

2013 Green Mobility Trophy . Readers of Auto Zeitung in Germany awarded the Opel Ampera the throphy and named the mid @-@ size sedan the best electric vehicle .

Rest of the world organizations

2012 Drive 's Green Innovation Award to the Holden Volt , as part of the Australia 's Drive Car of the Year Awards .

= = = Reviews and test drives = = =

The following tables summarize the results of long @-@ term tests reported by specialized media .

Notes :

1 . ^ The EPA run tests used a reproducible methodology to produce results that can be compared between vehicles and test sites . The remainder of the results were obtained using un @-@ controlled driving cycles and are comparable neither to each nor between different vehicles .