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PRODUCT INFORMATION

2013 HOLDEN VOLT

Fast Facts:

- Front-wheel drive, four passenger long range electric vehicle
- Travels over 600 kilometres on a fully charged battery and a full tank of fuel, depending on conditions
- Instant torque makes it quick off the mark, responsive and fun to drive
- Has a pure electric range of up to 87 kilometres (depending on driving conditions)
- Not a conventional hybrid – the first car of its kind in Australia
- Different to most electric cars, Volt can be recharged from a regular household outlet
- Can be fully charged from empty for as little as \$2.50
- Can be powered by renewable energy through a partnership with Better Place
- Long range capability eliminates concerns about being stranded by a depleted battery (range anxiety)
- Around 80 per cent of Australians living in major capital cities commute fewer than 80 kilometres daily and could travel petrol-free
- Introduces 'Holden first' forward collision avoidance and lane departure warning technology, offers eight airbags, rear camera
- Has advanced infotainment system with great audio interface, voice recognition, more hands-free connectivity
- Delivers keyless entry and start with sensor key technology
- Awarded prestigious North American Car of the Year and European Car of the Year honours
- Supported by a 49-strong Holden dealer network Australia-wide

Overview: the long range Holden Volt redefines electric drive

The Holden Volt is not a hybrid. It is a one-of-a-kind, all-electrically driven vehicle designed and engineered to operate in all climates, with a range of over 600 kilometres (depending on conditions).

Powered by GM's revolutionary Voltec propulsion system, it has a 16.5kWh lithium-ion battery pack and an electric drive unit that provide a pure electric range of up to 87 kilometres, depending on terrain, driving techniques and temperature.

A 1.4 litre petrol generator extends the range by operating the car's electric drive system until it can be plugged in and recharged or refuelled. This distinguishes the Volt from electric-only vehicles, which cannot be operated when recharging is not immediately available.

The battery and propulsion systems are sized so that when sufficient energy is available from the battery, the generator is not required for operation. During electric-only phase, the battery, motor, and power electronics are designed to deliver full performance, acceleration, top speed and hill climbing on electric power alone.

Every major element of the Holden Volt is designed for efficiency, including its aerodynamic exterior, lightweight wheels, low rolling resistance tyres, even the energy-saving premium stereo system.

Durable, efficient lithium-ion battery pack

Volt's battery pack is one of the first lithium-ion battery packs offered on a high-volume production vehicle. The T-shaped, 16.5kWh pack is positioned in a central tunnel and protected by ultra high-strength steel. It comprises nine linked battery modules that contain 288 prismatic lithium-ion battery cells, each of which functions as a building block.

Lithium-ion was chosen over nickel metal hydride because it packs two to three times the power of a nickel metal hydride battery in a much smaller package. It also is more efficient, offers more configurability and suffers little loss of charge when not in use.

Major features include:

- **Thermal management**

Because batteries can be sensitive to temperature changes, the Volt pack is climate-controlled via an exclusive active liquid control system that continually monitors and maintains the battery pack temperature for optimum performance and durability. Circulating liquid passes through a series of internal heat exchangers in the battery modules. The battery is designed to provide reliable operation, when plugged in, at temperatures as low as -25°C and as high as 50°C. In cold weather, the battery is preheated during charging to provide full power capability. In hot weather – the most challenging environment for a battery – the Volt's battery can be chilled during charging and driving. The Volt's thermal management system can also be powered during driving either by the battery or engine.

- **Diagnostics for safety and performance**

The battery management system continuously monitors the battery in real time.

More than 500 diagnostics run at 10 times per second. 85 per cent of the diagnostics ensure the battery pack is operating safely, while the remaining 15 per cent keep track of battery performance and life.

- **Energy management for durability**

Fully charging or fully depleting a battery shortens its life. Volt's energy management system never fully charges or depletes the battery. The battery is controlled, or buffered, so it operates within a safe state-of-charge window of 65 per cent. In demanding situations, the battery state of charge will raise the lower limit to ensure there is adequate power when needed. The battery's top and bottom buffer zones help ensure long life.

Electric drive supplies power to wheels

An 111kW electric drive unit powers Volt's wheels at all times. Positioned under the hood next to the generator, it packages a pair of electric motors and a multi-mode transaxle with continuously variable capability. Unlike a conventional powertrain, there are no step gears within the unit, and no direct mechanical linkage from the engine through the drive unit to the wheels.

Inside the drive unit, one or both of the motors drives the vehicle based on performance and speed to optimise efficiency. One of the motors serves a dual function, either to help drive the wheels, or to operate as a generator to keep the battery pack at its minimum state of charge.

To ensure the long-term durability of the electric motors, transmission fluid is pumped around and through the units to lubricate and keep the temperature down.

At higher loads and speeds, the second motor will activate as needed for efficiency. The Voltec propulsion system optimiser evaluates the best efficiency point hundreds of times per second.

It seamlessly switches from one-motor to two-motor operation to use as little energy as possible while still meeting the driver's needs.

1.4 litre generator extends range

Volt's extended driving range comes courtesy of a highly refined, 1.4 litre, 63 kW petrol generator that provides power to the electric motors.

The engine features a four-valves-per-cylinder, 16-valve aluminium cylinder head and is designed for ease of maintenance. Features include:

- Chain-drive application for low friction performance and lifetime, maintenance-free operation
- Piston-cooling oil jets for enhanced lubrication, increased longevity and longer maintenance levels
- Coil-on-plug ignition system eliminates spark plug wires for in greater operating reliability and lower maintenance requirements
- Platinum-tipped spark plugs with maintenance interval of 160,000 kilometres.

Volt requires 95 RON premium fuel because it optimises engine performance and ensures maximum fuel economy when operating in extended-range mode.

Charging

The Holden Volt doesn't require specialised recharging infrastructure as it can be recharged from a standard household outlet and charging is a simple plug-in process.

Volt comes equipped with a 6 metre charging cord, stowed in the cargo area. Its lithium-ion battery can be fully charged in less than six hours from a standard 240-volt 10A household power point. Charging time from a 240-volt 6A point is less than ten hours.

The charge cord pack is equipped with LED status indicators that illuminate green or flashing red to identify status. When all indicators are green, the vehicle can be charged. If any are flashing red, the charge cord will not permit vehicle charging due to the voltage being out of range or the electrical outlet not having a proper safety ground.

For more rapid charging options, **Better Place** is Holden's preferred partner for the delivery of faster-charging and renewable energy solutions.

The company has developed membership packages for Volt customers and assists in the installation of higher-speed (under 4-hour charge time/15A) 'Charge Spots' at homes and workplaces.

This faster charge option is aimed at fleet customers who prefer to run their vehicles predominantly on an initial battery charge.

Zero-emissions charging is provided through the purchase of renewable energy or 100 per cent Government certified renewable energy certificates.

No-compromise performance

The Holden Volt combines ultra-high efficiency with robust acceleration and performance.

Because of the electric drive unit's low-speed output torque, the Volt feels much like a V6 sedan at launch. On the highway, drivers can overtake with confidence, thanks to the drive unit's continuously variable ratio and 111kW of battery or generator and battery power.

Three drive modes: Normal, Sport and Hold

Volt is designed to perform in all climates and it offers performance modes for varying driving styles and preferences.

- **Normal mode:** the default setting and mode used most of the time. When battery energy level drops below the state-of-charge window, Volt enters extended-range operation, during which the engine automatically runs to sustain the charge and enable long range travel.
- **Sport mode:** this mode automatically reconfigures acceleration response to provide quicker torque application in sport driving situations. While it doesn't provide a higher full power output, it does provide more sensitive feedback to driver inputs.

- **Hold mode:** allows drivers to choose when Volt uses its petrol generator. This feature benefits owners who mix city and highway driving and wish to save the battery charge for city travel, where Volt's EV mode operates most efficiently.

Driving Dynamics

The Holden Volt's rigid body-frame-integral structure combines advanced, high strength steels and provides the foundation for its responsive driving dynamics.

Main underbody rails run continuously from front to rear and an isolated four-mount cradle contributes to outstanding noise and vibration performance.

Other contributors include:

- A wide track (1554mm/1577mm) and long wheelbase (2685mm) and a centre of gravity 40-mm lower than most conventional vehicles
- Standard chassis control systems such as ABS, traction control and electronic stability control
- An dual-pinion, rack-mounted electric power steering system, providing driver feedback via premium ZF steering gear
- MacPherson strut front suspension with forged aluminum components
- Cold-formed, high-performance front springs
- Semi-independent rear compound-crank suspension incorporating weight-optimised trailing arms.
- Hydraulic ride bushings
- An electro-hydraulic regenerative brake system which captures energy up to 0.2g; tuned for high-quality brake feel.

MacPherson strut front suspension features side-load compensated front strut modules to improve stability. Cold-formed, high-strength steel springs are lighter than conventional applications, use less coiling, yet deliver a rate tuned to specific weight and dynamic requirements.

Damping and spring rates are tuned for optimum performance. Hydraulic ride bushings in the control arms contribute to a higher degree of ride isolation, quieter performance, and more controlled transfer of road input loads.

The 26.5mm, hollow, direct-acting front stabiliser bar is mounted to the rear portion of the cradle with each end of the bar connected to the front strut via a direct-acting link.

Semi-independent rear suspension features a specifically adapted torsion beam with double-walled, U-shaped profile at the rear. The design combines the advantages of a conventional torsion beam axle with low weight and consistent camber control.

Primary difference between this compound crank and other torsion beam designs is a variable section formed cross-car beam. The control arms are attached to the steel cross-car beam with a patented 'magnetic-arc' welding process.

The trailing arms incorporate an advanced 3.3mm wall structure. Combined with weight-optimised rear springs, rear suspension is approximately 10 per cent lighter than traditional torsion beam suspensions.

The space-saving rear axle layout helps achieve a low centre of gravity for improved agility and allows the fuel tank to fit between the rear wheels.

Electric power steering

Volt's rack-mounted electric power steering is a dual-pinion system with variable assist. A combined electric motor/sensing unit monitors steering angle and delivers appropriate assist to the steering gear in all scenarios. The system draws its power from a 12V battery in the rear of the vehicle.

A premium ZF system incorporates outstanding torsional stiffness for near-perfect linear response, smooth, predictable transitions and an enhanced feeling of connectedness.

Brake systems

Volt's fully blended electro-hydraulic brake system is able to provide 100 per cent regenerative braking (i.e. battery recharge during braking events), 100 per cent friction braking (traditional disc braking) or any combination of each.

During regenerative braking, the system converts kinetic energy to electrical power, and then stores the energy in the battery pack. If the battery is fully charged, the brake controller directs the system to conduct friction braking.

The system uses a high-pressure hydraulic pressure accumulator to provide boosted braking. Extra solenoids in the system control the blending of friction braking and regenerative braking

Regenerative braking can provide up to 0.2g of deceleration, which covers about 94 per cent of braking events. Braking that involves more than 0.2g of deceleration is a combination of regenerative and friction braking.

The system is highly sensitive to driver inputs. During an emergency stop, the system seamlessly transitions to 100 per cent friction.

Low range braking can be chosen from the gear selector. It offers heightened regenerative braking and enables drivers to moderate their speed through the use of the accelerator pedal without applying the brake pedal.

The disc brake system features large steel vented rotors, single 60-mm piston steel calipers in the front, and single 38-mm piston steel calipers in the rear. A longer-wearing, non-asbestos organic brake lining is designed to reduce brake noise and enhance pedal feel.

Wheels and Tyres

Volt rides on lightweight forged aluminium wheels which weigh 8.1 kilograms each, compared with 11 kilograms for typical 17-inch wheels.

Its low rolling-resistance tyres were developed for optimum electric vehicle range, noise, feel, and all-weather dynamic performance.

A tyre pressure monitoring system and tyre inflation kit are standard fitment.

Interior

Volt offers the space, comfort, convenience and safety features expected of in a premium five-door sedan. Key technologies include:

- Touch-control switch system on the centre console
- High-resolution, 7" full colour LCD reconfigurable Driver Information Centre display
- High-resolution, 7" full-colour, centre stack touch screen display, the interface for infotainment and climate controls.
- Charge modes customisable according to need and electricity rates for efficient programming and lower costs.

Infotainment system features include:

- Satellite navigation
- Audio interface with
 - voice recognition and Bluetooth®,
 - DVD playback (while stationary)
 - MP3 plug and play functionality and
 - USB input with iPod® compatibility.
 - 30GB inbuilt hard drive
 - Premium Bose® audio system

Display screens

Volt has two 7-inch full colour LCD screens that display key information and house touch screen controls for infotainment, climate control, driver efficiency, charging and other key vehicle functions.

A reconfigurable, high-resolution, full-colour cluster display replaces the speedometer and other gauges found on a traditional instrument panel.

It is controlled via a Driver Information Centre select switch offering two display configurations, simple and enhanced, for information on:

- Battery state of charge and electric range
- Speedometer
- Fuel level and extended-mode range
- Driving efficiency
- Trip information
- Tyre pressure information
- Oil life
- Vehicle messages such as low fuel and error conditions
- Real time energy flow
- Following distance display

The second 7-inch full-colour, high-resolution touch screen display is mounted on the centre stack.

It features 3D graphics and is the primary interface for all infotainment and climate controls. When activated by the 'efficiency' (leaf) switch on the integrated center stack, the screen displays energy information, power flow and charging screens.

Energy information

There are three types of displays:

- **Energy Usage** screen displays information for the total of all the drive cycles since the last time the battery was fully charged. This includes distance traveled in electric and extended range modes, the total fuel used and average fuel economy. The Lifetime Fuel Economy shown on this screen represents a cumulative total over the life of the vehicle and can be reset only by the dealer.
- **Energy Efficiency** screen shows the energy efficiency over the most recent drive cycle based on driving style and climate settings.
- A third screen, **Efficiency Tips**, includes guides to improve energy use.

Power flow

Power flow screens show the energy flow between the engine, electric drive unit and battery. For example:

- **Battery Power** animation shows when energy is flowing from the battery to the drive unit and wheels.
- **Engine Power** animation occurs when the engine is active with energy flowing through the electric motors to the wheels.
- **Engine and Battery Power** animation occurs when the battery pack and engine are both shown as active, with energy flowing to the wheels.
- During **Regen Power Recovery** (which can occur in both electric and extended-range modes), power flows from the wheels to the battery pack. This happens during regenerative braking or coasting
- In **Power Off** mode, no components are active and there is no power flowing to the wheels.

Charging displays

Charging display screens are accessed via the 'Efficiency' switch or the 'Charging' button at the top of the touch screen. There are three programmable charge modes with relating screens:

- **Immediate Mode:** Volt starts charging as soon as it is connected to an electrical outlet, and the screen indicates the mode as well as estimated time of completion.
- **Delayed Departure Time Mode:** the owner schedules a departure time via the touch screen, and Volt calculates the charging start time and completion based on the schedule entered. The vehicle uses an internal clock for programmable timing.
- **Delayed Rate and Departure Time Mode:** Volt calculates the charging start time based on power utility rate schedules, rate preference and the programmed departure time for the current day of the week. In this mode, once the parameters are set by the driver, Volt will charge during the least expensive rate periods.

Safety system

- Eight airbags: dual-stage driver/passenger airbags; front driver/passenger knee airbags; side curtain airbags; thorax/pelvis side airbags
- Forward collision alert and lane departure warning systems
- Voice control for certain phone, audio and navigation functions
- Front and rear park assist
- Rear view camera
- Electronic Stability Control (ESC) incorporating:
 - Anti-lock Braking System (ABS)
 - Brake Assist (BA)
 - Electronic Brakeforce Distribution (EBD)
 - Traction Control System (TCS)
- Tyre pressure monitoring system
- Driver-activated pedestrian alert (horn chirp)
- LED daytime running lamps
- Seatbelt warning all seats
- Robust body frame integral structure - 80% advanced strength steels

Lane Departure Warning

This active safety feature helps to modify collision risks that may arise when drivers stray over lane markings unintentionally, or depart a lane without signalling first.

The system uses a windscreen-mounted digital camera that looks for lane markings to provide lane departure alerts over a certain speed.

A 'lanes detected' icon in the cluster shines green when at least one lane marking is detected. If the vehicle drifts out of the lane without turn signal indication, the Lane Departure Warning lamp switches to flashing amber and a warning tone sounds from the vehicle side affected.

Forward Collision Alert

The system uses the same windscreen-mounted camera for lane departure warning to detect slow or stationary traffic in front of the vehicle.

The system looks for vehicles ahead and warns drivers if they are following another vehicle too closely. It will also display a forward collision alert and trigger audible alerts if they are approaching another vehicle too rapidly and a collision appears to be imminent.

Forward Collision Alert can be adjusted to near, medium and far timing settings

Aerodynamics

Aerodynamicists used GM's wind tunnel to shape the Volt and reduce the energy required to overcome air resistance. A drag coefficient of just 0.28 contributes an estimated five kilometres of electric range and 80 kilometres of extended range.

Contributors to reduced turbulence and drag include a rounded and flush front fascia, tapered corners and grille, sharp rear styling, carefully designed spoiler, an aggressive rake

on windshield and back glass.

Warranty

Capped Price Servicing of \$185 is offered on Volt's first four standard scheduled log book services for the first three years or 60,000km, whichever comes first.

An eight year/ 160,000 kilometre transferrable warranty covers Volt battery and Voltec components. Included are all 161 battery components, charging and thermal-management systems and electric drive system components.

This is supported by a three year/ 100,000 kilometre warranty on the vehicle.

Place of Manufacture

General Motors Detroit-Hamtramck assembly plant, Michigan USA.

49 Holden Volt Dealers

Holden dealers from Townsville to Bunbury will sell and service the long range Volt electric car because its extended range capability means electric car ownership is no longer restricted to city dwellers.

Each dealer has committed to achieve environmental accreditation and invest in new tooling and infrastructure to support Volt servicing requirements.

Volt dealers have been required to achieve Green Stamp Plus Accreditation through the Victorian Automobile Chamber of Commerce Green Stamp program.

Dealerships attaining this accreditation must implement a minimum number of environmental management practices across their businesses. These can include recycling, efficient energy usage and reduction in the use and disposal of toxic chemicals.

Each dealer is installing a dedicated Volt charging station and investing in new tooling and training to ensure the highest standards of service for owners of Holden's first electric car.