

Encyclopedia of Electric Sports Cars



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First Edition, 2012

ISBN 978-81-323-2748-6

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Published by:
Orange Apple
4735/22 Prakashdeep Bldg,
Ansari Road, Darya Ganj,
Delhi - 110002
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WORLD TECHNOLOGIES

Table of Contents

Chapter 1 - AC Propulsion Tzero

Chapter 2 - Audi E-Tron

Chapter 3 - Fisker Karma

Chapter 4 - Honda CR-Z

Chapter 5 - Lightning GT

Chapter 6 - Tesla Roadster

Chapter 7 - Venturi Fétish

Chapter 8 - Wrightspeed X1

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Chapter- 1

AC Propulsion Tzero



The AC Propulsion tzero with the top off

The **tzero** is a hand-made electric sports car that was produced in limited numbers by the U.S. company AC Propulsion. The tzero is based on the Piontek Sportech kit car, which consists of a fiberglass body built over a reinforced steel space frame with double wishbone independent suspension and rack and pinion steering. AC Propulsion added the **AC-150** drivetrain, a single-speed electric system with an overall gear ratio of 9:1. Launched in January 1997, only three prototypes were built and plans for commercial

production were dropped in mid-2003. The name comes from t_0 , the mathematical symbol for a starting point in time.



Original Lead acid battery pack



New Lithium Ion battery pack

The original version of the roadster runs on 28 Optima Yellow Top Lead Acid batteries which produce 150 kW (200 horsepower) and 177 lbs·ft (240 N·m) of torque at 336 volts (this 28 * 12 V battery-equivalent) which rockets the 1040 kg car from 0 to 60 mph in 4.07 seconds. The single gear ratio limits the car's maximum speed to 90 miles per hour (140 km/h) at 12,000 rpm, although it is said that early prototypes fitted with multiple gear ratios could hit 155 miles per hour (249 km/h). Even with the single ratio, lead-acid models are capable of completing a quarter mile (400 m) drag race in 13.24 seconds. The expected range per charge of the tzero with the lead-acid batteries is 80 to 100 miles (130 to 160 km) as a result of consuming only 180 watt hours per mile (895 J/km) (DC) on the highway and due to regenerative braking. Within a single hour, the car can be charged from 0-95%. The base price of this version was to have been USD \$80,000.



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A second prototype was built in August 2003, powered by 6,800 lightweight lithium-ion cells, similar to those that make up the battery packs of laptop computers, giving it a 300 miles (480 km) range. Lighter than the original version by 700 pounds (320 kg), the 2003 edition goes from 0-60 mph in 3.6 seconds. The single gear ratio limits the car's maximum speed to just over 140 miles per hour (230 km/h) at 13,000 rpm with proper gearing, though it has never been tested at greater than 105 miles per hour (169 km/h). The base price of the car was USD \$220,000.

Because the car recharges its batteries when the throttle is released — slowing sharply as energy is recaptured — it can be driven hard using only the accelerator pedal. Also, if the car detects a turn with more than half a g -force (5 m/s^2), it eases the rear-wheel regenerative braking to prevent slides.



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AC Propulsion also produced a portable internal combustion powered generator mounted on a trailer known as the **Long Ranger** that could be towed behind the car and feed

power to the batteries during travel. The trailer used a 500 cc Kawasaki engine with a 9.5 U.S. gallon (40 liter) fuel tank and achieved 30 to 35 mpg over at least 20,000 highway miles. It is rated at 20 kW DC output and can maintain 60 to 80 mph. Video footage of the backtracking feature, which allows drivers to easily back a trailer through a set of slalom cones.



ACP Backtracking Genset trailer

Due to high production costs, however, AC Propulsion ceased to produce the tZERO. Only three still exist, one of which is owned by the company itself and the other two privately. The drivetrain was also used in the Wrightspeed X1.

Chapter- 2

Audi E-Tron

Audi e-tron



Manufacturer Audi AG

Production 2012 (expected production version of Detroit e-tron)

Sports car

Class roadster

supermini

Related Volkswagen BlueSport

The **Audi e-tron** family is a series of electric and hybrid concept cars shown by Audi from 2009 onwards.

It has been speculated that the second e-tron concept car, shown in 2010 in Detroit, provides a preview of a future mid-engined Audi sports car production model to be launched in 2012, possibly to be named **Audi R4** or **Audi R5**, which may be available in both electric and internal combustion engine-powered variants.

The name “e-tron” has been seen in the French-speaking press as laughingly close to the French word “étron” (*turd*).

e-tron (Frankfurt)



e-tron Frankfurt showcar

The first e-tron concept car was shown at the 2009 Frankfurt Motor Show. A two-seater, similar in appearance to the Audi R8, but slightly smaller, it is powered by four motors, providing four-wheel drive. Together, these produce 230 kW (308 bhp) and 4,500 N·m (3,319 ft·lbf) of torque, resulting in an acceleration of 0 to 100 km/h (62 mph) in 4.8 seconds.





A 470kg lithium-ion battery is located in front of the rear axle and provides a range of approximately 248 km (154 mi), with a full charge taking 6-8 hours from a normal household socket. The ceramic brake discs can also provide regenerative braking energy.

A limited production model based on this car, called the **R8 e-tron** is reported to be under development.

e-tron (Detroit)



e-tron Detroit showcar

The second e-tron concept (confusingly, also named "e-tron") was shown at the 2010 North American International Auto Show in Detroit. Smaller than the Frankfurt car, this model had only two motors, powering the rear wheels. Power output is quoted at 150 kW (201 bhp) and 2,650 N·m (1,955 ft·lbf), with acceleration from 0 to 100 km/h (62 mph) in 5.9 seconds. A similar production model, based on a future mid-engined automotive platform codenamed 9X1, shared with Porsche and Volkswagen, is reportedly under development.





A1 e-tron

The Audi A1 e-tron concept car, an electric variant of the Audi A1 production model, was first shown at the 2010 Geneva Motor Show. The A1 e-tron is a series plug-in hybrid, powered by an electric motor with a continuous output of 45 kW (61 PS; 60 bhp), and a peak output of 75 kW (102 PS; 101 bhp). A 254 cc Wankel engine is also used to power a 15 kW (20 PS; 20 bhp) range-extending generator.

e-tron Spyder



e-tron Spyder

Shown at the 2010 Paris Motor Show, this roadster is a plug-in hybrid powered by a 221 kW (296 bhp) twin-turbo TDI 3.0 L V6 diesel engine driving the rear wheels, plus two electric motors together producing 64 kW (86 bhp) powering the front wheels. Acceleration to 100 km/h (62 mph) is achieved in 4.4 seconds.



Audi presented the e-tron Spyder in January 2011 at the Las Vegas Consumer Electronics Show, near identical to the Paris show car, but this time painted bright red. The car was advertised with the same performance specifications, including an electronically limited top speed of 155 mph (249 km/h).

Chapter- 3

Fisker Karma

Fisker Karma



Manufacturer	Fisker Automotive
Production	2011
Assembly	Uusikaupunki, Finland by Valmet Automotive
Class	plug-in series hybrid luxury sports sedan
Body style(s)	4-door sedan
Layout	front engine, rear wheel drive
Platform	QTWW's Q-Drive
Engine(s)	2.0 litres (120 cu in) Turbocharged Ecotec VVT DI LNF + 2 pcs Electric Motors (201BHP equivalent each)
Transmission(s)	rear differential mating the two electric motors
Length	195.67 in (4,970 mm)

Width	78.11 in (1,984 mm)
Height	51.57 in (1,310 mm)
Designer	Henrik Fisker



Fisker Karma

The **Fisker Karma** is a plug-in hybrid luxury sports sedan revealed on 14 January 2008 at the North American International Auto Show. It is the first car from Fisker Automotive, a joint venture of Quantum Technologies and Fisker Coachbuild, LLC, announced on 5 September 2007. Fisker Automotive plans to have Valmet Automotive manufacture 75-100 cars for testing in 2010 with mass production in February 2011. The car is anticipated to have a PHEV-50, 50-mile (80 km) all-electric range, and sell for US \$95,900 for the basic model, and \$109,850 for the top model.

Features

The Karma is powered by Quantum Technologies' Q-Drive technology, an innovative petrol engine/electric motor combination; Q-Drive is a series hybrid system meaning that the engine is mated with a generator to provide an electrical connection to the motors and also recharge the batteries and as such the electric motors are the only mechanical driving force connected to the wheels.

The Karma includes as standard a solar paneled roof not only to aid in the recharging of its Lithium-Ion batteries but also to aid the cabin climate control system. The solar roof is capable of generating a half kilowatt-hour a day and is estimated to provide up to 4 to 5 miles (6.4–8.0 km) of additional range a week assuming continuously sunny days. Additionally, the car will offer a set of solar panels for the garage/house which may charge the Karma entirely 'off the grid'.





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Although Fisker Automotive has yet to release solid statistics regarding Karma's fuel economy, the company estimates the average driver will only have to refill the fuel tank annually provided they do not drive more than 50 miles (80 km) a day. Fisker Automotive has also suggested that when in 'sport-hybrid' mode the Karma will be capable of 100 miles per US gallon (2.4 l/100 km) of fuel consumed for a range of 300 miles (480 km). Despite its eco-friendly background the Karma features a 125 mph (201 km/h) top speed and is capable of reaching 60 mph (97 km/h) from a standstill in 5.8 seconds.

The Karma's two 201 brake horsepower (204 PS) motors produce 1,300 newton metres (960 ft·lbf) of torque, more than the Bugatti Veyron at 1,250 N·m (920 ft·lbf).

Convertible model

In January 2009 Fisker previewed the Karma S 'Sunset' at the North American International Auto Show, the world's first plug-in hybrid convertible, with a folding hardtop.

Production and delivery

The Finnish newspaper *Helsingin Sanomat* reported that Fisker Automotive and Valmet Automotive had reached an early agreement to manufacture the cars in Uusikaupunki, Finland. The Valmet factory located there currently produces Porsche Boxster and Cayman models (until 2012), and has previously produced various Saab models as well

as some other cars. On 13 November 2008, the final assembly contract was signed by both parties.



Fisker Automotive began accepting pre-orders in the U.S, and Europe and initially schedule sales of its Karma PHEV by the fourth quarter of 2009 in the US, and import into Europe starting in 2010. Fisker Automotive received 1300 orders for Karma in Europe and the U.S. by May 2010, and after re-scheduling the Karma launch to September 2010, the company again re-schedule production to February 2011. Instead, between 70 to 100 test cars will be built during 2010. Henrik Fisker showed the first production model Karma at the 2010 Paris Motor Show. As of January 2011, Fisker has received 3000 deposits.

The base model features an "eco-friendly interior", including salvaged lumber from fires or even from lake bottoms. Optional leather seating is available, but it will use much more of the cow hide than would customarily be found on luxury models—hides with scratches and other mars (which should not affect functionality) will be used.

Tesla lawsuit

On 14 April 2008 Tesla Motors filed a lawsuit against Fisker Automotive, alleging that Henrik Fisker stole Tesla's Model S hybrid technology and is using it to develop the Karma. Tesla's suit claimed that the design work done for the Model S sedan by Fisker Coachbuild was substandard, and that Fisker Automotive diverted its best ideas to the Karma. On 4 November 2008 CNET News reported that Tesla Motors would discontinue its suit after an interim ruling in favor of Fisker et al. A news release on the Fisker Automotive website stated that Tesla was ordered to pay \$1,144,285 in costs.

Awards

2009 marked the first time that an electric vehicle was named a North American Production Preview Vehicle of the Year by the North American Concept Vehicle of the Year Awards. The award went to Fisker Automotive for the Fisker Karma Sunset.

Chapter- 4

Honda CR-Z

Honda CR-Z (ZF1)



Manufacturer	Honda
Production	2010-present
Assembly	Suzuka, Japan
Predecessor	Honda CR-X
Class	Subcompact/supermini
Body style(s)	3-door hatchback
Layout	FF layout

Honda Hybrid System

Engine(s)	Gasoline: 1.5 L LEA I4 1,496 cc (91.3 cu in) SOHC 16-valve i-VTEC
	• (CVT) - 111 hp (83 kW) @ 6000rpm 106 lb·ft (144 N·m) @ 4800rpm
	• (MT) - 112 hp (84 kW) @ 6000rpm 107 lb·ft (145 N·m) @ 4800rpm
	Electric: DC brushless motor - MF6 Model
	14 hp (10 kW) @ 1500 rpm 58 lb·ft (79 N·m) @ 1000 rpm

Transmission(s)	CVT
	6-speed manual
Wheelbase	2,435 mm (95.9 in)
Length	4,080 mm (160.6 in)
Width	1,740 mm (68.5 in)
Height	1,395 mm (54.9 in)
Curb weight	1,236 kg (2,720 lb) (CVT)
	1,211 kg (2,670 lb) (MT)
Related	Honda Insight
	Honda Fit Hybrid

The **Honda CR-Z** is a compact hybrid electric automobile manufactured by Honda and marketed as a "sport hybrid coupe." The CR-Z combines a hybrid gasoline-electric powertrain with traditional sports car elements. The CR-Z is regarded as the spiritual successor to the second generation Honda CR-X in both name and exterior design.

In the U.S., it is one of the less polluting vehicles available and is rated as an Advanced Technology Partial Zero Emissions Vehicle (AT-PZEV) as defined by the California Air Resources Board (CARB). CR-Z is the only gasoline-electric hybrid model offered by any automaker that can be equipped with a manual transmission.

CR-Z represents the sixth unique version of Honda's IMA technology since the technology was first launched in the 2000 Insight. Sales of the CR-Z began in Japan in February 2010, and became Honda's third hybrid electric car in the market, along with the Civic Hybrid and the Insight. Sales in the U.S. began in August 2010.



Honda CR-Z Concept 2007



Honda CR-Z Concept 2009

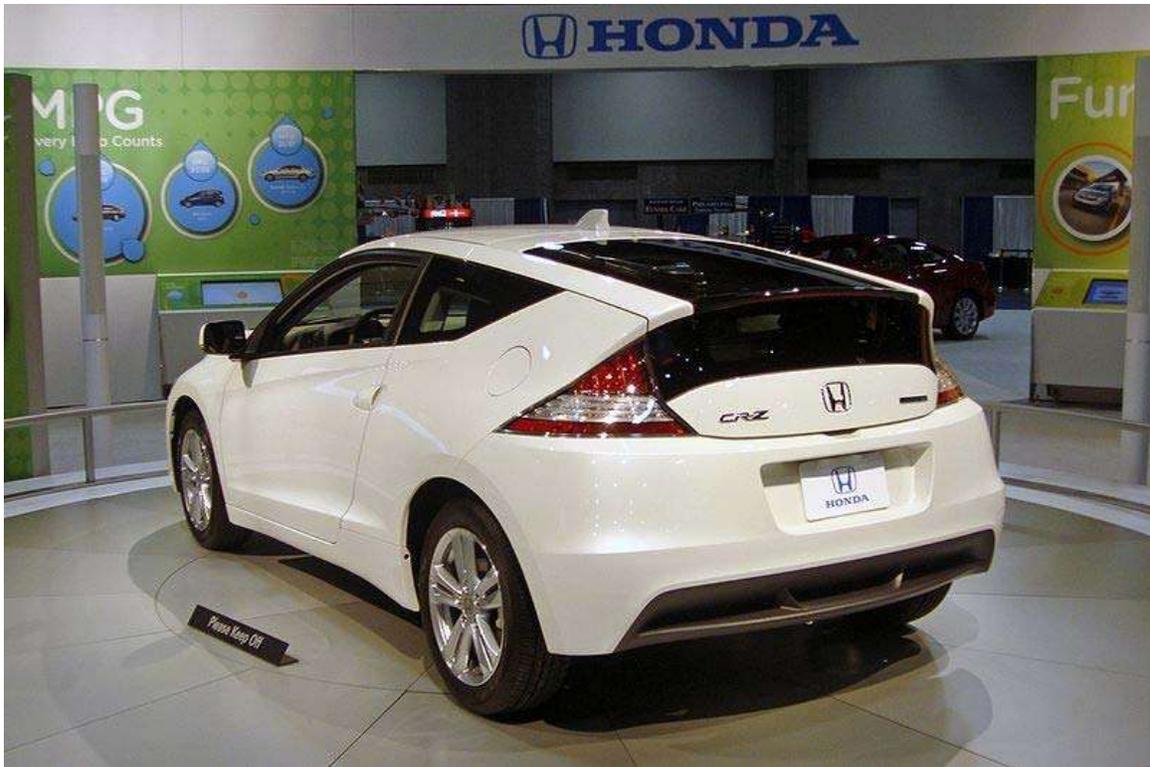


2011 Honda CR-Z production model

History

The design and production of the CR-Z followed two other Honda hybrid concept cars: the Honda Remix, introduced at the 2006 Los Angeles Auto Show, and the Honda Small Hybrid Sports, introduced at the 2007 Geneva Motor Show.

The Honda CR-Z was first introduced as a concept vehicle on October 23, 2007 at the 2007 Tokyo Motor Show. Honda explained the name "'CR-Z' stands for 'Compact Renaissance Zero'— an expression intended to capture the idea of a renaissance in the design of compact cars that begins anew from fundamentals." At the show, CEO Fukui stated that a production model is "in the works" and that the car was intended to be "sporty, incredibly efficient and inexpensive".



2011 Honda CR-Z production model.



A Honda CR-Z Mugen at the 2010 Australian International Motor Show.

The CR-Z was first shown in America at the 2008 Detroit North American International Auto Show. In the 2009 Tokyo Motor Show, Honda displayed a revised "CR-Z Concept 2009". In January 2010, Honda introduced the production CR-Z at the 2010 North American International Auto Show in Detroit.

Automotive News reported in June 2010 that since its debut at the Detroit Auto Show, the CR-Z Web site has had 1 million hits. Honda has been promoting the 2011 model from the Facebook game *Car Town*.





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Development

The project leader, Norio Tomobe, worked previously as chief engineer on Mobilio Spike and Elysion.

The basic concept of CR-Z is said to create a fun-to-drive sports car driving characteristics Honda aspired from that of the Elise, as well as the Mini and Volkswagen Scirocco. In a video, Torikai, the chief chassis engineer of CR-Z, explained that during the development process “this car was brought to Europe at each prototype stage to be tested under various road conditions to evaluate whether the desired performance had been achieved.”

Norio Tomobe believes the hybrid element will make it a sports car without guilt.

Powertrain



Rear view of the Honda CR-Z.

The CR-Z is powered by a 1.5 L (92 cu in) i-VTEC inline-4 engine, designated as LEA, with Honda's Integrated Motor Assist (IMA) hybrid-electric system. A six-speed manual transmission is standard equipment and a continuously variable transmission (CVT) is available. The system delivers a combined peak output of 122 bhp (91 kW) at 6000 rpm and 128 lb·ft (174 N·m) at 1000 to 1500 rpm (123 lb·ft (167 N·m) on CVT-equipped models). The gasoline motor itself contributes only 111 bhp (83 kW) at 6000 rpm and 106 lb·ft (144 N·m) at 4800 rpm. An early road test of a Japanese-market CR-Z resulted in 0-60 in 10.5 seconds and the quarter mile in 17.6 seconds. Inside Line performed the same 0-60 test in 8.8 seconds, and Motor Trend, in 8.3 seconds.

Fuel economy

Japanese fuel economy ratings are 4.0 litres per 100 kilometres (59 mpg_{US}) for CVT and 4.4 litres per 100 kilometres (53 mpg_{US}) for MT in 10•15 mode; and 4.4 litres per 100 kilometres (53 mpg_{US}) for CVT and 4.9 litres per 100 kilometres (48 mpg_{US}) for MT in JC08 mode.

The 2011 CR-Z U.S. EPA ratings are 31 miles per US gallon (7.6 L/100 km; 37 mpg_{imp}) for city and 37 miles per US gallon (6.4 L/100 km; 44 mpg_{imp}) for highway with manual transmission. The model with CVT transmission has a rating of 35 miles per US gallon (6.7 L/100 km; 42 mpg_{imp}) for city driving cycle and 39 miles per US gallon (6.0 L/100 km; 47 mpg_{imp}) for highway.

When comparing fuel economy to the CR-Z's older cousin, according to fueleconomy.gov, the 1988 gasoline-powered Honda CR-X HF had an EPA rating of 50 miles per US gallon (4.7 L/100 km; 60 mpg_{imp}) for city driving and 56 miles per US gallon (4.2 L/100 km; 67 mpg_{imp}) for highway. However, according to EPA's 2008 revised procedures, the CR-X rating is 41 miles per US gallon (5.7 L/100 km; 49 mpg_{imp}) city driving, and 49 miles per US gallon (4.8 L/100 km; 59 mpg_{imp}) highway driving.





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It is ranked number four on 2011 EPA top ten list of fuel efficient vehicles for CVT equipped model and number ten for manual transmission equipped model.

Price and sales by region

Europe

The CR-Z is scheduled to be launched in the European market by mid 2010. The European version of CR-Z was revealed at the 2010 Geneva Motor Show. Price in the United Kingdom starts from GB£16,999.

Japan

Sales of the CR-Z began in Japan on February 26, 2010 at a starting price of ¥2.27 million (~US\$25,340) before any government subsidies. Honda announced that in less than one month it has received orders for more than 10,000 vehicles, far exceeding its sales forecast.

As of the end of August 2010, more than 19,000 CR-Z were delivered and sales orders received are three times higher than expected, which lead to Japanese media comparing its success with the NSX in the 1990s, another sports car from Honda.

North America

Sales in North America started on August 24, 2010. The 2011 CR-Z is offered in three trim levels: base, EX, and EX with navigation. The base CR-Z starts at US\$19,950, the CR-Z EX starts at US\$21,510 and the EX with navigation trim is priced at US\$23,310. The CR-Z pricing is similar to the Honda Insight and has a lower price than the market leader Toyota Prius.

After its launch in late August 2010, there were 3,349 Honda CR-Z sold as of end of October, 2010. It has been consistently ranked as the fourth most sold hybrid for September and October.







In addition to commercials airing during sporting events, Honda is holding a CR-Z marketing competition available to universities throughout the United States. This competition allows Marketing students to compete for the best PR campaign for the vehicle. Indiana University South Bend is currently reigning in first place as they use

Facebook, Twitter, MySpace, and venues throughout their city limits to achieve success. Notable top ten finalist schools involved are Wayne State University, Northwood University, and the University of Syracuse, among others.

South Africa

Sales in South Africa are scheduled to begin on the 30th of August 2010 at a price of R299,999 (~US\$38,960) making it slightly cheaper than the entry level Prius for the South African market.

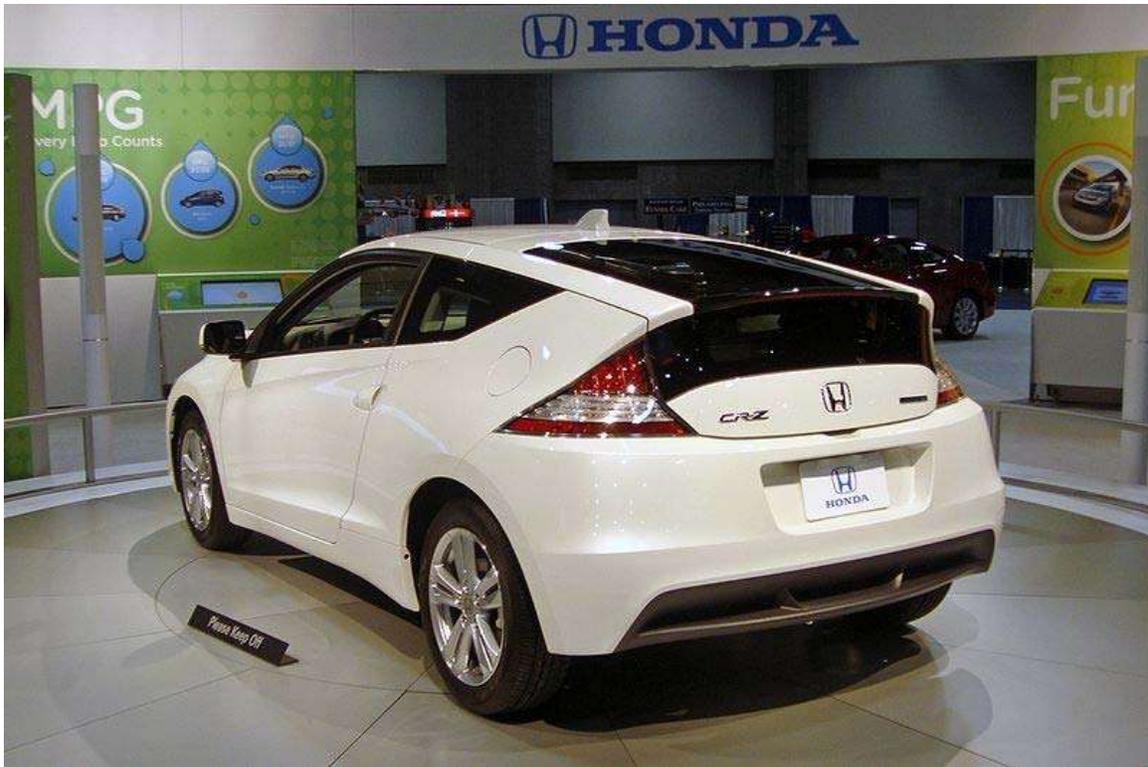




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Racing

Two Honda Performance Development CR-Z Racers entered the 25-hour of Thunderhill endurance race held on December 4-5, 2010 at Willows, California. The car, first shown to the public at 2010 SEMA Show, is fully stripped down with lowered suspension. A turbo charger is bolted to the engine raising output to 175 hp (130 kW) and 155 lb·ft (210 N·m) of torque, furthermore, the Integrated Motor Assist setup is modified and a push-to-pass function is added, making a total of 200 hp (149 kW) and 175 lb·ft (237 N·m) of torque when the button is pressed. One of the two entrants battled from a near 10-lap deficit to finish second in the Endurance 3 class, after suffering early in the race from two five-minute "stop-and-hold" penalties caused by refueling problems. The other entrant scored pole position of the class but failed to finish the race. The Honda CR-Z was one of the most showcased cars during the SEMA show earlier in the year and one of the cars produced 533 hp (397 kW). This is what the hybrid engine could withstand in terms of power.

Awards and recognition

- Japan Car of The Year 2010-11
- 2010 Good Design Award from the Japan Industrial Design Promotion Organization
- 2010 Green Car of the Year awarded by Top Gear

- Most Economical & Environment Friendly Sports hybrid in the 2010 RAC Brighton to London Future Car Challenge

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Chapter- 5

Lightning GT

Lightning GT



Manufacturer	Lightning Car Company
Production	2012– (planned)
Class	Supercar
Body style(s)	2-seat coupé
Engine(s)	Two 150 kW onboard (rear mounted) motors
Transmission(s)	5.5:1 reduction ratio, electronic differential, rear wheel drive
Wheelbase	2,590 mm (102 in)
Length	4,445 mm (175.0 in)
Width	1,940 mm (76 in)
Height	1,200 mm (47 in)
Curb weight	1,850 kg (4,100 lb)

The **Lightning GT** is a battery-electric sports car under development by the Lightning Car Company, in Peterborough and due for release in 2012. Over the last 2 years while the project team has been productionising the concept design, a showcar has attracted critical acclaim at leading automotive and environmental exhibitions around Europe such as; the Geneva Motor Show, the Hannover Messe, the Low Carbon Vehicle Show at

Milbrook and the Prince of Wales' Eco Garden Party at Clarence House. The car is now being engineered as a highly exclusive British built supercar, with production volumes being limited to 250 cars per annum. Engineering prototypes are currently under construction and an investment funding opportunity exists (refer to the company's Chairman Iain Sanderson at the Lightning Car Company Ltd direct). The engineering and production launch plan is timed to support first deliveries to customers in early 2012.

Technical details





The Lightning GT

The car is powered by twin 150 kW (204 PS; 201 bhp) rear-mounted synchronous motors, driving through independent reduction gearboxes under electronic torque control. The powertrain system is sourced from a leading German powertrain manufacturer providing rear-wheel drive and a peak power output of 300 kW (408 PS; 402 bhp). with 3,300 Nm of torque available at the wheels.



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The Lightning GT accelerates to 97 km/h (60 mph) in less than 5 seconds and has a recommended top speed of 200 km/h (120 mph). 'Conscientious exhilaration' is the term coined by the company to describe a driver's experience of the continuous surge of power and performance the car can deliver whilst emitting zero tailpipe emissions. Its body is made from Superform aluminium and the chassis is an innovative aluminium composites structure. Final assembly will be in Coventry by Coventry Prototype Panels.



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Battery

The standard battery specification includes two 22 kWh Altairnano lithium-titanate battery packs which will take about 10 minutes to recharge, assuming the substantial amount of power required is available. The 9kW standard onboard charger can fully recharge the batteries in 5 hours from a dedicated wired socket (easily fitted at home), or 15 hours from any standard 13 amp socket. An optional 18kW onboard charger connected to a suitable dedicated domestic power source can recharge the car in 2.5 hours. A full charge will give the vehicle a usable range of 240 km (150 miles). The batteries have an expected lifetime of 12 years and retain 80% of their capacity after 15,000 deep cycles. A third range extending battery pack option is planned which will allow a usable range of 360 km (225 miles).



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Price

The company is taking deposits of £4,000 for 2012 delivery, the vehicle is to be homologated under the EC Small Series Type Approval system and will be available for sale in the UK and across mainland Europe, as well as in Asia and other key markets.

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Chapter- 6

Tesla Roadster

Tesla Roadster



Manufacturer	Tesla Motors
Also called	Code name: DarkStar
Production	2008–present
Class	Roadster
Body style(s)	2-door Roadster
Layout	Rear mid-engine, rear-wheel drive
Transmission(s)	Single speed BorgWarner fixed gear
Wheelbase	2,352 mm (92.6 in)
Length	3,946 mm (155.4 in)
Width	1,873 mm (73.7 in)
Height	1,127 mm (44.4 in)
Curb weight	2,723 lb (1,235 kg)

Related	Lotus Elise
Designer	Tesla Motors

The **Tesla Roadster** is a battery electric vehicle (BEV) sports car produced by the electric car firm Tesla Motors in California. The Roadster was the first highway-capable all-electric vehicle in serial production available in the United States. Tesla had produced more than 1,200 Roadsters sold in at least 28 countries as of July 2010. Tesla began producing right-hand-drive Roadsters in early 2010 for the British Isles, Australia, Japan, Hong Kong and Singapore.

The Roadster is the first production automobile to use lithium-ion battery cells and the first production BEV (all-electric) to travel more than 200 miles (320 km) per charge. The world distance record of 501 km (311 mi) for a production electric car on a single charge was set by a Roadster on October 27, 2009, during the Global Green Challenge in outback Australia, in which it averaged a speed of 25mph. In March 2010, a Tesla Roadster became the first electric vehicle to win the Monte Carlo Alternative Energy Rally and the first to win any Federation Internationale de l'Automobile-sanctioned championship when a Roadster driven by former Formula One driver Érik Comas beat 96 competitors for range, efficiency and performance in the three-day, nearly 1,000-kilometer challenge.

According to the U.S. EPA, the Roadster can travel 244 miles (393 km) on a single charge of its lithium-ion battery pack, and can accelerate from 0 to 60 mph (0 to 97 km/h) in 3.7 seconds. The Roadster's efficiency, as of September 2008, was reported as 120 mpg_{ge} (2.0 L/100 km). It uses 135 Wh/km (21.7 kWh/100 mi or 490 kJ/km) battery-to-wheel, and has an efficiency of 92% on average.

The Roadster has a base price of US\$109,000 in the U.S. and a base price of £86,950 in the UK and €84,000 in continental Europe. As an electric vehicle, the Roadster also qualifies for several government incentives in many nations.







History

The car was officially unveiled to the public on July 19, 2006, in Santa Monica, California, at a 350-person invitation-only event held in Barker Hangar at Santa Monica Airport.

The San Francisco International Auto Show, held on November 18–26, 2006, was the Tesla Roadster's first auto show. Tesla Roadsters have been featured in numerous subsequent auto shows, including international shows in Los Angeles, Detroit and Frankfurt.

The first Tesla Roadster was delivered in February 2008 to Tesla co-founder, chairman and product architect Elon Musk. The company produced 500 similar vehicles through June 2009. In July 2009, Tesla began production of its 2010 model-year Roadster—the first major product upgrade since Tesla began production in 2008. Simultaneously, Tesla began producing the Roadster Sport, the first derivative of Tesla's proprietary, patented powertrain. The car accelerates from 0 to 60 mph in 3.7 seconds, compared to 3.9 seconds for the standard Roadster. Changes for the 2010 model-year cars include:

- An upgraded interior and push-button gear selector, including "executive interior" of exposed carbon fiber and premium leather, and clear-coat carbon fiber body accents.

- Locking, push-button glove box wrapped in leather.
- A centrally mounted video display screen to monitor real-time data, including estimated range, power regenerated, and the number of barrels of oil saved. This convenient screen is visible to the driver and passenger.
- Adjustable, custom-tuned suspension with the option of sport and comfort settings.
- More powerful and immediate heating, ventilation and air-conditioning.
- More efficient motor and hand-wound stator. The new motor generates more kilowatts per amp—more mechanical power—than the predecessor.
- A suite of sound-deadening measures to dramatically reduce noise, vibration and harshness. For instance, engineers added pellets to a member of the chassis side rail. These pellets expand by 5,000 percent during the adhesive heating cycle to eliminate rattles.



A Roadster running at the Goodwood circuit. The Tesla Roadster is increasingly popular on circuits throughout Europe, including the UK's Crystal Palace.

Beginning mid-March 2010, Tesla Motors, in an effort to show off the practicality of its electric cars, sent one of its Roadsters around the world. Starting at the Geneva autoshow, the roadster will travel until its arrival at the Paris Autoshow on September 28, 2010.

In July 2010, Tesla introduced the "Roadster 2.5," the latest update of the Roadster. New features in Roadster 2.5 include:

- A new look, which includes a new front fascia with diffusing vents, and rear diffuser reflecting the future of Tesla design
- Directional forged wheels available in both silver and black
- New seats with improved comfort, larger more supportive bolsters and a new lumbar support system
- Power control hardware that enables spirited driving in exceptionally hot climates
- An optional 7" touchscreen display with back-up camera
- Improved interior sound reduction including new front fender liner material make the cabin quieter

The Roadster is the most expensive prize ever offered on *The Price Is Right*, \$112, 845, in a playing of Green Road on April 22, 2010. A Roadster is used as a promotional tool for sustainable energy.

Development

The Roadster was developed by Tesla Motors to mass produce AC Propulsion's tzero concept car. The production idea was conceived by Martin Eberhard and Marc Tarpenning who incorporated Tesla Motors in Delaware on July 1, 2003, to pursue the idea commercially. South African-born entrepreneur Elon Musk took an active role within the company starting in 2004, including investing US\$7.5 million, overseeing Roadster product design from the beginning, and greatly expanding Tesla's long-term strategic sales goals to include developing mainstream vehicles after the sports car. Musk became Tesla's Chairman of the Board in April 2004 and had helped recruit JB Straubel as chief technology officer in March 2004. Musk received the Global Green 2006 product design award for the design of the Tesla Roadster, presented by Mikhail Gorbachev, and he received the 2007 Index Design award for the design of the Tesla Roadster.







Before Tesla had developed the Roadster's proprietary powertrain, the company licensed AC Propulsion's EV Power System design and Reductive Charging patent which covers integration of the charging electronics with the inverter, thus reducing mass, complexity, and cost. Tesla then designed and built its own power electronics, motor, and other drivetrain components that incorporated this licensed technology from AC Propulsion. Given the extensive redevelopment of the vehicle, Tesla Motors no longer licenses any proprietary technology from AC Propulsion. The Roadster's powertrain is unique.

On 11 July 2005, Tesla and British sports car maker Lotus entered an agreement about products and services based on the Lotus Elise, where Lotus provided advice on designing and developing a vehicle as well as producing partly assembled vehicles, and amended in 2009. helped with basic chassis development. The Roadster has a parts overlap of roughly 6 percent with the Lotus Elise. Tesla's designers chose to construct the body panels using resin transfer molded carbon fiber composite to minimize weight; this choice makes the Roadster one of the least expensive cars with an entirely carbon fiber skin.

Several prototypes of the Tesla Roadster were produced from 2004 through 2007. Initial studies were done in two "test mule" vehicles based on Lotus Elises equipped with all-electric drive systems. Ten Engineering Prototypes (EP1 through EP10) which led to many minor changes were then built and tested in late 2006 and early 2007. Tesla then produced at least 26 Validation Prototypes (VP1 through VP26) which were delivered

beginning in March 2007. These final revisions were endurance and crash tested in preparation for series production.

In August 2007, Martin Eberhard was replaced by an interim CEO, Michael Marks. Marks accepted the temporary position while a recruitment drive went into place. In December 2007, Ze'ev Drori became the CEO and President of Tesla Motors. In October 2008, Musk succeeded Ze'ev Drori as CEO. Drori became Vice Chairman and left the company in December. In January 2008, the NHTSA announced that it would grant a waiver of the *advanced* air bag rule noting that the Tesla Roadster already includes standard air bags; similar waivers have been granted to many other small volume manufacturers as well, including Lotus, Ferrari, and Bugatti. Tesla delivered its first production car in February 2008 to Musk.

Tesla announced in early August 2009 that Roadster sales had resulted in overall corporate profitability for the month of July 2009. The company said it earned approximately US\$1 million on revenue of US\$20 million. Profitability arose primarily from improved gross margin on the 2010 Roadster, the second iteration of Tesla's award-winning sports car. Tesla, which like all automakers records revenue when products are delivered, shipped a record 109 vehicles in July and reported a surge in new Roadster purchases.

Tesla, which signed a production contract with Group Lotus in 2007 to produce "gliders" (complete cars minus electric powertrain) for the Roadster, announced in early 2010 that Roadster production would continue until early 2012, in part due to tooling changes at Lotus' assembly plant in the UK.

Production



Interior of Roadster 2.5 from July, 2010.

Tesla cumulative production of the Roadster reached 1,000 cars in January 2010. The Roadster is an American car with a vehicle identification number common to all cars considered American manufactured, but it has parts from around the world. The body panels come from French supplier Sotira. These are sent from France to Hethel, U.K., where Tesla contracts with Lotus to build the Roadster's unique chassis. The Roadster shares roughly 6 percent of its components with the Lotus Elise; shared components include the windshield, air bags, some tires, some dashboard parts, and suspension components. The Roadster's single-speed gearbox is made in Detroit to Tesla's specifications by Auburn Hills, Michigan-based supplier Borg Warner. Brakes and airbags are made by Siemens in Germany, and some crash testing was conducted at Siemens as well.

For Roadsters bound for customers in North America, the chassis is then sent to Menlo Park, California, for final assembly. For Roadsters bound for customers in Europe or elsewhere outside of North America, the chassis is sent to a facility near Hethel, U.K., for final assembly. At these final assembly locations, Tesla employees install the entire powertrain, which consists of the battery pack, power electronics module, gearbox and motor. Tesla also performs rigorous "pre-delivery inspection" on every car before customers take ownership.

On 22 March 2010, Tesla ordered a minimum of 2,400 units from Lotus until 31 December 2011.







History of production

Subsequent to completion of production car number one at Hethel, the company announced problems with transmission reliability. The development transmission, with first gear enabled to accelerate 0 to 60 mph (0 to 97 km/h) in 4 seconds, was reported to have a life expectancy of as low as only a few thousand miles. Tesla Motors' first two transmission suppliers were unable to produce transmissions, in quantity, that could withstand the gear-shift requirements of the high torque, high rpm electric motor. In December 2007, Tesla Motors announced plans to ship the initial Roadsters with the transmissions locked into second gear to provide 0 to 60 mph (0 to 97 km/h) acceleration in 5.7 seconds. The first production car was not delivered with this interim solution; P1 has both transmission gears enabled. According to the plan, the initial transmissions will be swapped out under warranty when the finalized transmission, power electronics module (PEM), and cooling system becomes available. The EPA range of the car was also restated downward from 245 to 221 miles (394 to 356 km). The downward revision was attributed to an error in equipment calibration at the laboratory that conducted the original test.

- During the first two months of production, Tesla produced a total of three Roadsters (P3/VINF002, P4/VINF004, and P5/VINF005). Production car # 1 (P1) and P2 were built prior to the start of regular series production, which began March 17, 2008.
- By September 10, 2008, Tesla had delivered 27 of the cars to customers. It was also reported that a newer, better transmission had been developed and that production of the car was hoped to reach 20 per week by December 2008, and 40

per week by March 2009. Over the next 20 days, however, only 3 more cars had been delivered to customers which brought the total to 30 as of September 30, 2008.

- By November 19, 2008, more than 70 of the cars had been delivered to customers.
- By December 9, 2008, the 100th car had been delivered to its customer.
- By February 11, 2009, 200 Roadsters had been produced.
- By April 2, 2009, 320 Roadsters had been delivered.
- In May 2009, Tesla issued a safety recall for all 345 of its Roadsters that were manufactured before April 22, 2009. Tesla sent technicians to customers' homes to tighten the rear, inner hub flange bolts. Tesla Motors told customers that without this adjustment, the driver could lose control of the car and crash. The problem originated at the Lotus assembly line that builds the Roadster and Lotus is also recalling some of its own vehicles. Tesla reminded customers that millions of cars are recalled every year.
- By the end of May 2009, the 500th Roadster had been delivered.
- Tesla made its first profit ever in July 2009, when it shipped 109 vehicles, the most ever so far for a single month.
- By September 15, 2009, 700 Roadsters had been delivered.
- Tesla announced on January 13, 2010, that it had produced its 1,000th Roadster. The company has delivered vehicles to customers in 43 states and 21 countries worldwide. In 2009 Tesla began taking orders from customers in Canada, and Canadian deliveries began in February 2010.
- In January 2010, Tesla began producing its first right-hand-drive Roadsters for the UK and Ireland. The 2010 model-year right-hand-drive Roadster includes a suite of unique noise-reduction materials and an upgraded sound system. The Roadster starts at £86,950 and costs about 1.5p per mile.
- On 29 January 2010, in a Form S-1 filing of its preliminary prospectus with the U.S. Securities and Exchange Commission, the company stated that it would halt production of the Roadster in 2011 and replace it with a new model which would not be introduced until 2013 at the earliest: "...we do not plan to sell our current generation Tesla Roadster after 2011 due to planned tooling changes at a supplier for the Tesla Roadster, and we do not currently plan to begin selling our next generation Tesla Roadster until at least one year after the launch of the Model S, which is not expected to be in production until 2012..."
- On 16 March 2010, Tesla Motors announced that it had "negotiated agreements with key suppliers that will increase total Roadster production by 40 percent and extend sales into 2012", also indicating that it would expand into the Asian and Australian markets by 2011.
- On 2 December 2010, Tesla had delivered more than 1400 Roadsters.

Sales

Tesla had delivered more than 1,200 cars to customers in more than 25 countries by July 2010. Tesla CEO, Chairman and Product Architect Elon Musk said in June 2009 that the company would begin producing a right-hand-drive version of the car in 2010. The base price for the 2010 models, which began shipping to customers in July 2009, was

US\$109,000. The Roadster has a bumper-to-bumper 3-year, 36,000-mile (58,000 km) warranty. Tesla also offers an extended powertrain warranty and a battery replacement warranty. Options ranging from colors to audio to high-power connectors for faster charging will increase the price.







In July 2009, Tesla announced that US consumers could finance the Roadster through Bank of America. Financing is available for up to 75 percent of the total vehicle purchase price. A customer approved for a 5-year financing term on a base Roadster could put down as little as \$20,000 before taxes and net of the US federal tax credit. The monthly payment would be approximately \$1,700 at a 5 percent annual percentage rate (APR). That monthly payment is typical for high performance, although the Roadster costs roughly \$4 to refuel and does not require routine oil changes or exhaust system work. Unlike internal combustion engines, Teslas get a 100 percent waiver on sales, luxury and use taxes in at least four states, and they qualify for commuter lane privileges, free parking and free charging in many regions.

Tesla sells Roadsters directly to customers. It sells online, in 13 showrooms and over toll-free phone lines in North America and Europe. Tesla does not operate through franchise dealerships but operates company-owned stores. The company has said that it takes its retail cues from Apple, Starbucks and other non-automotive retailers.

Outside the United States



A Tesla Roadster in Barcelona

The company has been shipping cars to European customers since the summer of 2009. Tesla sold out of its EU special-edition vehicle, which had a 2010 model-year production run of 250 cars, with a base price of €99,000.

Tesla opened a showroom in London, its first outside the US, on June 25, 2009, and announced at the same time that it would start building right-hand-drive models from early 2010. Tesla opened a store in Munich in September 2009 and a store in Monaco in November 2009. It opened stores in Zurich and Copenhagen in the summer of 2010. Reservations for the 2010 Roadster are available for a 3,000 Euro refundable reservation fee.



Tesla on display at the 2010 Canadian International Autoshow in Toronto



Rear view of the vehicle

Service

Electric vehicles require much less service and maintenance than internal combustion engine vehicles. They do not require routine oil changes. They do not have any tailpipe emissions and therefore do not require any muffler or exhaust system work. They do not require replacement spark plugs, pistons, hoses or belts. The conventional parts of the car—including the brakes, body work and any interior and HVAC work—can be performed by any qualified automotive technician, exotic car garage or other local provider.

Tesla recommends that customers bring their car to a service center for an antifreeze change every five to seven years. Tesla's website recommends the owner bring the vehicle in for service "once a year or every 12,000 miles". For other concerns with Tesla's all-electric powertrain, Tesla has created a "mobile service unit" that dispatches company-trained technicians to customers' homes or offices in case the owner is experiencing problems. Tesla charges the customer according to the distance the service unit needs to travel: one US dollar per mile roundtrip with a 100 dollar minimum. Technicians drive company vans equipped with numerous tools and testing equipment to do "in the field" repairs, enhancements and software upgrades. Tesla debuted its "house call" approach in the spring of 2009, when the company announced a recall due to a manufacturing problem in the Lotus assembly plant, which also affected the Lotus Elise and other models from the British sports car maker.

The first Tesla Motors service center, in Los Angeles, California, was opened on Santa Monica Boulevard on May 1, 2008. Tesla Motors publicly opened their second showroom and service area in Menlo Park, California on July 22, 2008. The Menlo Park location is also the final assembly area for Tesla Roadsters. Tesla also operates service centers in New York City, Miami, Florida, Chicago, Illinois and Seattle, Washington.

Tesla plans to build additional service centers over the next few years to support sales of its next vehicle, the Model S sports sedan. Planning is underway for an additional 15 service centers in United States major metropolitan locations. Possible locations for sales and service locations in Europe were announced in a letter to customers in May 2008.







Specifications

Motor

The roadster is powered by a 3-phase, 4-pole electric motor, producing a maximum net power of 248 hp (185 kW). Maximum torque is 200·ft·lbf (270 N·m), obtained at 0 rpm and almost constant up to 6,000 rpm, a common feature of electric motors and one of the biggest differences (from the performance point of view) with internal combustion engines. The motor is air-cooled and does not need a liquid cooling system. The Sport Model introduced during the 2009 Detroit Auto Show includes a motor with a higher density, hand-wound stator that produces a maximum of 288 hp (215 kW). Both motors are designed for rotational speeds of up to 14,000 rpm, and the regular motor delivers an efficiency of typically 90%, or 80% at peak power. It weighs less than 70 pounds (32 kg).

Transmission

Starting in September 2008 Tesla Motors selected BorgWarner to manufacture gearboxes and began equipping all Roadsters with a single speed, fixed gear gearbox (8.2752:1) with an electrically actuated parking pawl mechanism and a mechanical lubrication pump.

The company previously worked with several companies, including XTrac and Magna International, to find the right automatic transmission, but a two-gear solution proved to be too challenging. This led to substantial delays in production. At the "Town Hall Meeting" with owners in December 2007, Tesla announced plans to ship the initial 2008 Roadsters with their interim Magna two-speed direct shift manual transmissions locked into second gear, limiting the performance of the car to less than what was originally stated (0 to 60 mph (0 to 97 km/h) in 5.7 seconds instead of the announced 4.0 seconds). Tesla also announced it would upgrade those transmissions under warranty when the final transmission became available. At the "Town Hall Meeting" with owners on January 30, 2008, Tesla Motors described the planned transmission upgrade as a single-speed gearbox with a drive ratio of 8.27:1 combined with improved electronics and motor cooling that retain the acceleration from 0 to 60 mph (0 to 97 km/h) in under 4 seconds and an improved motor limit of 14,000 rpm to retain the 125 mph (201 km/h) top speed. The upgraded system also improved the maximum torque from 200 to 280 ft·lbf (270 to 380 N·m) and improves the Roadster's quarter mile times.

Gear selector

In the interior the gear selector is similar to a push-button automatic with buttons labeled P,R,N and D while some earlier models have a gear stick similar to that in cars with manual transmission.







Performance

The Roadster's 0 to 60 mph (0–97 km/h) acceleration time is 3.9 seconds for the Standard Model and 3.7 seconds for the 2010 Sport Model. MotorTrend, which performed the first independent instrumented testing of the Roadster Sport, confirmed the company's reported 0 to 60 mph time of 3.7 seconds (MotorTrend recorded 0 to 60 mph of 3.70 seconds; it recorded a quarter-mile test at 12.6 sec @ 102.6 mph). The top speed is electronically limited to 125 mph (201 km/h). The Roadster covers the quarter-mile drag strip in 12.757 seconds at 104.74 mph (168.56 km/h). It weighs about 2,700 lb (1,200 kg) and is rear wheel drive; most of the car's weight is centered in front of the rear axle. Its body style and smooth underbody result in a C_d of 0.35.

Tesla began delivering the higher performance Sport version of the Roadster in July 2009. The Roadster Sport has adjustable dampers and a new hand-wound motor, capable of 0 to 60 mph (0 to 97 km/h) in 3.7 seconds. Scotty Pollacheck, a high-performance driver for Killcycle, drove a 2010 Tesla Roadster Sport at the Wayland Invitational Drag Race in Portland, Ore., in July 2009. He did a quarter-mile (~400 m) in dry conditions in 12.643 seconds, setting a new record in the National Electric Drag Racing Association among the SP/A3 class of vehicles.

The EPA combined range (specifying distance traveled between charges) measured in February 2008 for early production Roadsters was 231 mi (372 km) city, 224 mi (360 km) highway, and 227 mi (365 km) combined (city/highway). In August 2008, additional testing with the newer Powertrain 1.5 resulted in an EPA combined range of 244 mi (393

km). The vehicle set a new distance record when it completed the 241-mile (388 km) Rallye Monte Carlo d'Energies Alternatives with 36 miles (58 km) left on the charge.

Simon Hackett and Emilis Prelgauskas broke the distance record for an electric vehicle, driving 501 km (311 miles) from Alice Springs to Marla, South Australia, in Simon's Tesla Roadster. The car had about 4.8 km (three miles) of range left when the drive was completed.

Battery system



Connected power supply

Tesla Motors refers to the Roadster's battery pack as the Energy Storage System or ESS. The ESS contains 6,831 lithium ion cells arranged into 11 "sheets" connected in series; each sheet contains 9 "bricks" connected in series; each "brick" contains 69 cells connected in parallel (11S 9S 69P). The cells are of the 18650 form-factor commonly found in laptop batteries. The pack is designed to prevent catastrophic cell failures from propagating to adjacent cells, even when the cooling system is off. Coolant is pumped continuously through the ESS both when the car is running and when the car is turned off if the pack retains more than a 90% charge. The coolant pump draws 146 watts.

A full recharge of the battery system requires 3½ hours using the High Power Connector which supplies 70 amp, 240 volt electricity; in practice, recharge cycles usually start from a partially charged state and require less time. A fully charged ESS stores approximately 53 kWh of electrical energy at a nominal 375 volts and weighs 992 lb (450 kg).

Tesla Motors stated in February 2009 that the current replacement cost of the ESS is slightly under USD\$36,000, with an expected life span of 7 years/100,000 mi (160,000 km), and began offering owners an option to pre-purchase a battery replacement for USD\$12,000 today with the replacement to be delivered after seven years. The ESS is expected to retain 70% capacity after 5 years and 50,000 miles (80,000 km) of driving (10,000 miles (16,000 km) driven each year). Tesla Motors provides a 3 year/36,000 mile warranty on the Roadster with an optional 4 year/50,000 mile extended warranty available at an "additional cost" (2008 Roadster buyers received the 4/50 extension at no cost while later purchasers need to pay). A non-ESS warranty extension is available for USD\$5,000 and adds another 3/36 to the coverage of components, excluding the ESS, for a total of 6 years/72,000 mi (120,000 km).

Tesla Motors announced plans to sell the battery system to *TH!NK* and possibly others through its Tesla Energy Group division. The TH!NK plans were put on hold by interim CEO Michael Marks in September 2007. Think now obtains their Lithium-Ion batteries from Enerdel.

Recharging

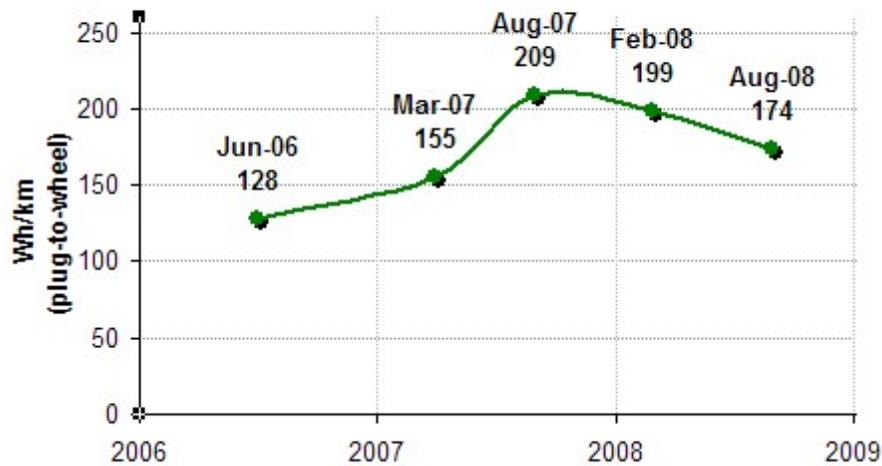
The Tesla Roadster uses a unique charging connector, although Tesla has indicated they will convert to the SAE J1772 standard. The vehicle can be recharged using:

- a wall-mounted 208–240 volt, 70 amp maximum current Home Connector. This appears to be the TS-70 charging station from ClipperCreek.
- a portable 120–240V, 40A maximum current Universal Mobile Connector cable that can plug into a NEMA 14-50 receptacle and other 240V receptacles using adapters.
- a portable 120V, 15A maximum current Spare Mobile Connector cable that plugs into a standard North American domestic socket.

Charging times vary depending on the ESS's state-of-charge, the available voltage, and the available circuit breaker amp rating (current). In a best case scenario, Tesla documents a recharge time of just under 4 hours using a 240v charger on a 90 amp circuit breaker and a worst case of 48 hours using a 120v outlet and a 15 amp breaker.

Energy efficiency

Evolution of Tesla Roadster's Efficiency



Evolution of the Roadster's plug-to-wheel efficiency (smaller values indicate better efficiency).

In June 2006, Tesla Motors reported the Roadster's battery-to-wheel efficiency as 110 W·h/km (17.7 kW·h/100 mi) on an unspecified driving cycle (either a constant 60 mph (97 km/h) or SAE J1634 test) and stated a charging efficiency of 86% for an overall plug-to-wheel efficiency of 128 W·h/km (20.5 kW·h/100 mi).

In March 2007, Tesla Motors reported the Roadster's efficiency on the EPA highway cycle as "135 mpg [U.S.] equivalent, per the conversion rate used by the EPA" or 133 W·h/km (21.5 kW·h/100 mi) battery-to-wheel and 155 W·h/km (24.9 kW·h/100 mi) plug-to-wheel.

In August 2007, Tesla Motors' dynamometer testing of a Validation Prototype on the EPA combined cycle yielded a range of 221 mi (356 km) using 149 W·h/km (23.9 kW·h/100 mi) battery-to-wheel and 209 Wh/km (33.6 kW·h/100 mi) plug-to-wheel.

In February 2008, Tesla Motors reported improved plug-to-wheel efficiency after testing a Validation Prototype car at an EPA-certified location. Those tests yielded a range of 220 mi (354 km) and a plug-to-wheel efficiency of 256 mpg_{ge}, or 199 W·h/km (32.1 kW·h/100 mi).

In August 2008, Tesla Motors reported on testing with the new, single-speed gearbox and upgraded electronics of Powertrain 1.5 which yielded an EPA range of 244 mi (393 km) and an EPA combined cycle, plug-to-wheel efficiency of 174 W·h/km, 630 kJ/km (28 kW·h/100 mi).

The Roadster's motor efficiency, battery-to-wheel, is 92% on average and 85% at peak power. For comparison, internal combustion engines have a tank-to-wheel efficiency of about 15%.

Petroleum-equivalent efficiency

The Roadster does not actually use gasoline; therefore, petroleum-equivalent efficiency (mpg, l/100 km) cannot be measured directly but instead is calculated using one of several different methods:

A number comparable to the typical Monroney sticker's "pump-to-wheel" fuel efficiency can be calculated based on regulations from the DOE and its energy content for a U.S. gallon of gasoline of 33,705 $\frac{\text{W}\cdot\text{h}}{\text{gal}}$ (also called the Lower Heating Value (LHV) of gasoline):

$$\frac{33705 \frac{\text{W}\cdot\text{h}}{\text{gal}_{\text{ge}}}}{135 \frac{\text{W}\cdot\text{h}}{\text{km}} \times \frac{1.6 \text{ km}}{\text{mi}}} \times 77.6\%_{\text{charging eff.}} = 120 \text{ mpg}_{\text{ge}} = 1.95 \frac{\text{L}_{\text{ge}}}{100 \text{ km}}$$

For CAFE regulatory purposes, the DOE's full petroleum-equivalency equation combines the primary energy efficiencies of the USA electric grid and the well-to-pump path with a "fuel content factor" that quantifies the value of conservation, scarcity of fuels, and energy security in the USA. This combination yields a factor of 82,049 $\frac{\text{W}\cdot\text{h}}{\text{gal}}$ in the above equation and a regulatory fuel efficiency of 293 $\text{mpg}_{\text{geCAFE}}$.

Recharging with electricity from the average USA grid, the factor changes to 12,307 $\frac{\text{W}\cdot\text{h}}{\text{gal}_{\text{US}}}$ to remove the "fuel content factor" = $\frac{1}{0.15}$ and the above equation yields a full-cycle energy-equivalency of 44.0 $\text{mpg}_{\text{ge full-cycle}}$. For full-cycle comparisons, the sticker or "pump-to-wheel" value from a gasoline-fueled vehicle must be multiplied by the fuel's "well-to-pump" efficiency; the DOE regulation specifies a "well-to-pump" efficiency of 83% for gasoline. The Prius' sticker 46 miles per US gallon (5.1 L/100 km; 55 mpg_{imp}), for example, converts to a full-cycle energy-equivalent of 38.2 $\text{mpg}_{\text{full-cycle}}$.

Recharging with electricity generated by newer, 58% efficiency CCGT power plants, changes the factor to 21,763 $\frac{\text{W}\cdot\text{h}}{\text{gal}}$ in the above equation and yields a fuel efficiency of 77.7 mpg_{ge} .

Recharging with non-fossil fuel electricity sources such as hydroelectric, solar power, wind or nuclear, the petroleum equivalent efficiency can be even higher as fossil fuel is not directly used in refueling.

Monetary cost offers another way to find an equivalent fuel efficiency. Tesla Motors reports an energy cost of approximately US\$0.04/mile if using PG&E's night-time incentive charging, available in only 2 U.S. states during the night. Comparison with a gasoline price of US\$3.00/ U.S. gallon, for instance, results in an equivalent of 75 mpg_{ge} using E-9 or 100 mpg_{ge} using retail pricing.

Reviews

Tesla Roadster reviews can be grouped in two main categories: reviews on cars in serial production (model year 2008–2010) and older reviews of "validation prototypes," typically from 2006–2008, before Tesla began serial production and customer deliveries.

The global online auto review site Autoguide.com tested Tesla's fourth-generation car in October 2010. Autoguide editor Derek Kreindler said "The Tesla Roadster 2.5 S is a massively impressive vehicle, more spacecraft than sports car. Theories like global warming, peak oil and rising oil prices should no longer bring heart palpitations to car fans. The Tesla shows just how good zero-emissions "green" technology can be. Quite frankly, getting into a normal car at the end of the test drive was a major letdown. The whirr of the engine, the shove in the backside and the lithe little roadster that seems to pivot around you is replaced by a grunting, belching, feedback-free driving experience." He continues on that "but for a \$100,000 car, it could use some work" complaining of purposfully cheap work.

In the March 2010 print edition of British enthusiast magazine EVO (p. 120), editor Richard Meaden was the first to review the all-new right-hand-drive version of the Roadster. He said the car had "serious, instantaneous muscle." "With so much torque from literally no revs the acceleration punch is wholly alien. Away from traffic lights you'd murder anything, be it a 911 Turbo, GT-R or 599, simply because while they have to mess about with balancing revs and clutch, or fiddle with launch controls and invalid warranties, all you have to do is floor the throttle and wave goodbye."

In December 2009, Wall Street Journal editor Joseph White conducted an extended test-drive and determined that "you can have enormous fun within the legal speed limit as you whoosh around unsuspecting Camry drivers, zapping from 40 to 60 miles per hour in two seconds while the startled victims eat your electric dust." White, a Pulitzer Prize-winning journalist, praised the car's environmental efficiency but said consumer demand reflected not the environmental attributes of the car but its performance. "The Tesla turns the frugal environmentalist aesthetic on its head. Sure, it doesn't burn petroleum, and if plugged into a wind turbine or a nuclear plant, it would be a very low-carbon machine. But anyone who buys one will get the most satisfaction from smoking someone's doors off. The Tesla's message is that "green" technology can appeal to the id, not just the superego."

In December 2009, MotorTrend was the first to independently confirm the Roadster Sport's reported 0 to 60 mph time of 3.7 seconds. (MotorTrend recorded 0 to 60 mph of 3.70 seconds; it recorded a quarter-mile test at 12.6 sec @ 102.6 mph.) Engineering Editor Kim Reynolds called the acceleration "breathtaking" and said the car confirms "Tesla as an actual car company. ...Tesla is the first maker to crack the EV legitimacy barrier in a century."

In November 2009, Automobile Magazine West Coast editor Jason Cammisa spent a week driving a production Tesla Roadster. Cammisa was immediately impressed with the

acceleration, saying the car "explodes off the line, pulling like a small jet plane. ... It's like driving a Lamborghini with a big V-12 revved over 6000 rpm at all times, waiting to pounce—without the noise, vibration, or misdemeanor arrest for disturbing the peace." He also took the car to Infineon Raceway in Sonoma, California, and praised the car for its robustness, saying the Roadster,

"wins the Coolest Car I've Ever Driven award. Why? Despite the flat-out sprints, the drag racing, the donuts, the top-speed runs, and dicing through traffic like there's a jet pack strapped to the trunk, Pacific Gas and Electric—which generated power for the Tesla—released into the atmosphere the same amount of carbon dioxide as would a gasoline-powered car getting 99 mpg. And the Roadster didn't break. It didn't smoke, lock up, freeze, or experience flux-capacitor failure. Over the past ten decades, no company has been able to reinvent the car—not General Motors with the EV1, not Toyota with the Prius. And now, a bunch of dudes from Silicon Valley have created an electric car that really works—as both an environmental fix and a speed fix."

In May 2009, Car and Driver technical editor Aaron Robinson wrote a review based on the first extended test-drive of a production Tesla Roadster. Robinson had the car for nearly a week at his home. He complained of "design anomalies, daily annoyances, absurd ergonomics, and ridiculous economics" and stated he never got to see if the car could go 240 miles on a single charge because of the torturous seating forced him to stop driving the car. He also complained of Tesla increasing the car prices on those who had already made deposits and charging extra for previously free necessary components.

In February 2009, automotive critic Dan Neil of the Los Angeles Times called the production Tesla Roadster "a superb piece of machinery: stiff, well sorted, highly focused, dead-sexy and eerily quick." Neil said he had the car for 24 hours but "caned it like the Taliban caned Gillette salesmen and it never even blinked."

In February 2009, *Road and Track* tested another production vehicle and conducted the first independently verified metered testing of the Roadster. Engineering editor Dennis Simanitis said the testing confirmed what he called "extravagant claims", that the Roadster had a 4.0 s 0 to 60 mph acceleration and a 200-mile (320 km) range. They said the Roadster felt like "an over-ballasted Lotus Elise", but the weight was well-distributed, so the car remained responsive. "Fit and finish of our Tesla were exemplary", which *Road and Track* thought fit the target market. Overall, they considered it a "delight" to drive. Testing a pre-production car in early 2008, *Road and Track* said "The Tesla feels composed and competent at speed with great turn-in and transitioning response", though they recommended against it as a "primary grocery-getter".

In January 2009, automotive critic Warren Brown of the Washington Post called the production Roadster "a head-turner, jaw-dropper. It is sexy as all get-out." He described the feeling behind the wheel as, "Wheeeeeeee! Drive a Tesla, even if you have to fly to Tesla's Menlo Park, Calif., headquarters, to get your hands on one for a day. ... If this is the future of the automobile, I want it."

In the autumn of 2008, *Top Gear's* Jeremy Clarkson reviewed two production Roadsters with the v1.5 transmission and described the driving experience with the exclamations "God almighty!", "Wave goodbye to the world of dial-up, and say hello to the world of broadband motoring!" and "This car is Biblically quick!" when comparing the acceleration versus a Lotus Elise. Clarkson also noted, however, that the handling of the car was not as sharp as that of the Lotus Elise: "through the corners things are less rosy." The Stig recorded a time of 1:27.2 on a moist track, faster than a Nissan 370Z on a dry track but slower than a Porsche 911 C2S also on a damp track, and also slower than the Lotus Exige, Exige S and Evora. The segment also showed the car's batteries running flat after 55 miles (89 km), saying that the recharge would take 16 hours and also that the car then broke down. Tesla Motors' spokesperson responded with statements in blogs and to mainstream news organizations that the cars provided to Top Gear never had less than 20% charge and never experienced brake failure. In addition, neither car provided to Top Gear needed to be pushed off the track at any point. Finally, although Clarkson showed a limp windmill and complained that it would take countless hours to refuel the car using such a source of electricity, the car can be charged from a 240V outlet in as little as 3.5 hours. After numerous blogs and several large news organizations began following the controversy, the BBC issued a statement saying "the tested Tesla was filmed being pushed into the shed in order to show what would happen if the Roadster had run out of charge. Top Gear stands by the findings in this film and is content that it offers a fair representation of the Tesla's performance on the day it was tested," without addressing the other misrepresentations that Tesla highlighted to the media. After several weeks of increasing pressure and inquiries from the BBC, Clarkson wrote a blog for The Times of London, acknowledging that "that the film we had shot was a bit of a mess." In the months that followed Clarkson's acknowledgment, the original episode—including the misstatements—reran on BBC America and elsewhere without any editing, though the BBC is still looking into *Top Gear's* journalism standards, according to British media reports.

In a review of a Roadster prototype before the cars were in serial production, *Motor Trend* gave a generally favorable review in March 2008, stating that, it was "undeniably, unbelievably efficient" and would be "profoundly humbling to just about any rumbling Ferrari or Porsche that makes the mistake of pulling up next to a silent, 105 mpg Tesla Roadster at a stoplight."; however, they detected a "nasty drive-train buck" during the test drive of an early Roadster with the older, two-speed transmission.

In a July 8, 2007, review of a prototype Roadster, Jay Leno wrote, "If you like sports cars and you want to be green, this is the only way to go. The Tesla is a car that you can live with, drive and enjoy as a sports car. I had a brief drive in the car and it was quite impressive. This is an electric car that is fun to drive."

In a November 27, 2006, review of a prototype Roadster in *Slate*, Paul Boutin wrote, "A week ago, I went for a spin in the fastest, most fun car I've ever ridden in—and that includes the Aston Martin I tried to buy once. I was so excited, in fact, that I decided to take a few days to calm down before writing about it. Well, my waiting period is over, I'm thinking rationally, and I'm still unbelievably stoked about the Tesla."

Awards

- INDEX: Award 2007
- *BusinessWeek*: Best Product Design of 2007, Ecodesign
- *Forbes*: Best Cars 2006: New car that best lived up to the Hype
- *Time*: Best Inventions 2008—Transportation Invention
- *Time*: Best Inventions 2006—Transportation Invention
- *Popular Mechanics*: Breakthrough Awards 2006
- Global Green USA: Product/Industrial Design
- *CarDomain*: People's Choice: Most Exciting 2007 Car Launch
- 2009 Best Green Exotic, *duPont REGISTRY*

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Chapter- 7

Venturi Fétish



Venturi Fétish

The **Venturi Fétish** is the world's first production two-seater **electric sports car**. It is produced by Venturi in Monaco, and the futuristic design of the car was done by the Parisian designers Sacha Lakic. The Fétish was first introduced in concept form at the 2002 Salon International de l'Auto (International Geneva Motor Show). It will remain an absolute rarity, since the manufacturer is committed to deliver only 25 vehicles worldwide. The retail price for this car has dropped to €297,000 as of May 2007 (approx. US\$400,000), VAT included. No sales data is available, so it is unclear if any have shipped to customers yet.



Technical specifications

The car's acceleration is comparable to a normal internal combustion engine sports car, producing approximately 250 horsepower (180 kW), with a 0-100 km/h (0-60 mph) time of "under 5 seconds" according to the 2007 press kit. Its top speed is less comparable however, at 160 km/h (100 mph), which is respectable considering that it only has one gear. Later it was improved to 250km/h. It runs at a constant translation of 9.58 : 1, with a torque of 220 N·m (162 lb·ft).





One other particular attraction of the car is that due to the electric traction motor, the full 220 N·m (162 lb·ft) torque is available at all motor speeds including from a dead stop, as opposed to the progressive delivery of an internal combustion engine car, where maximum torque is only available within certain RPM ranges.

The company specifies the car with a range of 250 km (combined use). The batteries are all lithium ion accumulators, offering a complete recharge in 1 hour (under 30 kW three-phase) and in 3 hours with a standard grid thanks to its onboard charger.

Chapter- 8

Wrightspeed X1

X1 Prototype



Ian Wright next to the X1

Manufacturer	Wrightspeed
Production	None, prototype only
Class	Roadster
Body style(s)	Open wheel roadster
Layout	Rear mid-engine, rear-wheel drive
Platform	Ariel Atom
Engine(s)	3-phase, 4-pole AC Induction
Transmission(s)	Single gear ratio 8.25:1 (no clutch)
Wheelbase	2345 mm / 92.3 in
Length	3410 mm / 134.25 in
Width	1798 mm / 70.8 in
Height	1195 mm / 47.0 in

Curb weight	697 kg / 1536 lb
Related	Ariel Atom, tzero
Designer	Ian Wright

The **Wrightspeed X1** is a one-off heavily modified Ariel Atom to use an all-electric powertrain. The Atom was chosen for its light weight and efficient design. The electric motor and inverter are sourced from AC Propulsion, makers of the TZero concept car, while the batteries are low weight, high energy density lithium ion provided from A123 Systems. As with the *Atom* the transmission is a Honda unit, but stripped of its shifting mechanism and other parts to provide only the second gear speed, allowed by the wide speed and torque range available from the electric motor.





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Built by San Francisco-based New Zealand engineer Ian Wright, the X1 created a stir when it bested several sports cars in a drag race, including a Carrera GT (though with a rolling start, a disadvantage for the gas burning vehicles), all while being filmed by local news station KRON 4. Despite the impressive performance, the vehicle is intended only as a proof of concept. Future production is planned; however, according to the website, "... the production car will be quite different, since it will meet the safety standards, which the prototype does not. It will, however, be at least as quick as the prototype.". Mr. Wright was an early employee of electric-car company Tesla Motors, but soon left to pursue his own ideas.



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V V I



Front wheel and brake



Springs and shock absorber



Steering rack



Cockpit



Rear suspension



Rear view



Wrightspeed logo

Performance

- 0–96.56 km/h (0-60 mph) 2.9 seconds
- Standing quarter mile (400 m) 11.6 seconds
- Top speed 167.37 km/h (104 mph) (electronically limited)
- Range >160.93 km (>100 miles) in urban use
- Charger: onboard conductive. Input 100-250V 50 or 60 Hz.
- Current: user adjustable up to 80A
- Energy consumption 125 WHr/km (200 WHr/mile) in urban use, equivalent to 1.4 L/100 km (170 mpg) (8920 WHr/L or 33,705 WHr/gallon)

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