

Zero to Sixty With Zero Pollution

Every car lover's dream: 0 to 60 in 4 seconds, a beautifully sculpted aerodynamic body to die for, 135 miles per gallon equivalent, priced \$4,800 less than¹ a Porsche 911.¹ Best of all: no tailpipe. Charging from fully dead to fully full takes 3.5 hours, and the battery pack is guaranteed for 100,000 miles or 5 years.²



Figure 1 The California-made Tesla: 0 to 60 in 4 seconds, 135 miles per gallon equivalent, priced \$4,800 less than a Porsche 911. Best of all: no tailpipe. Charging from fully dead to full takes 3.5 hours, and the battery pack is guaranteed for 100,000 miles or 5 years. (Source: Tesla)

That is the Tesla, the California-made all-electric sports car, powered by lithium batteries, a zero-polluting beauty.

Look no further than what would be the fantasy of every muscle car devotee in the world, the battery-powered Tesla Roadster, named 2007 “car of the year” by *Wired*, which described it as “easily the coolest alternative fuel vehicle ever made, one that proves electric cars can be every bit as breathtaking as the finest fossil-fuel guzzling super cars and the direction the auto industry must

go.”³

It is by no means the only all-electric car that has been drop-dead gorgeous: General Motors EV1, initially marketed at the “Impact,” was a thing of incredible beauty. On gasoline, it would have gotten about 100 miles to the gallon, and those to whom GM leased the EV-1 loved the car. General Motors, however, preferred crushing EV-1s to selling them, so it retrieved all those it had leased and sent virtually all of them to junkyard crushers.⁴

¹ Exactly what a Tesla will sell for is somewhat unclear. A September, 2008 placed the base price of the Model S five-passenger luxury sedan, expected to travel about 240 miles per charge and available in late 2010 at about \$60,000. See Green Car Congress, “Tesla to Build Model S EV in San Jose, CA,” Sep. 17, 2008, <http://www.greencarcongress.com/2008/09/tesla-to-build.html>.

Time magazine raved that the EV1 “was a marvel of engineering, absolutely the best electric vehicle anyone had ever seen.

Built by GM to comply with California's Zero Emission Vehicle (ZEV) Mandate, adopted in 1990 and requiring that two percent of the state's vehicles to have no emissions by 1998 and 10 percent by 2003. The law was repeatedly weakened over the next decade and finally shelved in 2002 after General Motors, DaimlerChrysler and the George Bush (the son) sued for its

repeal.⁵ The EV1 was “quick, fun, and reliable,” said *Time*, adding that the car “held out the promise that soon electric cars — charged from the grid with all sorts of groovy power sources, like wind and solar — could replace the smelly old internal-combustion vehicle.”⁶

The car maker, however, contended that EV1 couldn't supply the range or durability required by the mass market, and that the car itself, a super-light two-seater, was not what American consumers were looking for.⁷

Yet that was not a view shared by those who leased the cars. As one wrote—

Driving the EV1 was unlike driving any other car. No key. No maintenance (except periodically rotating the tires and a coolant change at 100,000 miles). No visits to the gas station. No lag between pressing the pedal and getting a response from the engine. Jackrabbit starts — 0 to 30 in 3 seconds, and the prototype's top speed was 183 mph. Production cars were limited to a top speed of 80 mph.⁸

Drivers also loved Honda's battery-powered car, EV+, which delivered about 100 miles on a charge and seated four.⁹ It, too, was taken away from drivers by the manufacturer. Ditto with Toyota's RAV-4 EV, able to travel 125 miles on a charge.

Indeed, it is important to get one thing straight: zero-polluting cars that are practical, don't cost a fortune and are incredibly fun to drive because the distance from the accelerator to the wheels is traveled at the speed of light, are unavailable to the public for only one reason: car makers refuse to sell them.



Figure 2 General Motors retrieved leased EV-1s from customers and hauled them to the scrap yard where they were crushed.

The companies will provide all manner of reasons for their refusal—the range is inadequate, they take too long to charge, the cost of making them is too high—but in every case, the makers are substituting their judgments for those that are supposed to count the most: the customer's. In a nation and within an industry where the “free market” is worshiped as if it were a deity, the company's simply and adamantly refuse to listen to it.

There is no shortage of half-truths and outright falsehoods in discussions of just what can be done to reverse global warming. But the biggest whoppers are about planes, trains, automobiles and other vehicles that travel from point to point with people or cargo in them. All of that could be accomplished with zero or near-zero air pollution but the end result might be the end of not just General Motors, Ford and Chrysler, but Boeing and its aircraft, General Electric and its locomotives and Kenwood and its trucks. (This section focuses principally on vehicles that travel over ground, while another addresses air pollution from ships.)



Figure 3 Toyota discontinued production of the battery-powered RAV4 Electric Vehicle in the spring of 2003. (Source: Toyota)

Innovation can be a nasty business. Good innovation can be and often is destructive. The personal computer wiped out the typewriter industry, the polio vaccine put makers of iron lungs out of business, digital cameras have brought the era of film to an end, and the list goes on and on. Just as there are technologies waiting in the wings to generate electricity with zero pollution, so too are rivals of the conventional internal combustion engine straining to get through the door to the market. Not on the road yet but under development—again not by mainstream, old line car makers—is the “concept and development” Tzero made by California-based AC Propulsion¹⁰ and the made-in Monaco Venturi Fetish, which at a price of €297,000 (\$465,000) makes the Tesla a veritable bargain.¹¹

AC Propulsion offers the Ebox, a Scion xB 5-speed converted to run on electricity provided by 5,088 small lithium ion batteries, a type that pack more power per pound than any other and is widely used for laptop computers.¹² With a range of up to 150 miles, the Ebox has an acceleration of 0 to 60 in 7 seconds, moves at 95 miles per hour, recharges in 2 to 5 hours and sells for \$68,000 to \$73,000.¹³

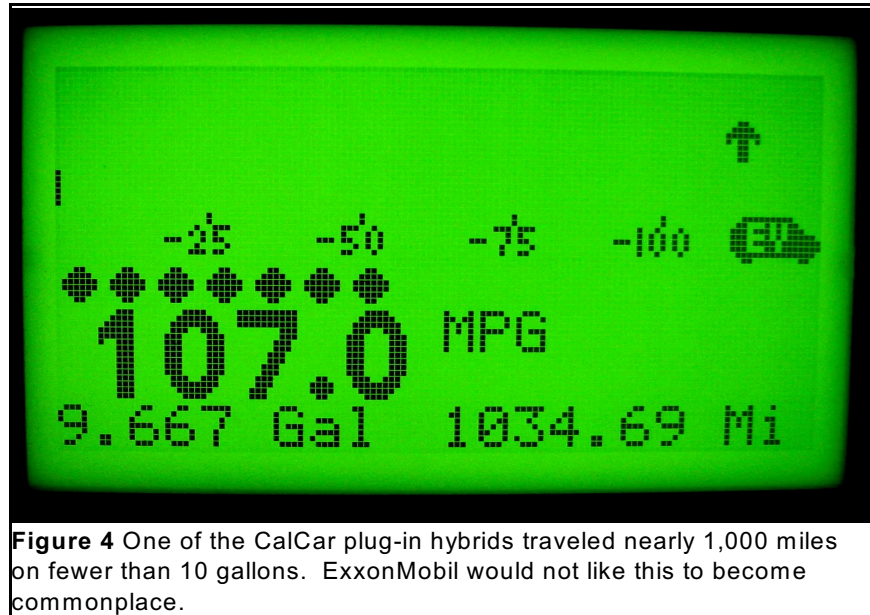
TINKERING WITH PRIUS

The car maker that has arguably done the most to place cleaner autos on the roads is Toyota. Other companies such as Honda and General Motors would allow customers to lease their zero-polluting vehicles, but not buy them, but Toyota would sell in addition to lease.

Toyota stopped selling its RAV4-EV in 2003, saying that sales had been a meager 300 per year, compared to 300,000 Prius gas-electric hybrids.¹⁴ That may be, but to all reports, those RAV4-EVs are still on the road.¹⁵

Toyota's gasoline-electric technology has been immensely popular, but there are some folks, principally in California, who decided it could be improved. So they did.

Toyota's most popular hybrid, the Prius, arrives with batteries and a small gasoline engine. Most of the time, the batteries power the car as it silently navigates traffic at low speeds, with the small engine kicking in at about 25 miles per hour, allowing the Prius to accelerate from 0 to 60 miles per hour in 10.2 seconds.¹⁶ Although virtually every aspect of the Prius is state-of-the-art—the brakes help recharge the batteries, the



computer turns the engine off when stopped, the engine uses a technology more efficient than that found in most cars—in the eyes of some it has one major deficiency: the Prius cannot be plugged in, so it still uses more gasoline than it should.

Converting the Prius to allow it to be plugged into household current makes it possible to use electricity from the grid to recharge the batteries. The gas engine runs less, producing lower pollution and consuming less fuel. In California, a small group of somewhat rebellious Prius owners who like to tinker have mounted a campaign to not only convert their own cars to grid electricity, but show others how to do so as well. These so-called plug-in electric hybrid vehicles, or PHEVs, “help commercialize PHEVs,” in their words.¹⁷



Figure 5 Not content to drive a Prius hybrid that got a mere 50 miles to the gallon, a group of self-described entrepreneurs, engineers, environmentalists and consumers started the California Cars Initiative (CalCars.org), a Palo Alto-based nonprofit organization to convert them to 100 mile per gallon “plug-in” hybrid electric vehicles, “harnessing buyer demand to help commercialize PHEVs,” in their words. They can now recharge the batteries on household current. (Source: CalCars)

Conversions are limited to certain vehicle types. The easiest are for the 2004 to 2008 Prius models (not 2001–2003 Prius) and the Ford Escape/Mercury Mariner Hybrid.

Toyota has clearly been reluctant to produce a plug-in/hybrid version of the Prius for retail sales. However, the automaker seems to have finally yielded to pressure and begun testing three different models, leading *Popular Mechanics*, whose reporter test drove one, to conclude that “the next generation Prius, due around calendar year 2009, will almost certainly use a plug-in system.”¹⁸

Whichever battery type Toyota adopts, it will need more hybrids on the road to meet a self-imposed target of selling one million hybrids each year beginning early next decade. And PHEV’s are sure to make up a healthy

portion of those vehicles.

The Re-“Volt”ing of General Motors

With the recent quadrupling of gasoline prices and escalating concerns over global warming, General Motors has—or, at the least, *says* that it has—rethought its decision on the commercial viability of electric cars.¹⁹ The company now says that it will introduce a new electric hybrid car, the “Volt,” in late 2010.²⁰

The car will be a battery-powered, four-passenger electric vehicle using either a gasoline engine in the U.S. or a diesel in Europe to generate power to extend its 40-mile battery-only range indefinitely. Unlike the Prius, which is a “parallel” hybrid in which an internal combustion engine provides most of the drive to the wheels, assisted by a battery-powered electric motor, the Volt “series” uses only electricity for propulsion. There is a gasoline engine onboard, but its sole job is to turn a generator to produce electricity. Here are the details.²¹

NISSAN THROWS DOWN THE GAUNTLET

Whether Toyota offers an all-electric car in the United States, one major competitor, Nissan Motor Company, has said it will sell one in the United States and Japan by 2010.²²

The commitment, announced by Nissan chief executive, Carlos Ghosn could make it the first major automaker to bring a zero-emission vehicle to the American market. Ghosn said Nissan would sell a lineup of electric vehicles globally by 2012.²³

In early 2008, Nissan and its French alliance partner, Renault, signed a deal with the California-based Project Better Place to produce electric cars for sale in Israel and Denmark. Under the arrangement, Renault will provide the cars and Nissan will supply lithium-ion battery packs. The Israeli government plans to encourage sales of electric cars by sharply cutting taxes to levels below those on gasoline-powered versions.²⁴

GARBAGE IN, BUT NOT OUT

As hybrid technology becomes more widespread in cars, it has also been making a transition to trucks. Volvo's version of the technology couples a diesel engine with an electric motor. Electricity provides the initial push, but not the racket of a diesel-only garbage truck. At about 12 miles per hour, the diesel kicks in, and when the truck stops it automatically switches off. The batteries are recharged during braking by generating electricity from the truck's forward momentum, an ideal approach for stop-and-go use such as garbage collection.²⁵ In addition, an extra battery pack, recharged at night, powers the garbage compactor. Altogether, fuel and air pollution emissions are expected to be reduced between 20 and 30 percent when the truck is placed in commercial service in 2009.²⁶



Figure 6 Volvo's version of the hybrid technology couples a diesel engine with an electric motor. Electricity provides the initial push, but not the racket of a diesel-only garbage truck. At about 12 miles per hour, the diesel kicks in, and when the truck stops it automatically switches off. Fuel use and air pollution emissions are expected to be reduced between 20 and 30 percent when the truck is placed in commercial service in 2009. (Source: The Auto Channel)

OVER THE ROAD, WITH NEAR ZERO POLLUTION



Figure 7 In a collaborative effort between one of the largest U.S. truck makers, Kenworth, and a British Columbia, Canada manufacturer of engines, Westport Innovations, the two have developed a truck fueled by LNG. Versions of it are to be used at the ports of Los Angeles and Long Beach, through which 60 percent of the imports into the U.S. pass. (Source: Kenworth)

Another option for trucks—as well as ships and locomotives—is to convert from conventional petroleum based fuels to something else. One option is liquefied natural gas (LNG), widely used in China and other nations with ample supplies of natural gas. Over-the-road 18 wheelers running on natural gas produces a small fraction of the pollution from conventional diesel engines.

In a collaborative effort between one of the largest U.S. truck makers, Kenworth, and a manufacturer of natural gas engines based in British Columbia, Canada, Westport Innovations, the two have developed a truck fueled by LNG. Versions of it are to be used at the ports of Los Angeles and Long Beach, through which most imports pass. Kenworth has also built a no-idle truck, as well as a diesel electric hybrid truck.²⁷

These innovations are important because trucks will typically haul containerized goods from a port to warehouses many miles away, where they are stored to be placed on still more 18-wheelers. Waiting to drop off or pick up goods, the diesels will idle—even though that is prohibited in most areas—generating immense amounts of diesel pollution that floods into nearby residential neighborhoods.

The ports of Los Angeles and Long Beach, California, for example, make up the nation's largest harbor complex, handling 44 percent of all goods imported by cargo container into the United States. In 2007, the equivalent of 7.85 million 40-foot shipping containers poured through the ports, with most then moving along the region's highways to massive rail yards and warehouses before heading to the nation's interior. The volume of cargo, which has tripled in the last two decades, is forecast to almost triple again in the next 20 years. In 2006, trucks averaged about 39,000 trips per day.²⁸

Pollution from 18-wheelers, cars, garbage trucks and other vehicles can be sharply reduced, and in some instances eliminated altogether within months or, certainly, a few years from starting. That pollution is not now being eliminated in any substantial way, however.

As a result, the costs of pollution are being borne by those who breathe, not those who emit the toxins. The effect of such an arrangement, while profitable for those who make, ship, transport or sell goods or people, is to force those who are the victims of air pollution to subsidize those who produce it with their health and lives, as well as those of their children—and perhaps most importantly, the future survival of life as we know it.

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3. Chuck Squatrigli, "Here's Our Pick for Car of the Year. What's Yours?" *Wired* <http://blog.wired.com/cars/2007/12/heres-our-pick.html>
4. GM built 1,117 of the cars between 1996 and 1999, including 660 "Generation I" EV1 cars in the 1997 model year (1996-97) and 457 "Generation II" EV1 cars in the 1999 model year (1998-99). A few were donated to museums, including the Smithsonian in Washington, D.C., whose EV1 is a first-generation 1997, with serial number 660, the last "Generation I" car produced. EV1 electric automobile. http://americanhistory.si.edu/ONTHEMOVE/collection/object_1303.html
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14. Toyota, "RAV4 EV," <http://www.toyota.com/vehicles/rav4ev/index.html>
15. On a blog, one contributor, Earl Killian, wrote on March 14, 2008 --
"David, what is unproven or untested about ZEV technology? The 5,600 vehicles that were put on U.S. roads by the major automakers in response to the CARB ZEV program performed quite well. Our family now has 76,000 miles on our RAV4-EV we bought in 2002, and it continues to go strong. Several RAV4-EV owners have over 100,000 miles on their vehicles, and Southern California Edison's fleet of them has lots of data to suggest this is proven, tested technology."
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