

Plug-in Hybrids

Vehicles of Tomorrow



FLOYD ASSOCIATES

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➤ What is a hybrid vehicle?

A hybrid vehicle is a vehicle that combines power from different sources for propulsion. The most popular type is a gasoline-electric hybrid which uses an internal combustion engine combined with electric motors to power the vehicle.

➤ Types of hybrid vehicles

According to a research report by Deutsche Bank, hybrid vehicles can be categorized into the following segments:

Micro hybrid: Stops the engine during idle and instantly starts the engine when the vehicle starts moving. This system usually does not provide any additional boost to propulsion so the efficiency gain is minimal but this type has the lowest additional cost. Efficiency gains: 5%-10%.

Mild hybrid: Stops the internal combustion engine when the car is idle and the electric motor provides additional power when needed. This allows for the use of a smaller, more fuel efficient internal combustion engine. Efficiency gains: 10%-20%.

Full hybrid: The electric motor provides enough power for low speed, short distance drives. In addition, like the mild hybrid the electric motor provides additional power allowing for the use of a smaller, more fuel efficient gasoline powered engine. Efficiency gains: 25% to 40%.

Plug-in hybrid: A large battery allows the car to charge overnight providing the power for short distance drives. This allows the car to operate like an electric vehicle during short drives. After the battery is depleted a gasoline engine is used to either power the vehicle or to power a generator to recharge the battery. Efficiency gains: 40% to 65%.

Electric vehicle: Receives all energy requirements from an electric source and is recharged by plugging the vehicle into a power source.

➤ The future of hybrids

The NHTSA's report on Corporate Average Fuel Economy Standards projects that by 2015 the market for hybrid vehicles will increase to 20% of the U.S. market. Global Insights, a market research firm, projects a 47% market share for all types of hybrids in the U.S. and an even larger share in Europe by 2020. Given that the current market share for hybrids is 2% to 3% this is a segment that is projected to grow rapidly in the near future.

As battery technologies improve and economies of scale are realized the efficiency and price of hybrids are predicted to drop. This will lead to faster adoption of hybrid vehicles and although currently selection is limited, by the end of 2011 it is projected that there will be 75 different hybrid vehicles available compared to 13 in 2007.

➤ Why hybrid?

The battery capacity that is needed for an all-electric vehicle is currently very costly. A Deutsche Bank study cites an average of \$11,000 of additional cost for an all electric vehicle compared to a comparable gasoline powered vehicle. Also due to limitations in current technology the range for most all-electric vehicles is limited to about 100 miles and to up to 250 miles for high-end electric vehicles.

Compared to a gasoline powered vehicle a hybrid uses less fuel, has a smaller carbon footprint, and has a comparable range and performance. Due to the unpredictability of gas prices and increasing consumer demand for more fuel efficient vehicles the demand for hybrids is projected to increase dramatically.

➤ Tax incentives

As part of the American Recovery and Reinvestment Act of 2009 the Federal Government provides a tax credit of 10% of the cost (up to \$2,500) of two- or three-wheeled plug-in vehicles with a battery capacity of at least 2.5 kWh. In addition to these incentives there are many other state and local incentives to purchasers of hybrid and electric vehicles.

The state of California has also introduced AB 118 into the Senate, which will provide \$100 million for incentives aimed at increasing the use and the development of alternative fuel vehicles.

➤ The Obama Administration

On March 19, 2009 President Obama unveiled a \$2.4 billion grant program to aid electric cars while visiting a testing center in Pomona, CA. He has pledged to put a million plug-in hybrid vehicles on the road by 2015. President Obama's environmental agenda is a part of his broader push for his \$3.5 trillion budget. His administration's policies are clearly aimed at growing the market and use for vehicles that run on alternative sources of energy and at reducing the Nation's dependency on fossil fuels.



SELECT HYBRID AND ELECTRIC VEHICLES

Aptera (Carlsbad, California) is the manufacturer of the 2 Series, a two-passenger, three-wheel vehicle. Two versions of the vehicle are under development, an all-electric and an electric-gasoline hybrid. The electric version will have a range of over 100 miles, an



efficiency rating of over 200 mpg and will charge in about 8 hours. The hybrid version of the vehicle, the Aptera 2h, has an estimated range of about 600 to 700 miles. Both vehicles are estimated to have a zero-to-sixty time of less than 10 seconds. The fuel efficiency is attainable due to the unique styling which gives the Aptera 2 Series a low drag coefficient. The 2 Series is estimated to be priced from the mid

\$20,000s to the mid \$40,000s and the delivery date has been delayed to late 2009.

The Chevrolet Volt (Detroit, Michigan) is a plug-in gas-electric hybrid that is due for release in 2010. The Volt will have the capability to travel 40 miles on pure electric power and is reported to cost approximately \$40,000.



Fisker Automotive (Irvine, California) is a joint venture between Fisker Coachbuild and Quantum Technologies. The Fisker Karma is a plug in luxury series hybrid with an 80 mile all electric range. It is expected to have a hybrid range of about 300 miles, a zero-to-sixty of less than six seconds and fuel economy of about 100 mpg. Like the Tesla, this technology comes at a price; the base price is projected to be around \$88,000.



Lumeneo Smera (France) is a small, two-passenger electric car. It has four wheels and employs tilting technology to help the car corner. It has a zero-to-sixty of about 8 seconds, an estimated top speed of 80 mph, and a range of 92 miles on one charge. It is in the development phase and it is unclear when the Smera will reach production.



Miles Electric Vehicle (Los Angeles, California) is an electric car producer based in the U.S. but with manufacturing facilities in China. Currently they only produce low speed electric vehicles but they are developing the XS500, a vehicle capable of traveling at highway speeds. The XS500 is projected to have a top speed of 80 mph, a range of 120 miles, and has a projected MSRP of about \$35,000. The car is due to be released in 2009.



Mini-E (Munich, Germany) is an all-electric version of the popular Mini which is part of the BMW Group. It has a top speed of 85 mph and a range of 150 miles. It will seat only two due to the large battery that it utilizes. The Mini-E is currently in testing and only 500 are available to lease at \$850 per month.



Persu Mobility (Los Angeles, California) is the manufacturer of the Persu Hybrid a two-passenger, three-wheel plug-in hybrid vehicle. It is expected to have a zero-to-sixty of less than 6 seconds, an all electric range of 20 miles, a hybrid range of



approximately 500 miles and fuel efficiency of approximately 100 mpg. It is produced by Persu Mobility in collaboration with world class strategic partners and employs the innovative "tilting" technology licensed from Carver Engineering. The Persu Hybrid is projected to go into production in 2012 and will have an estimated base price of about \$25,000.

The Pininfarina B0 (Italy) is a 50-50 joint venture between the Pininfarina Group which is behind the design of the Ferrari and Bolleré, a French conglomerate. The B0 (pronounced B-Zero) is an all-electric vehicle and is expected to have a range of about 150 miles with a top speed of 80 mph. Estimated production date and price are currently unknown.



Tesla (San Carlos, California) is the manufacturer of the Tesla Roadster, a high performance electric vehicle. It has a zero-to-sixty of less than four seconds and can travel 244 miles on a single charge and has an estimated fuel efficiency of 120 mpg. The design and basic chassis was provided by Lotus Cars and the first batch of the Tesla Roadster has been delivered. The Roadster sells for \$109,000 and has recently faced production problems and delays.



Triac (San Jose, California) is an electric vehicle produced by Green Vehicles. It is a three-wheel, two-passenger, all-electric vehicle with a top speed of 80 mph, a range of over 100 miles and a recharge time of five hours. The MSRP is \$22,995 and due to recently announced delays the vehicle is due for delivery in April of 2009.



XR3 (Phoenix, Arizona) is a two-passenger, three-wheel diesel plug-in hybrid vehicle. The vehicle is set to have a max speed of 80 mph and a fuel economy of over 225 mpg as a hybrid. The XR3 is a kit car and must be assembled and costs about \$25,000 and it also lacks many of the safety features found in most cars.



ZAP (Santa Rosa, California) is in development of the Alias, an all electric, two-passenger, three-wheel vehicle due for production in late 2009. The vehicle is said to have a zero-to-sixty of less than six seconds, a range of 150 miles, and a top speed of over 156 mph. The Alias is expected to start around \$30,000. But given the troubled history of ZAP, and concerns about their inability to meet past promises the feasibility of the project is in question.



Zytek Electric Vehicles (UK) produces the EV Smart, a Smart Fortwo that has been converted to an electric vehicle. The EV Smart is expected to have a range of 62 miles, top speed of 75 mph, and recharge to 80% in about 4 hours. Pilot projects are currently underway and a commercial vehicle is expected by 2012.



THE PERSU MOBILITY ADVANTAGE

- The Persu Hybrid will be unique in that it will provide a sporty, elegantly designed, ultra fuel-efficient vehicle with a range of approximately 500 miles at a fraction of the cost of a luxury sports car. These benefits will enable the Persu Hybrid to establish itself as a leader in a sub-segment of the hybrid vehicle industry.
- Persu is led by James Selwa, an industry veteran who has served as an executive in many very successful luxury brands. He has also orchestrated the development of two standalone businesses-one for Maserati N.A. and the other a start up for Rolls-Royce Motor Cars N.A. He was also the former President/CEO & Owner of Lotus Cars USA. The other members of the executive team are all composed of successful automotive veterans with extensive industry experience.
- NGEN Partners, one of the leading clean technology investment firms, has contributed \$9 million in funding to date. Institutional investors like NGEN provide not only financing but also a wealth of knowledge and expertise in the development of new ventures.
- Even without advertising the Persu Hybrid has generated significant interest and coverage. Currently there are over 19,000 people registered to purchase the vehicle. A third-party, company funded research has found that over 60% of respondents would consider purchasing the Persu Hybrid. Pre-registrants were mostly male, in their 40's and had a median income in the \$90,000-\$100,000 range.
- The company has partnered with many innovative, established companies in the development of the Persu Hybrid. It has licensed the Dynamic Vehicle Control or the "tilting" technology from Carver Engineering and has partnered with world class strategic partners for development of the propulsion system.
- The Persu Hybrid has all of the modern safety features that you would expect from a car and since it is enclosed it is exempt from helmet laws and motorcycle license requirements in many states. Enclosed three-wheel vehicles are allowed to travel in the carpool lane even with a single occupant in some states.

- The Persu Hybrid's low weight and aerodynamics allow for the use of a smaller 3kWh Li-ion battery which is significantly less expensive than the 10 to 15 kWh required for other plug-in hybrids and the up to 50kWh necessary for high-end electric vehicles. At the current price of about \$1,000 per kWh this equates to a significant cost savings. Additionally, there are tax incentives of up to \$2,500 specifically for two and three-wheel plug in vehicles.
- Persu Mobility is planning to outsource most of the production of the Persu Hybrid to experienced firms in the automotive industry and so will be less capital intensive than most of its competitors and will be able to provide a faster time to market.



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