

**Plug-In Hybrid Vehicles:
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A few insightful entrepreneurs and ex-auto executives are on the cusp on altering transportation as we know it in the San Francisco Bay Area, and potentially the entire world. Plug-in hybrid electric vehicles (or PHEVs) began as a General Motors concept in the 1960s, and after a number of brief and unsuccessful introductions in the United States and Europe, a number of major automotive companies, electric utilities, environmental groups, and financially backed start-ups are directing a substantial amount of resources towards making plug-in hybrids a reality. The majority of this activity within the United States is taking place in the Bay Area, for reasons that will be touched upon later in this paper.

Plug-in electric hybrid vehicles are hybrid vehicles with batteries that can be recharged by simply plugging them into an electrical outlet. Similar to most hybrid vehicles, PHEVs combine a conventional combustion engine with a rechargeable energy storage system to power electric motors and enhance fuel economy while decreasing pollution emissions. PHEVs simply have the added feature of being able to recharge through an electrical outlet. One can fill up their tank at the gas station and also plug it in to any 120-volt outlet. Essentially, a second fuel tank is created that is always used first, and the traditional gas tank serves as a backup. Advocate groups such as CalCars.org claim that with plug-in hybrids 1) local drivers almost never need to gas-up, 2) lifetime service costs are lower for PHEVs, and 3) a PHEV can provide power to an entire home in the case of an emergency outage.

A number of white papers and studies have been conducted to determine the impact on green house gas emissions and air quality that plug-in hybrids could potentially have, with the most recent and comprehensive study coming from the Electric Power Research Institute and the Natural Resources Defense Council. They conducted a “well-to-wheels” scenario analysis that accounted for the emissions from the generation of electricity to charge PHEVs and from the production, distribution, and consumption of gasoline and diesel fuels. The primary conclusions from their research are that 1) annual and cumulative green house gas emissions are significantly reduced regardless of how strict or loose one applies assumptions about PHEV penetration rates and the resource used for electricity generation, 2) the maximum annual GHG emissions reduction that the United States could benefit from in 2050 should PHEVs be adopted in the next few years

is 612 million metric tons, 3) the cumulative amount of GHG emission savings between 2010 and 2050 would range from 3.4 to 10.2 metric tons, 4) every region in the country will experience a reduction in GHG emissions regardless of the electricity generation resource. Admittedly, these are the results from a somewhat biased institution on a topic that has yet to be completely explored. There are a number of consulting firms and other organizations that are currently conducting similar analysis. While under certain scenarios PHEVs may not be significantly more “green” than their conventional counterparts (i.e. areas of the country that are reliant on coal for the majority of their electricity generation), a number of reputable organizations are beginning to proceed with measures to create practical applications for plug-in hybrids.

The state of California and particularly the Bay Area is home to technological innovation and progressive thinking, especially with regards to environmentalism and alternative energy sources. The Silicon Valley has long been a hotbed for technology and start-up investment, but recent government sponsored environmental initiatives has put California at the forefront of the energy issue in America. California instituted the nation’s first and most aggressive initiative towards increasing the use of renewable energy and has been a leader in setting policy on energy efficiency, carbon trading platforms to combat global warming, and environmental sustainability. The combination of government support and an innovation infrastructure in place, has enticed a number of opportunists to explore applications for plug-in hybrid vehicles. With 40% of GHG emissions in the state of California coming from cars and trucks, it is easy to understand why entrepreneurs are attracted to plug-in hybrids. One of the most notable and successful ventures to date, can be found in the growth witnessed by Tesla Motors and the partnerships they are developing in the Bay Area to roll out their version of a PHEV.

Tesla Motors is one of the only start-up automotive companies that have been able to compete with the “majors” foray into plug-in hybrids, and they are also already beginning to roll out their PHEVs to the public with a substantial increased schedule later this year. Given the company’s location in the Bay Area and prospects for tremendous growth and market penetration, Tesla along with other PHEV manufacturers are beginning to attract partners and developing the infrastructure necessary to facilitate widespread use of PHEVs. While one can easily equip their garage with the capability to

serve as recharging stations, electric utilities and other entities are stepping into the fold. The reason that electric utilities are attracted to and proponents for PHEVs is simple. As drivers rely more on electricity versus gasoline to fuel their PHEVs, utilities are able to sell more energy off the grid to consumers. As an added bonus, electric utilities are able to sell more energy during their off peak hours since most PHEV drivers will charge their cars during the nighttime when electricity usage is traditionally low. In addition, PHEVs can potentially serve as emergency on site generators when electric capacity on the grid is constrained. For these reasons, electric utilities are not only proponents of plug-in vehicles, but they are investing heavily in their application. Pacific Gas & Electric, one of the largest and most environmentally friendly utilities in the United States, is equipping its' industrial fleet with PHEVs and strategically developing a model for a large scale rollout of recharging stations.

Recently, non-traditional automotive and energy companies have also shown interest in participating in the plug-in hybrid fervor. Just last month, Hyatt announced a partnership with Tesla Motors where they will be installing recharging stations at three of their hotels throughout the Bay Area. Strategically for Hyatt, the partnership reinforces the notion that the general public (or at least consumers in the Bay Area) is becoming more aware and willing to adopt environmentally friendly technologies. In addition, given the list of orders that Tesla Motors has received from Hollywood celebrities and corporate executives, it appears as though PHEVs are starting to be considered stylish as well as practical.

While the model being produced and sold by Tesla Motors currently costs approximately \$100,000, costs concerns should be alleviated in the next few years as prices are expected to drop into the range of \$35,000 to \$55,000. Going forward, however, the primary obstacle for the adoption of plug-in hybrids on a widespread scale is going to be standardized and available recharging stations. While PHEV owners will always have the ability to recharge at home in their garage, the format of recharging stations could lead to inconveniences and inefficiencies. In the past, automotive manufacturers have argued over the best method for recharging PHEVs and have used two different incompatible technologies. Earlier this decade GM and Toyota backed one technology, while Ford and Honda developed and promoted another. Ultimately the

California regulators steeped in and chose the Ford/Honda version which was more like a standard power plug in order to make the process as consumer-friendly as possible. Tesla recently received a grant from the California Air Resources Board to develop recharging stations with the hope that they could be used by multiple makes of plug-in hybrid vehicles.

While plug-in hybrids will have a positive impact on GHG emission reductions and the Bay Area is clearly positioning itself to lead the charge towards making them mainstream, the positive impact that PHEVs will have on the urban design of the city is quite lackluster. Only minor adjustments to the transportation infrastructure will be necessary to facilitate growth in PHEVs (the build out of recharging stations), however many of the issues facing the U.S. transportation system are not addressed. The high density of San Francisco leads itself to pedestrian traffic; however the adoption of PHEVs does not increase or promote the walk-ability of the city. PHEVs will continue to be reliant upon the existing freeway and parking network. Not only will they fail to decrease congestion on the road, but an argument can be made for PHEVs actually increasing the highway traffic in the city. Plug-in hybrids could potentially convert BART (Bay Area Rapid Transit) users that previously used the rail system as a means to limit their environmental footprint. Thus, with the air quality benefits associated with PHEVs, even more cars (albeit PHEVs) could find their way to the road. Plug-in hybrids are still automobiles and will be used to “free” people from the city by allowing them to escape to the suburbs. As mentioned in our readings, this scenario does not combat the urban decay of some cities and actually has a negative impact on low-income households as public transit systems are routinely overlooked. Even though PHEVs are a “civilized” form of the automobile that can have dramatic effects on efficiency and GHG emission reduction, at the end of the day even with sophisticated traffic management systems, the sheer volume of people and cars in the region will lead to vehicles overwhelming cities and continue the geographic expansion of the Bay Area.

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