

# The Electric Car

## *A Brief History and What's Next?*

### **The Beginning**

At the end of the 19th century, any vehicle not pulled by a horse or mule was considered an alternative power vehicle, powered by steam, electricity or gasoline. But oil was discovered in Texas in 1901 and by 1920, gasoline fueled internal-combustion engine vehicles dominated the marketplace. Electricity and steam powered vehicles became distant also-rans. Oil was cheap, effective, readily available and easily transportable. It was also dirty, noisy and smelly but these characteristics were minor in comparison with its cost and availability.

Electric cars were introduced in the first half of the 19th century. At the end of the 20th century, electric vehicles held most world speed and distance records. They were cleaner, quieter, easier to operate and easier to maintain than steam or gasoline fueled cars but had a fatal weakness: battery technology limited the driving range of electric cars to between 40 and 50 miles before needing a 6 to 8 hour charge. Electric vehicles continued to be manufactured in the U.S. through 1939.

### **The ZEV Mandate**

No electric cars were produced in the U.S. between 1939 and 1996. That changed when General Motors produced the EV1 in response to California's 1991 zero emission vehicle mandate which required 2% of all new cars sold by major auto manufacturers in California in 1998 to meet 'zero emission' standards. The first EV1 autos used lead-acid batteries. Second generation GM EV1 cars had a range of 160 miles using nickel metal hydride batteries. A total of 4-5,000 electric vehicles were sold in the U.S. under the ZEV mandate.

In 2001 GM and Daimler Chrysler sued California for regulating fuel economy in violation of U.S. law, after which California relaxed the zero emission vehicle mandate. In late 2003, GM cancelled the EV1 program and other manufacturers soon followed suit. The film "Who Killed the Electric Car?" suggested that GM's EV1 program was canceled once California relaxed its zero emission vehicle mandate because 1) production was no longer essential; 2) electric cars impacted the oil industry; and 3) sale of electric cars adversely affected GM's replacement parts after-market. Virtually all EV1 cars, leased to the public, were recalled and destroyed by GM who estimated that they invested \$1 billion in development of the EV-1. General Motors recently announced that the electric Chevy Volt (hybrid electric vehicle) will be available for sale in the U.S. in 2010.

## **21<sup>st</sup> Century**

According to the US Department of Energy, more than 60,000 electric cars are in use in the US with more than 15,000 operational in California. More than 800 vehicles (mainly Toyota RAV4 EVs), produced during California's zero emission mandate have survived with several logging more than 110,000 miles, proving durability and maintainability.

### **What's next?**

Although there is no zero emission mandates in place, the marketplace has spoken. The combination of high gasoline prices, global warming and the absurdity of U.S. dependence on Middle Eastern sources of oil has inspired development and manufacture of electric vehicles.

- Five low-speed (neighborhood) model electric vehicles and six expressway capable electric vehicles are currently in production.
- In addition to Chrysler, Ford, GM, Toyota, Nissan, VW and Renault, a dozen or more new auto firms have introduced or plan to introduce electric cars by 2010.
- The industry is rapidly moving towards new battery technology. Tesla Motors and Miles Electric Vehicles amongst others are now using Lithium-ion battery technology.

### **Europe and Japan**

Since the first oil embargo in 1973 Europe has shown a continuous interest in electric vehicles. Today, electric cars are being built across Europe from Norway to Italy. Not to be left out, Mitsubishi and Subaru announced that they would be manufacturing lithium ion-powered cars before 2010. Toyota and Honda and Nissan will also have production models available in the U.S.

### **Neighborhood Electric Vehicles**

43 states and Washington D.C. allow operation of Neighborhood Electric Vehicles (NEVs) that can travel on streets which have a maximum 35 mph speed limit. Local jurisdictions have the right to ban their use or may require licensing and liability insurance. NEVs must have seatbelts, four wheels, windshield safety glass, windshield wipers, headlights, taillights, and turn signals but airbags aren't required. NEVs cannot legally travel faster than 25 mph. They're usually equipped with lead acid batteries offering a range of about 30 miles. Prices range from around \$6000 to more than \$14,000.

### **Freeway Electric Vehicles**

Aside from Toyota RAV4 EVs, most electric vehicles operating in the U.S. in 2008 are NEVs. Freeway capable vehicles are expected to be readily available by 2010. In addition to Tesla, Chevy (Volt), Mitsubishi, Nissan, Honda (hydrogen fuel cell technology) and Toyota, we can look for electric vehicles from Think (Norway), Smart EV (Mercedes) and Zenn (Toronto).

## **Electric Vehicle Benefits**

- Pure electric vehicles are true zero emissions vehicles. No greenhouse gases are emitted during vehicle operation.
- Gasoline is eliminated, replaced by grid sourced electricity generated from traditional and increasingly renewable sources. Many electric vehicles have factory installed or aftermarket solar panels installed on roofs.
- Fuel cost (electricity) per mile is 20-25% of gasoline or flex-fuel cost.
- 95% of the energy used to recharge EVs comes from domestic sources. Dependence on foreign oil is reduced.
- Very low vehicle operation and maintenance costs.
- Self energy generation through regenerative braking.
- Simple battery recharging through standard household 110V outlets and recharging stations.
- Electric vehicles are in production and available today at prices in a similar range to that of traditional gasoline and hybrid cars. A few models are also available in the luxury price range.

## **Limitations**

- 250-300 mileage range using Lithium-ion batteries
- Battery cost, weight, disposal
- Few commercial battery recharging stations
- At-home battery charging is not practical for apartment dwellers and those who cannot park near their home

## **Overcoming limitations**

- EV mileage range will increase as battery technology improves.
- Battery footprint, cost and weight will be reduced through new technology.
- Battery recharging stations will spread as EV production increases

## **Implications and Consequences**

- Physical vehicle characteristics and conveniences will change. Vehicles will take on non-traditional appearances
- Vehicle reliability and durability will increase
- Vehicle operating costs will decline as fuel costs, repair costs and replacement parts costs will all decline
- Reduced congestion due to smaller vehicle footprint
- More consumer choices
- Reduced dependence on fossil fuels, imported oil