

Electric Vehicle Development: The Past, Present & Future

Lixin Situ

Hong Kong Automotive Parts and Accessory System R&D Centre 78 Tat Chee Ave. Kowloon Tong, Hong Kong
E-Mail: lixinsitu@apas.hk

Abstract - A vehicle is considered Green when it more environmentally friendly than the traditional petroleum combustion engine, in which includes any nontraditional vehicle like, HEV, Plug In, EV, Fuel Cell, Bio fuel etc. that improves fuel economy. The development of electric vehicle has been over a hundred years but failure to gain the public acceptance in various stages due to various reasons which explained. While EV was never mass produced, Hybrid electric vehicle gains the momentum in recent years. Ford has launched its second generation of HEV and GM also announced the debut of the Volt in 2010. Comparing to the regular HEV, Plug in is the new trend in hybrid auto development due to extend travel range in electrical mode and a possibility of a zero emission as long as travel distance is less than charging threshold. However, more recently, an electrification trend in automotive industry has been evolved and will revolutionize the industry. With the correct policy and government help and advancement of electric vehicle technology, the prospect of Electric Vehicle will be bright and the focus point of future development.

Keywords – electric vehicle, hybrid, plug in, green, history

I. INTRODUCTION

As associated with energy independence and environmental issue, alternative fuel vehicle, especially Electric and Hybrid electric vehicle has become part of the government policy all over the world. The United States mandates a stricter fuel economy standard. China issued a new energy vehicle policy to accelerate & subsidize the deployment of electric this year and set a goal of 500k for 2011. Hong Kong also set a clear vision for EV application in the near future.

As for the auto industry, a silent green revolution is undergoing significant transformation after gasoline prices rose significantly to exceed US\$2 level and market demands for such vehicle. The industry introduced more fuel efficient HEVs and less polluted vehicles to the market. As oil prices surged rapidly during the last few years, the phenomenon has pushed pure electric vehicle development regaining traction among automakers and governments.

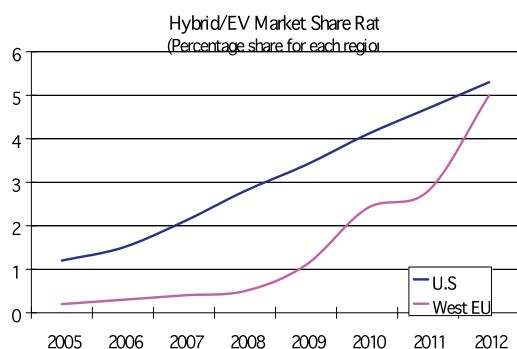


Fig. 1 HEV Market Share [1]

The consumer market has brought significant gain in alternative fuel vehicle as well as HEV and electric vehicles. A HEV study (Fig. 1) conducted by Polk & Company indicated an upward trend of market share of HEV sales in United States and Western Europe. An even bigger share of HEV and EV were predicted when they combined. In fact, selection of HEV models from OEMs have grown from two (Insight & Prius) in 2000 to more than twenties as today. Sales of the HEV are in the fast track along with more than 300,000 HEV sold in 2007[2]. Further known commitments of HEV and electric vehicle from OEM will improve the HEV production even more. Adding plug-in and electric vehicle to the line up will strengthen and accelerate the current electrification trend.

Chevy Volt, the first plug-in hybrid, and a bunch of planned electric vehicles saluted for end consumer in the North America will lead to a round of new energy vehicle in the market.

II. HISTORY OF ELECTRIC VEHICLE DEVELOPMENT

The development of electric vehicle has a long history. Since the invention of electric motor, electric vehicle has been around for 150 years. From simple non-chargeable to modern state of art control system, the development of Electric vehicle can be classified into three stages: Early years, Midterm and Present as described in Fig 2[3].

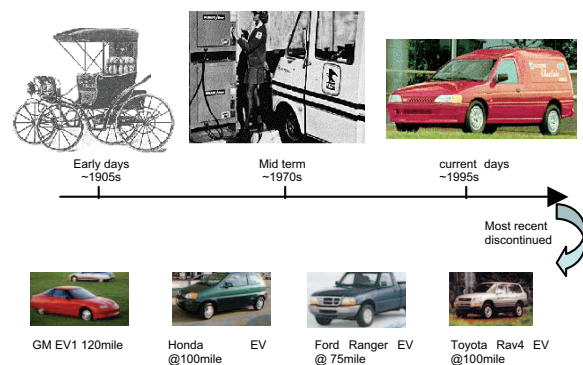


Fig 2: Electric vehicle time line

A. Early development stage

Electric vehicle was considered among the earliest automobile and well ahead of combustion engine. It dominated the vehicle registration with 3:1 comparing to gasoline vehicles in the late 1920s to 1930s and held most of the land vehicle performance record in early 1900s. It was a major transportation tool and widely used in the society for local transportation improved from horse carriages.

Until 1930, electric vehicle leadership was overtaken by gasoline vehicle development and was never able to reclaim the status for following reasons:

Maturity of Gasoline vehicle and can be mass produced at a reasonable cost. With the mass production of Model T & manufacture process revolution, vehicles became suddenly available to general public and proceed as a way to improve life; Gasoline vehicle took over as the leader and surpass electric vehicle both in performance and cost. Infrastructure improvement and demand of inter-city travel required a longer travel distance that was never able to exploit by electric vehicle before. Lacking of charge infrastructure development, reliable electricity transmission and limited travel distance, electric vehicle no longer suited for consumer demand and lost the edge to regular gasoline vehicle. Limited or no electrical infrastructure support forced the resignation and abundance of earlier electric vehicle.

Widely discovery of gasoline in the state and ready availability of cheap fuel also contributed the spread of gasoline vehicle. Petrol in the 1930s provided a direct cheap source of energy for vehicle transportation. It could be carried around by container which enabled and extended the mobility of owning a vehicle.

B. Midterm development (1930s-1980s)

Electric vehicle production and development came to a halt as personal transportation after combustion engine took over in 1935. Political sensitivity with OPEC created a necessity of energy independence during the 1960s and 1970s. U.S Government and environmentalist reintroduced tougher fuel efficient standard for the industry and ignited a board interest in electric vehicle in the period. Energy crisis in early 70s driven the US postal service placed a large order of 350 EV test fleet. It is the highest node of midterm development.

However, partly due to limited performance, other governmental priorities, lack of board infrastructure support and range of corporation participation, the development quiet down quickly during this period.

C. Modern Development

Modern EV development was dominated by EV1 who produced by GM for fleet application. Following a program funded by Department of Energy, Ford developed EV Ranger pick up truck, Toyota provided Rav4 EV and Honda had an EV available as well during late 1990s and early 2000s.

Table 1: Recent EV list

Model	Maker	Max Distance
EV1	GM	~100 miles
Ranger	Ford	75 miles
Rav4	Toyota	~100 miles
Car	Honda	~100 miles

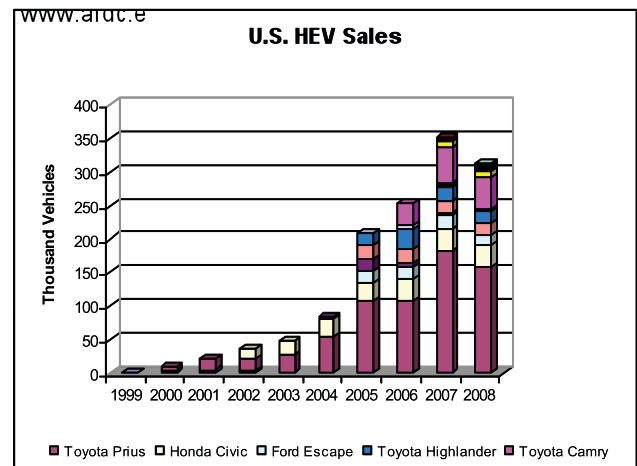
Unfortunately, this short surge of EV availability did not realized into commercial production because of a complicated issue of politics, economic, education and technology that includes vehicle production cost and safety concerns. EV1, Ranger, Rav4 and Honda EV were intended for fleet test only, almost all the vehicles has been discontinued, destroyed and recycled. Only a handful of electric vehicles were survived under the hands of EV enthusiasts.

D. Modern HEV development

Digital Reference: K210509135

However, in 1999 and early 2000s, a new type of electric vehicle emerged from pure electric vehicle. Honda introduced the first HEV, Honda Insight, to the US Market that brought another milestone in auto industry. With brisk market acceptance and success of the Prius, HEV technology shows it maturity and potential. Ford introduced the first American hybrid electric vehicle, Escape SUV HEV, during the ‘Manhattan on a Tank’ event and registered 600 miles/tank in congestive city traffic that opened a new era of competition in US among HEVs.

Table 2. US HEV Sales[4]



By year of 2008, the HEV sales were more than 2.5% [5] for total sales volume. In deep, the next generation of HEV from Toyota, Honda and Ford has introduced into 2009 with further refinement along updated technology. Fuel efficiency has improved as well.

Table 3. Major HEV offering [6]

Ford	Escape, Marina & Fusion
Honda	Civic, New Insight
Chrysler	Aspen
Mazda	Tribute
Nissan	Altima
GM	Malibu, VUE, Aura, Yukon, Denali, Tahoe
Toyota	Prius, Camry, Highlander
Lexus	RX400h, GS450h, LS600hL

Toyota is the clear leader in the HEV arena base on volume and range of models with it “synergy drive system”[7]. Honda and Ford are right behind with their offering in full hybrids. GM offers its “two mode”[8] technology in hybrid passenger cars and trucks as well.

E. Future Development

As gasoline price rise rapidly, combined with environmental concern, the society renews the call for social responsibility. Electric Vehicle and other AFV suddenly becomes popular again.



Fig 4: Oil Price index[9]

With announcement of the Chevy Volt [10] plug-in concept couple years ago and pure electric vehicle from Nissan, a new round of EV development has resurrected into OEM's cycle plan in the up coming years. The fruit of this EV trend will be seen in the next three years.

Comparing to previous electric vehicle development, there are a few factors that will ensure this initiation be successful in the future:

Vehicle operators are the direct target customers of developing EV. Market driven approach always creates competitive & attractive products at reasonable cost and performance.

Early technology and environmental adopter will the initial leaders and users. They are willing to support and has the capability to influence the success. Also various education programs and EV initiatives transform general understanding of fuel efficient vehicles and their benefits. Warm acceptance of electric vehicle is high in the coming years.

Cooperation in charge station and infrastructure development has gained attention at different level. Various business models are being explored. The industry and government are confident that final plan will reach prior to the mass launch of electric vehicle.

Energy storage technology improvement makes lithium battery application became safe in vehicle. Sophistication of system management upgrades and improves electric vehicle to a comparable level of combustion engine. Lastly, proper government policy provides a development foundation for the industry. Special tax incentives and subsidy will offset consumer burden for purchasing electric vehicle. It is a confident vote for the product when government is willing to provide financial & strategic support.

III. CONCLUSION

Like many emerging technology, electric vehicle development and application have been around for a long time, but until recently, the technology has not really taken off. Even though HEV started as a good alternative to gasoline vehicle and well publicized by the media, but it only represented as the intermediate step or near term solution.

Government regulation and environmental prospect, in particular will drive the adoption of transportation electrification. Electric vehicle will be the final goal. In fact, as OEM introduce more EV model to the end consumer by 2012, the presents of electric vehicle will be widely seen and recognized.

Along with new electric vehicle development on the way, it will also introduce tremendous opportunity in associated technology especially in Power electronics. We shall utilize this opportunity and contribute to the green trend.

IV. REFERENCES

- [1] www.hybridcars.com/news/new-study-hybrid-cars-rise-especially-europe-25267.html
- [2] The US Department of Energy Analysis
- [3] Electric Cars @ www.about.com & wikipedia.com
- [4] Data comes from the US Department of Energy @ www.afdc.energy.gov/afdc/data
- [5] www.afdc.energy.gov/afdc from US Department of Energy
- [6] Names and models are trademarks of respect automobile manufactures.
- [7] Trademark of Toyota Motor Company
- [8] Trademark of General Motor
- [9] Oil index @ www.digitlook.com