

## A REVIEW ON TECHNOLOGICAL IMPACT OF ELECTRIC VEHICLES ON SOCIETY

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**Abstract:** Environmental degradation is an important content when transportation is considered i.e the emissions of vehicles that causes reduction in earth's life. Initiation and advancement of EV's has a greener contribution to the society. Furthermore number of advancements, changes, up gradation and needs required to match the demand has been grown. Electric vehicles efficiencies, batteries, transmission systems and grid technology were the important roles in bringing the possible beneficiary to the society. Various studies, work and its implementation has been executed by more number of countries with different transmission arrangements, various battery built using different materials showed better efficient and green batteries and furthermore with using V2G technology of balancing the electrical parameters practically between grid - vehicle. All the technological advancement has been in progress from past many years and has contributed huge to the technology. Energy required to run the EV's played an important role in environmental effects. The plants which are used for energy generation for charging EV's should always rely on renewable energy that showed better and healthy technology utilization. All the variations, advancement and its effects was observed and technological improvements could be achieved in any of the parameters, but the way to chose the each and individual parameters that can bring lots of improvements ahead of the challenges need to be clearly studied and defined. The review conducted can be taken as the brief data's to conclude the impact of EV's on the society.

**Keywords :** Contribution, Development, EV's, Environmental, Parameters, Society, Technology,

### 1 INTRODUCTION

The burning of fossil fuels and the emissions has a drastic effect on the ozone layer and the total earth's safety has been degrading day by day. The natural disaster what the nation is facing in irregular manner is a present observation that must be treated and studied at most important region of focus and scope of importance. Of all the parameters, transportation is a major important in the content of study which has contribution of 20 % to the effect. Various designs, arrangements, new fuels, upgrading the technology to reduce emissions has been tried and executed. But of all the parameters Design of electric vehicles has been promising technology to contribute and save the earth from degradation. The utilization of electric vehicles showed a positive effect to the environment. Government has been interested in planning and developing new rules, guidelines and various policies. The stock of EV's was around 180000 at 2012. This showed 0.02% of vehicle stock internationally lead to the initiation and focus more on R & D. The drastic importance of electric vehicle has been initiated internationally. Challenges have been faced in power train, batteries and charging infrastructure. Varieties of power trains, different types of batteries used and various charging technology has been adopted and successfully growing. The EV's showed a positive effect on the environment. The EV's utilized are better than Internal Combustion engines. The main point here to improve regarding the relationship between EV's and Charging station i.e. power grid. Based on all the literature done, our aim was to

study the positive and negative impact of EV's on society. Methodology was chosen to describe the important steps in designing and developing EV's. Our intense was to study in detail regarding the impact either in terms of science, technology, marketing and many more. [1] [6] [7] [12].

## **2. OBJECTIVE**

The objective of the study is to find the social economical impact of EV's on society by considering various literatures, reports and articles published which is generally taken as citation. Based on the literatures or work performed, the contribution of technology has been examined [1] [3] [12] [13].

## **3. SCOPE**

The scope of the present study is confined to impact of EV and its technology. The analysis of study was planned and designed based on the prior works performed and published. The frequency of technological focus was limited to the standard of references chosen [1] [6].

## **4. LITERATURE REVIEW**

EV's growth can bring lots of developmental changes in the environment and nation. EV's are environmental friendly compared to IC engines. Zero emissions could be treated as the best eco friendly technology criteria. Development of EV's from its imitation and updating has larger technological market growth which needs to be focused in systematic point of view. Development of EV's from its initiation to till date is wide range of areas where they have targeted. Power trains designed and developed from series to parallel arrangements which has a variations in contribution of mechanical specification required and comforts aspects, change in batteries technologies like lead acid, nickel based and lithium types which showed difference in efficiencies achieved. Charging technologies has been improved from slow charging to fast charging stations. For efficient charging the balance of variations, constants of current, voltage, ampere and frequencies are challenging parameters in balancing the conditions. Environmentally the development of EV's and energy required to run these vehicle that produces emissions makes a prominent steps in considering from the energy source plants which later supplies for EV's through charging stations. V2G is an important technology which is still improving these days where energy is transferable from EV's to Grid and Grid to EV's, which generally balances the technical load challenges. Developments of smart grids for better user interface between EV's and charging stations in demand response conditions. Once it comes to the market capture or awareness about the technology, EV's has sold out lakh's of units per year internationally. America, Japan are the countries with highest number of EV's sold out per year. The role of most of the advanced countries are bringing out more number of market size by 2020. Considering the positive and negative impacts of the technological benefits, various individual literature have been studied and its effect, contribution and most of the parameters and discussed further [6] [8] [11].

## **5. METHODOLOGY OF STUDY**

Research review was an important step in finding the right direction to find the variation of technology observed in these many years and their technical, social and economical contributions has been examined. Focusing more on technical contribution, development research articles were chosen and

correlated to find the maximum effect of EV's on society. [3] [5] [8] [6] [11].

### Developmental Methodologies Chosen

#### EV's Current status

EV's contribution has changed a lot from 19<sup>th</sup> centuries till date. The invention of electric motor has been initiated with development of EV's in 18<sup>th</sup> centuries. Different development of electric motors and its development brought variations in efficient power drive. Different fuel vehicle are parallel on the way of its invention. But the right efficient vehicle as choice plays an important role in its specification. So the EV's has a major contribution in the society and a number development seems a revolutionary changes n the market.

#### Power Train

The main components of power transmission systems are the energy storage units and energy transfer units. Either the size of the battery decides the distance travelled or power consumed or the type of energy transmission arrangements that could have maximum energy utilization or a high economically driven vehicle. Vehicles of different arrangements, Hybrid electric vehicles, plug in hybrid electric vehicles, battery electric vehicles in series or parallel conditions. All the above arrangement showed better and negative results that has contribution to the EV's and environmental impacts also. The technological changes are shown in the below figure 1.

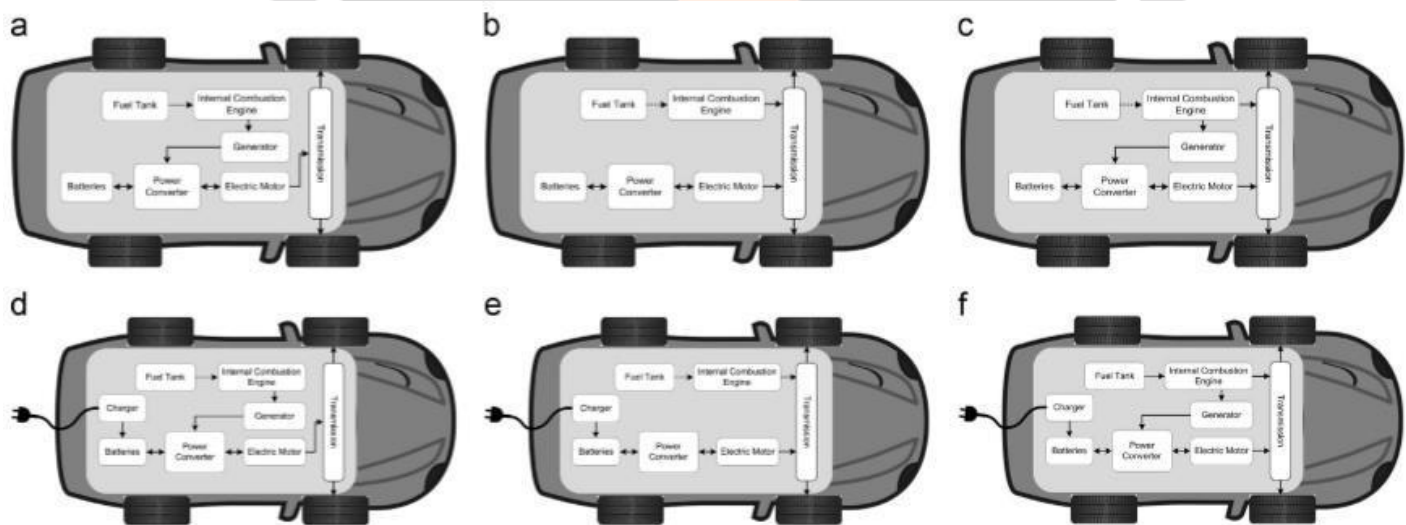


Fig. 1. Power train configurations: (a) Series HEV, (b) Parallel HEV, (c) Series-parallel HEV, (d) Series PHEV, (e) Parallel PHEV, (f) Series-parallel PHEV [6].

#### Battery

Battery is the major and energy storage unit, which is a very important criteria to make the technology advanced and more number of units could be sold with its development , because the changes in battery storage capacity and making it lighter in weight is a major technological development considering the environmental point of view. Different form of batteries has been invited and showed a positive results but the energy storage capacity and EV’s longer distance travel with better economical vehicle is still the challenging area. The evolution and technological changes of the batteries are shown in the below figure 2. The parameters of the batteries, like nominal voltage, energy density, specific power, energy density,, percentage of self discharge per month, memory effect, operating temperature and production cost per kWh data’s has been collected refer figure 3.

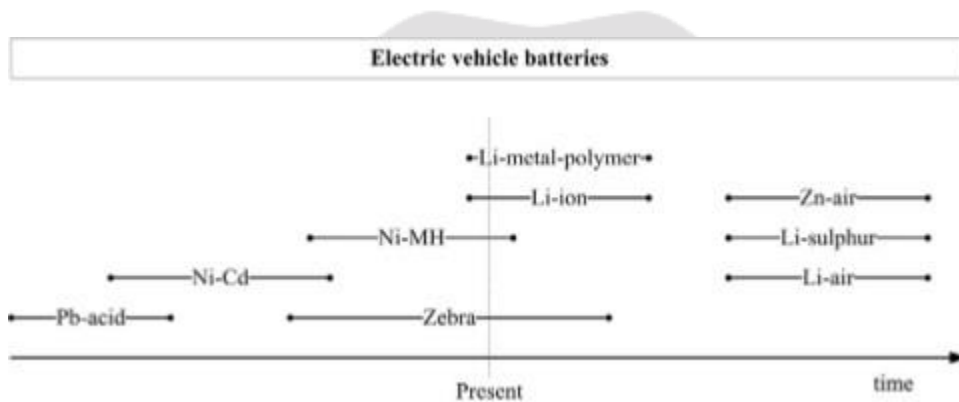


Fig. 2. Development timeline of EV battery [6].

Battery type	Nominal voltage (V)	Energy density (Wh/kg)	Volumetric energy density (Wh/L)	Specific power (W/kg)	Life cycle	Self discharge (% per month)	Memory effect	Operating temperature (°C)	Production cost (\$/kWh)
Lead acid (Pb-acid)	2.0	35	100	180	1000	< 5	No	-15 to +50	60
Nickel-cadmium (Ni-Cd)	1.2	50-80	300	200	2000	10	Yes	-20 to +50	250-300
Nickel-metal hydride (Ni-MH)	1.2	70-95	180-220	200-300	< 3000	20	Rarely	-20 to +60	200-250
ZEBRA	2.6	90-120	160	155	> 1200	< 5	No	+245 to +350	230-345
Lithium-ion (Li-ion)	3.6	118-250	200-400	200-430	2000	< 5	No	-20 to +60	150
Lithium-ion polymer (LiPo)	3.7	130-225	200-250	260-450	> 1200	< 5	No	-20 to +60	150
Lithium-iron phosphate (LiFePO <sub>4</sub> )	3.2	120	220	2000-4500	> 2000	< 5	No	-45 to +70	350
Zinc-air (Zn-air)	1.65	460	1400	80-140	200	< 5	No	-10 to +55	90-120
Lithium-sulfur (Li-S)	2.5	350-650	350	-	300	8-15	No	-60 to +60	100-150
Lithium-air (Li-air)	2.9	1300-2000	1520-2000	-	100	< 5	No	-10 to +70	-

Fig. 3. Comparison of EV battery types [6].

### Environmental Impacts

It has been claimed and observed the zero emissions of EV’s but the energy since creation burning fuels makes an



important contribution to the environment. Results shows that energy source creation plant should generally run on Renewable resources rather that coal fired which again further it deploys the environment.

**Vehicle-to-grid (V2G) technology in smart grid**

The initiation of V2G technology has started at the initial phase. The Unidirectional method of V2G technology showed an improvement in balancing the power grids and EV’s loading conditions, different current parameters and many others. The main technological difference between uni-directional and bi-directional V2G are observed in figure 4.

V2G Types	Description	Services	Benefits	Drawbacks
Uni-directional	Uni-directional V2G technology controls the EV charging rate in a single power flow direction from the grid to EV based on energy scheduling and incentive system.	(a) Ancillary service - load levelling	(a) Minimize power losses (b) Maximize profit (c) Minimize operation cost (d) Minimize emission	(a) Limited service available
Bi-directional	Bi-directional V2G refers to the dual direction power flow between EV and the power grid to achieve numerous benefits.	(a) Ancillary service - spinning reserve (b) Active power support / load leveling and peak load shaving (c) Reactive power support / power factor correction/ voltage regulation (d) Harmonic filtering (e) Support for the integration of renewable energy resources	(a) Minimize power losses (b) Maximize profit (c) Minimize operation cost (d) Minimize emission (e) Prevent power grid overloading (f) Improve load profile (g) Regulate voltage level (h) Failure recovery (i) Maximize renewable energy generation	(a) Battery degradation (b) Complex hardware infrastructure (c) High investment cost (d) Social barriers

Fig. 4. Comparison of uni-directional V2G and bi-directional V2G [6].

**6. DISCUSSION**

Based on the developmental methodologies chosen and considering their literature is discussed further. The important steps considered as developmental reviews are, Current EV’s status, Power Train, Battery Technology, Environmental impacts and V2G Technology. It was clearly observed from past literature and current developmental status that EV’s has captured the society and market matching the needs of the customer. Technological challenges are always ahead in terms of specification but the end needs remains the same as matching the society needs and high efficient outputs. The power train which is a mechanism to drive the vehicles plays an important efficient vehicle that satisfies human needs and mechanical aspects of views. Different hybrid arrangement has been tried for developing Hybrid vehicles which finally developed different efficient power train arrangements as discussed clearly in Figure 1. The energy storage system which has a major contribution to the EV’s efficiency. Different batteries made of varieties of chemical inert materials showed a variation and improvement in development of efficient vehicle. The electrical controllable parameters showed a variation in

controlling the energy as a major source. Literature shows positive environmental effects produced by EV's but the emissions discharged for charging through grids makes an important factors in deciding to rely more on renewable energies. Parallel development of V2G technological impacts showed a balanced condition in running the EV's in the society. The impact of uni-directional and bi-directional V2G makes a choice in its developments.

## 7. CONCLUSION

Reviewing the various literatures on EV's developmental stages till to date. The literature and discussion shows a clear positive impact on society (Environmental changes). Drastic high Price of fuel and degradation of environment ozone layer development of EV's captured the market internationally and successfully accepted by the society. More number of EV's customer demand and supply has to match only upgrading the technology and huge numbers of manufacturing or production sectors. Reaching the requirements has shown improvements in market various conditions like technology, markets, financial improvements and many others. Technological developments and its research and development lead to the various changes in different sectors that indirectly bring the improvement in the EV's sector. Different power train arrangement, developed from petrol, gasoline and hybrids shows a major improvement and developing high efficient vehicles. Various technological advancement in developing a high efficient battery showed a remarkable positive impact on EV's continuity. Environmentally accepted EV emission and its beneficiary is a major role in driving the technology, but the major concern is about using of renewable energies for creation of energies in power grids and charging stations. Because the emissions released in creation of energy simultaneously effects the environment. So the development of V2G technology which is a balancing parameters in controlling the demands via electrical parameters .However whatever the parameters chosen has either positive and impacts either on environment or society. The magnitude of the contribution plays an important role as a deciding factor to enhance, involve and bringing out the green technology that saves the planet earth. The further scope of work defines the major or higher percentage of impact to choose as future review and more findings could be clearly defined for further rules, polices and standard guidelines required.

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