EV Technology; A Review

Dileep Kumar Sahu[1] Manish Sawale[2] Nivedita Singh[3]
[1,2,3]UG Student
[1,2,3]Department of Electrical and Electronics Engineering
[1,2,3]Oriental Institute of Science and Technology, Bhopal, M.P., India

Abstract — Electric Vehicles are in a Verge to replace conventional means of transportation. There are more charging stations as a result of EVs' growing popularity, which has a big impact on the electrical system. To reduce the negative impacts of EV charging and to increase the advantages of EV grid integration, several charging strategies and grid integration techniques are being developed. This study presents a brief review of the state of the EV industry, standards, charging infrastructure, and the grid effect of EV charging. The history and evolution in EV technology is presented in this paper. Types of EVs developed is overviewed and their impact on the society is briefly discussed.

Keywords: Electric Vehicle, Internal Combustion Engine (ICE), AC/DC hybrid microgrid, Storage Battery unit, Charging Infrastructure

I. Introduction

Electrified vehicles are not a new concept. In the late 1890s, at the dawn of the automotive revolution, a decisive battle occurred. Electric cars battled it out with Internal Combustion Engine (ICE) (petrol) vehicles and was priority for humanity's future. Indeed, in those days electric vehicles were approximately two times to the ICE (petrol) vehicles [1].

EVs have achieved notable milestones, including the first vehicle to exceed 62mph (100kmh) in 1899. However, overriding factors that remain familiar today ensured that internal combustion engine-based vehicle won overall adoption battle [2]. The reason was simple, as electric cars were constrained by distance range, it was just few miles during 1890. With development of electric motor starter for gasoline-powered automobiles, eradicating the traditional disadvantage of gasoline-powered automobiles: the need to start the car with a hand crank! Finally, it was determined that petrol vehicles were the superior choice to electric vehicles due to its low cost [3].

Electric vehicles became simpler and more efficient over the course of the twentieth century, hence over next decade they can become our “Standard Vehicle”. Over the last decade, there has been a surge in interest for electric vehicles. Tesla's Roadster debuted in year 2008, has revolutionized vehicle industry and prompted its competitors like as Chevrolet & Nissan to introduce their Electric vehicles. An overview of electrical vehicle with all its components is shown in figure 1[4].

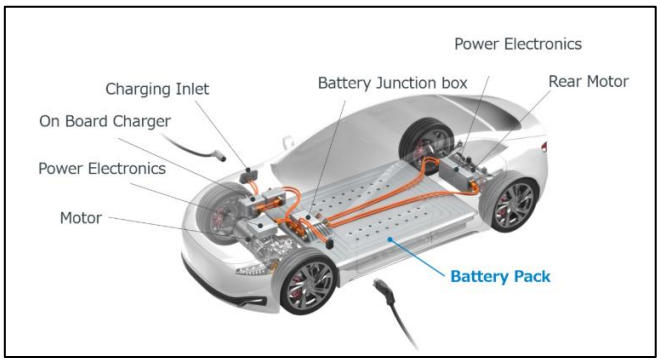

Fig. 1: Over view of electric car.

II. Impact of EV on Society

Now a days electric vehicles are widely adopted which have impacted our society both in terms of use of technology for mobility and shifting our economy far away from petroleum fuel. This is very much useful in reducing environmental footprint of our transportation system. Figure 2 shows interdependency of society and electric vehicles. [5] There will be power quality issues and negative effects with increasing penetration of EV in our transportation. The influence on rise in power demand due widespread adoption of EV is the first and possibly most visible consequence of growth in the EV. In terms of battery technologies, it has vast growing opportunities for research and development, notably in terms of increase in the energy density and charging speed [6, 7]. The widespread adoption of electric vehicles (EVs) is followed by a slew of obstacles, including those related to energy, transportation, and industry. EV necessitates the construction of charging stations infrastructure for charging of electric vehicles. Furthermore, as EV’s are highly penetrated in distribution network, smart grid solutions require a large capital investment [8]. The simultaneous or uncoordinated charging of EV’s clusters, on the other hand, significantly rises consumption of electricity, causing an unanticipated peak on the Utility grid and overloading the distribution-network, leading to degradation of voltage quality, increase in power loss and increased costs and uneconomical dispatch of energy [9, 10].

Adaptation of EV by our society, significantly related to charging station facility. EV charging station necessitates electrical energy in large quantity, which is largely supplied by fossil fuel-based power plant. As a result, Electric vehicle can become a green & clean alternative to the current transportation system only when renewable energy sources will provide the energy needed to charge EV’s such as solar.

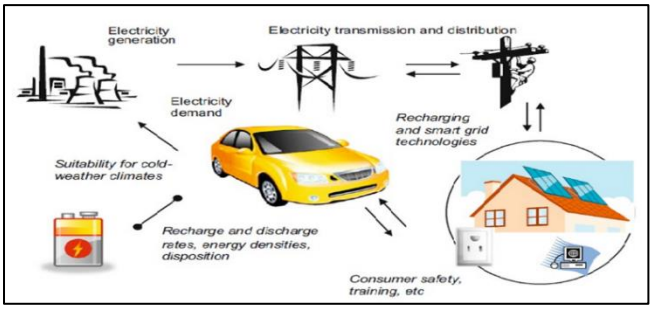

Fig. 2: Impact of electric vehicle on society

III. EV CATEGORIES

All-electric cars (AEVs) and hybrid electric vehicles (HEVs) are the two primary categories into which EVs fall [11]. The only electrically driven motors found in AEVs are electric ones. Battery EVs (BEVs) and fuel cell EVs (FCEVs) are two more subcategories of AEVs. An external charging mechanism is not necessary for an FCEV. However, a BEV's storage unit can only be charged using external electricity from the grid. One kind of HEV that has the ability to recharge its battery from the grid is a plug-in hybrid electric vehicle (PHEV). BEVs and PHEVs are referred to as EVs in this study. The classification of various EV kinds is shown in figure3, and figure 4 explains how power moves from the energy source to the wheels.

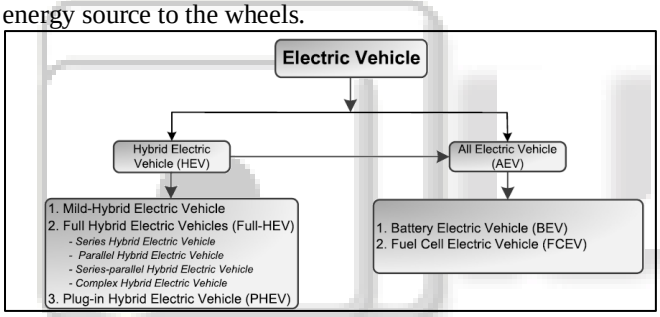

Fig. 3: EV categories

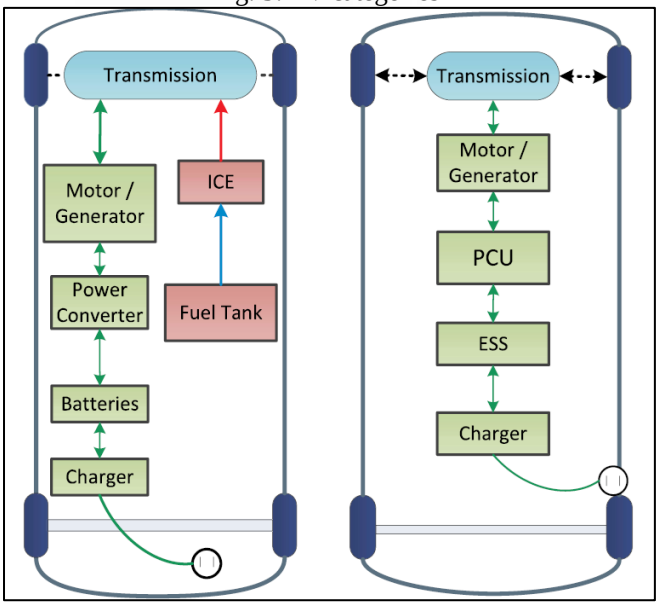

Fig. 4: Power flow in different types of EVs (a) PHEV, (b) BEV.

According to recent reports, the number of EVs on the road reached 3 million in 2017, compared to just hundreds a decade earlier (figure 5) [12]. Figure 6 [13] lists the countries that led the EV sales in 2018. Despite the many benefits of EVs, only a small number of countries are participating in the global EV market, primarily due to the high cost and limited production number.

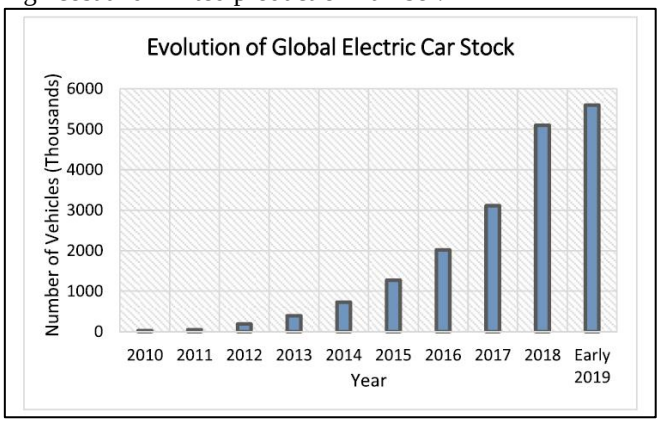

Fig. 5: EV market status

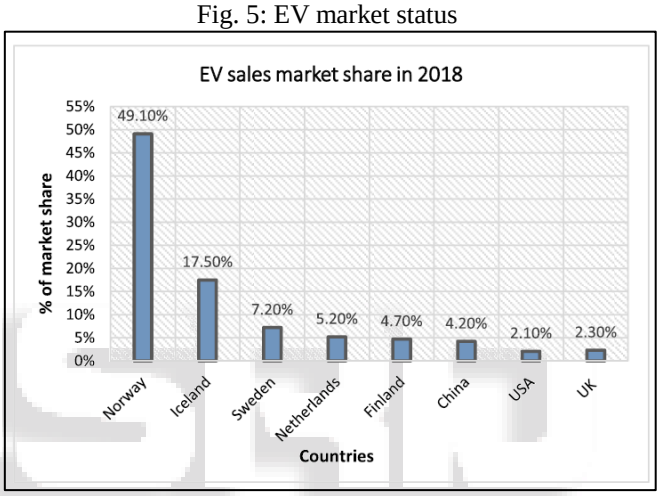

Fig. 6: EV Market Sales 2018

IV. CHARGING INFRASTRUCTURE

The Charging infrastructure facilitates an electric circuit or system for power flow between EVs and connected supply system [14, 15]. In literature numerous structures is available based on power used, accommodation of the charging circuit, physical contact requirements, and direction of power flow as shown in figure 7.

Reason why the output of the wind declines after ten seconds; it is also the reason why the wind output begins to decrease after ten seconds. Up to ten seconds into the functioning of a hybrid microgrid, both solar and wind turbines can simultaneously create an excess amount of electricity over what is required by the load. Because of this, excess electricity from the hybrid microgrid is delivered to the grid, which helps to reduce the strain that is exerted on the system [16].

As seen in figure 8, the mobility, coordination, and control structure of EV charging may be categorized based on the distribution grid, EV charging stations, and EVs. mobility of vehicles. Static and dynamic charging are two categories for EV charging infrastructure in this regard. When charging with static charging, the car is seen as being parked in a charging station. The dynamic or mobility aware charging scheme, on the other hand, takes into account various temporal movements, including vehicle arrival and departure

times, trip histories, and any unforeseen EV arrival or departure events [17-20]. This is more realistic because it takes into account the spatiotemporal relations of EVs, but it is more complicated and needs sophisticated control infrastructure [17].

As seen in Figure 9 [21], EV chargers can be categorized as unidirectional or bidirectional based on the direction of power flow. A unidirectional DC-DC converter and a diode rectifier are used to manage charging in an EV charger with a unidirectional topology [22, 23]. Due to its simplicity, the unidirectional charger is simple to operate. Compared to bidirectional varieties, it has fewer connecting problems and reduces battery deterioration. The majority of grid ancillary services, however, cannot be supplied by unidirectional chargers [24, 25]. Both a bidirectional grid-connected AC-DC converter and a bidirectional DC-DC converter are features of a bidirectional EV charger [26]. Because this type of charger can function in both charging and discharging modes, EVs are able to provide the grid a number of auxiliary services.

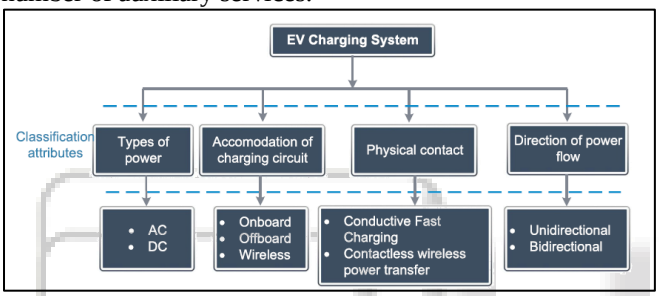

Fig. 7: EV charging infrastructure

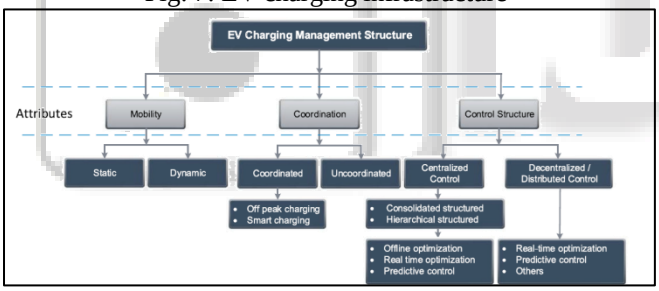

Fig. 8: Classification and control of EV charging infrastructure

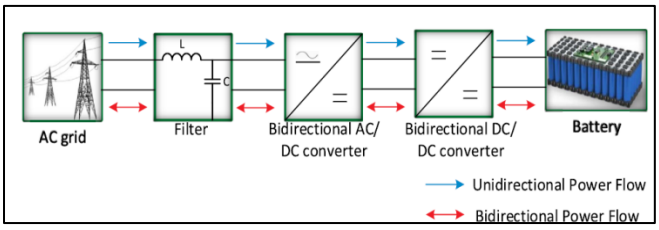

Fig. 9: Power flow direction

V. Conclusion

The popularity of EVs is predicted to rise dramatically over the next ten years due to improvements in grid integration facilities, charging infrastructure, and EV technology. Therefore, to guarantee the most possible advantages from EVs with distributed generators, more technological developments are necessary, such as the appropriate smart charging infrastructure, dependable communication systems, and coordinated charging system to quantify the effects on the power grid. Furthermore, the power system may become completely automated with sophisticated energy management systems thanks to a potential future grid technology called the Energy Internet. Every facet of grid integration infrastructure and EV charging is covered in this article.

One of the main requirements for EVs to become more popular in the market is the establishment of global standards for EVs and the infrastructure supporting charging. This paper presents a brief review on all such aspects.

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