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Study of Battery Charging Technologies for Electric Vehicles

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Abstract**—** As everyone is aware, coal, oil, and gas are all running out of supply. We owe it to future generations to conserve as much natural resources as possible. There is a probability of switching to an electric vehicle from a conventional vehicle by reading this article. The battery power, its maintenance, capacity, and performance with the vehicle are the most important considerations when purchasing an electric vehicle. So, recharging batteries is a need. There are a variety of charging methods for electric vehicles and their batteries. Charging methods include AC, DC, conductive, battery swapping, inductive, solar, and the use of power electronics, to name just a few. It's possible to use a hybrid system of dynamic wireless charging, for example (DWC). Grid to Vehicle (V2G) and Vehicle to Grid both use electric vehicle batteries as potential energy storage devices in micro grids (G2V). In recent years, a large number of charging stations have been built in various countries. Earlier this year, TATA Corporation began developing charging stations in India as well. We'll learn about numerous methods for recharging electric vehicles in this research. At full power, the fast charger causes a 10V dip in the electric grid, but it decreases low-order harmonics. The ABB PCS DCFC fast charger, with a 50kw rating, was the most recent technology to be implemented (125A DC). As part of the smart grid, and as an emerging trend in the automotive industry, electric vehicles are now being studied. These vehicles have the potential to reduce energy consumption and pollution. Finally, we'll cover a variety of electric vehicle charging methods.

Index Terms— Natural resources, charging technologies, Battery, Charging stations, Micro grid.

I. INTRODUCTION

There must be a major reduction in greenhouse gas emissions by 2020 as part of this ambitious strategy 450 parts per million carbon dioxide equivalent is the long-term limit set by the International Energy Agency for atmospheric concentrations of greenhouse gases. [1]. Currently, the majority of greenhouse gas emissions come from automobiles' internal combustion engines. Approximately 16 percent of global man-made carbon dioxide emissions are attributed to automobiles. EV charging station planning has been done in a variety of ways and for a variety of reasons. Electric vehicles can help with charging station planning by acting as a spinning reserve for peak load and enhancing system performance. The decrease of loss and elimination of voltage deviation are only two examples of how EVs might assist us enhance our bottom line. [2]. Interconnection protection must be distinguished from network or EVCS protection. [4]. Because of its inexpensive maintenance and good speed torque characteristics, brushless DC motors (BLDC) are widely utilised in electric vehicles and are considered the best option for electric vehicles. [5]. In the past few years, public awareness of the negative aspects of fossil fuels have increased.

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In addition to contaminating the environment, fossil fuels are also a major contributor to global warming. These resources are not renewable or sustainable, hence there is a limited supply. This is why electric vehicles, which use on-board energy storage systems, are getting greater attention as a viable alternative to cars fueled by fossil fuel [13].

II. LITERATURE SURVEY

I learned from this research that the internal combustion engines in automobiles are responsible for a significant amount of the greenhouse gas emissions now being produced. Internal combustion engines, in addition to releasing greenhouse gases, also discharge toxic chemicals into the atmosphere, endangering human health. If the internal combustion engine can be avoided, hazardous pollutants and greenhouse gas emissions can be significantly decreased.. For charge scheme assessments, a common evaluation methodology is needed. The purpose of this standardisation is to ensure that published research results may be reproduced and reused. Research resources can be more effectively utilised if the results of previous studies are made available to the public. Analytical results and theories for PHEV charging must be developed in order to assist system level performance planning and trade off efficiently [1].

For commercial and residential facilities, such as offices and residences, a new method was proposed for the ideal size and location of different types of EV charging stations. Fossil fuel transportation's economic and environmental challenges have sparked a global movement toward electrification. Even though several countries are aiming for 100% EV penetration in the near future, the market share of electric cars (EV) has already reached 28.8% in Norway, 6.4% in the Netherlands and 1.4% in China. A variety of methodologies and objectives have been used to plan EV charging stations [2].

Bidirectional isolated AC–DC converters for automobile battery charging applications have been analysed in this study, and three key sections have been outlined. Battery chargers for electric vehicles (PEVs) are discussed in the first section. Additional information on Vehicle to Grid and the input power quality and electromagnetic compatibility requirements are also provided in this section. The HV battery in all PEVs can be externally recharged by connecting to the low-voltage utility grid and plugging in various types of conductive or inductive battery chargers. With the ability to deliver V2G (vehicle-to-grid) services as well as charge HV batteries, bidirectional converters are becoming increasingly popular [3].

III. BATTERY CHARGING WITH AC

Currently, the majority of greenhouse gas emissions come from automobiles' internal combustion engines. Motor vehicles account for around 16 percent of the world's man-made carbon dioxide emissions, according to the United Nations. Internal combustion engines, in addition to releasing greenhouse gases, also discharge toxic chemicals into the atmosphere, endangering human health. If the internal combustion engine can be avoided, hazardous pollutants and greenhouse gas emissions can be significantly decreased. PHEVs, which are plug-in hybrids with electric motors, may be an option in this situation. To lessen its dependence on pollution-producing combustion engines, each hybrid vehicle has a battery-powered electric motor and an internal combustion engine. Technically, a plug-in hybrid electric vehicle (PHEV) is a more advanced version of a standard hybrid electric vehicle (HEV) (EV). 1 In addition to the internal combustion engine, both PHEVs and HEVs use an electric motor. A HEV's battery can only be charged2 through regenerative braking, which turns the vehicle's kinetic energy into electricity.

DIFFERENT MODES OF CHARGING

According to the aforementioned PHEV definitions, a vehicle's propulsion system can have both an electric motor and a combustion engine. There are two types of PHEV operation: charge depleting

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(CD) and charge sustaining (CS), which are determined by the primary method of propulsion (CS). When in CD mode, the PHEV shuts down the IC engine and relies only on the battery for propulsion until it achieves a certain state-of-charge (SOC) value. The SOC value represents the amount of charge left in the battery. The battery's minimal energy storage need is indicated by the threshold SOC. In order to keep the battery charge above but close to the minimum SOC, the PHEV changes to CS mode, which uses the combustion engine to power the car. By eliminating the CS mode, PHEVs can significantly cut fossil fuel use and greenhouse gas emissions. A third mode, referred to as charge blended (CB), has been proposed to improve fuel efficiency. A driving cycle in CB mode makes best use of both the internal combustion engine and the electric motor, allowing them to run longer on the most efficient setting while also reducing greenhouse gas emissions.

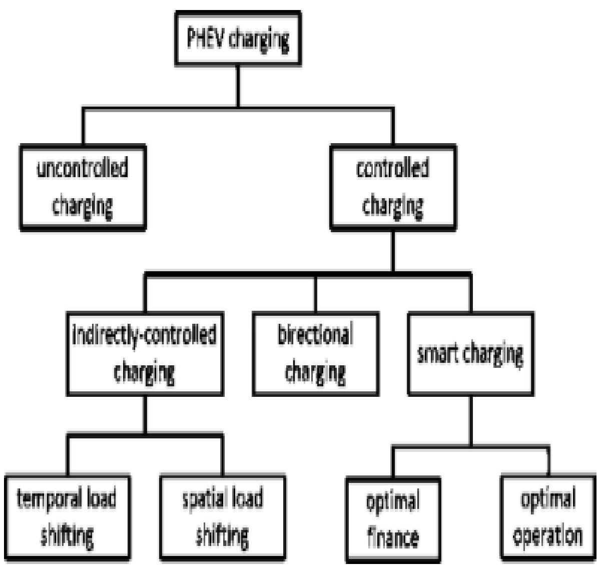
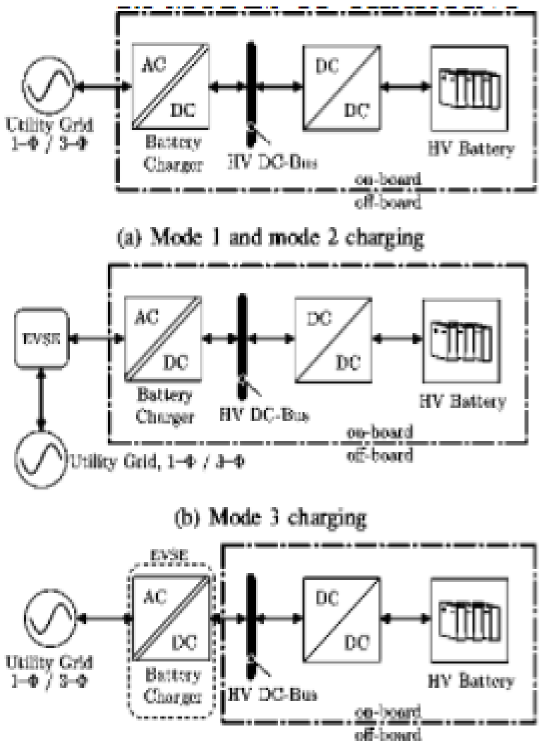


Figure 1. PHEV charging schemes classification

MODES OF CHARGING



Mode 1 charging (on-board): Figure 2.4(a): slow charging whereby energy is sourced from the AC grid utilizing a typical single-phase or three-phase household-type socket. The charging current is limited to 16 AAC, while the AC voltage may not exceed 250 VAC for a single phase, and 480 VAC for a three-phase supply outlet. The IEC-recommended AC voltage is 230/400 VAC, resulting in a maximum charging power of 3.7 kW (single-phase) and 11 kW (three-phase) [6], [7].

Mode 2 charging (on-board): Figure 2.4(a): slow charging from a household-type socket with an incable protection device. The voltage ratings are the same as for mode 1, but the maximum current is 32 AAC. Thus, the achievable charging power is 7.4 kW (single-phase) and 22 kW (three-phase) [6], [7].

Mode 3 charging (on-board): Figure 2.4(b): slow or fast charging using dedicated EVSE, involving a PEV socket outlet with control, protection function, and other additional safety features installed.

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Charging currents up to 63 AAC are allowed. The maximum power level is thus 14.5 kW (singlephase) and 43.5 kW (three-phase). Very high AC charging currents up to 250 AAC are also described by the standard [4], [6], [7].

Mode 4 charging (off-board): Figure 2.4(c): fast DC-current charging, with charging currents up to 400 ADC that are provided by an off-board charger which is located within the EVSE. For inductive chargers, the power is transfered via a magnetic coupling (wireless,). This technology offers galvanic isolation, connector robustness, power compatibility, durability, and a user friendly interface. However, these advantages come at a cost of a low conversion efficiency and the need for new, costly charging infrastructure. A separate international standard, SAE-J2954, is currently being prepared by the Society of Automotive Engineers (SAE), concerning the alignment of the vehicle as well as the infrastructure needed. Inductive battery chargers are not further discussed.

IV. BATTERY CHARGING WITH DC AND POWER ELECTRONICS

With the scarcity of fossil fuels and the knowledge that they would run out sooner rather than later, researchers are driven to discover a solution for urban transportation. With no need for fossil fuels and the ability to be charged using a conventional wall outlet, electric vehicles (EVs) have emerged as the ideal option. Every day, the IC engine emissivity requirement is getting closer to zero because of the growing environmental concern. However, using an IC engine will not allow for zero emissivity, hence EVs are the only viable option for city transportation. Another benefit of driving electric vehicles is that the weight and cost of the batteries are decreasing on a daily basis. In today's environment, commercially manufactured batteries have more power storage capacity in a limited size and have been proven useful for usage in electric vehicles.

For EVs to go even farther, regenerative braking is the best option. Regenerative braking is a method of reusing the energy that would otherwise be squandered by the vehicle's brakes. Traditional IC engine vehicles can't use regenerative braking since it's not possible. Energy that would otherwise be squandered while braking is used to recharge a battery. In this method, the vehicle's inertia functions as a generator for the electric motor, which in turn generates electricity. The battery serves as a load that is connected directly to the generator, allowing the battery to be charged. Regenerative braking has been shown to extend the range of electric vehicles by 15% to 20%. Few restrictions remain, such as the inability to recharge a battery after it is fully charged. Rather than being squandered as heat, the electrical energy generated is instead dissipated. This means that in addition to the regenerative braking technology, mechanical brakes are required.

WORKING OF BLDC MOTOR

Because of its inexpensive maintenance and good speed torque characteristics, brushless DC motors (BLDC) are widely utilised in electric vehicles and are considered the best option for electric vehicles. A synchronous motor is one in which the magnetic field created by the stator and rotor rotates at the same frequency. The position of the rotor is critical to controlling the BLDC motor, and the commutation of the BLDC is established on the basis of the rotor position. Hall effect sensors are commonly used in BLDC motors to determine the rotor's location.

DC FAST CHARGING STATION CONFIGURATION FOR V2G

Figure 3 depicts the dc fast charging station design for a microgrid's V2G-G2V infrastructure. Off-board chargers supply power to five electric vehicle batteries connected to the dc bus. An LCL filter and a step-up transformer are used to link a grid-connected inverter to the dc bus. The charging

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station's most critical components are outlined below.

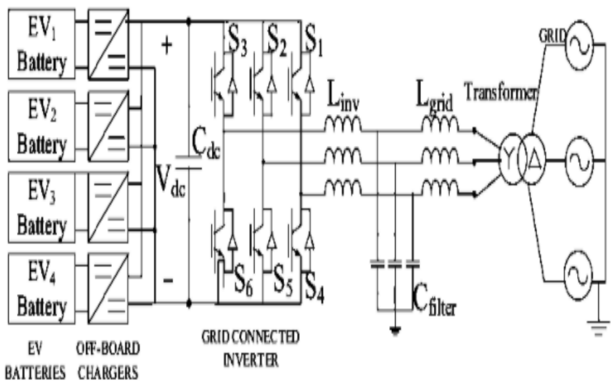

Figure 2 EV charging station for fast dc charging

BATTERY CHARGING USING SOLAR

Depletion of energy supplies and environmental difficulties on Earth caused by the emission of carbon dioxide are now known as global warming at the dawn of the twenty-first century. Several fixed locations have been investigated for the installation of solar power generation systems, which directly convert solar energy into electric power. These include unoccupied land, building roofs and walls, park clock towers, monument indication signals along highways, etc.

Additional to solar power applications, the use of electric vehicles (such as solar cars and boats) may be a crucial technology in the future to address environmental concerns. Today, there are a number of different sorts of electric vehicles, some of which are conceivable. Renewable energy or grid support are both viable options for shore power when it comes to ensuring a constant supply.

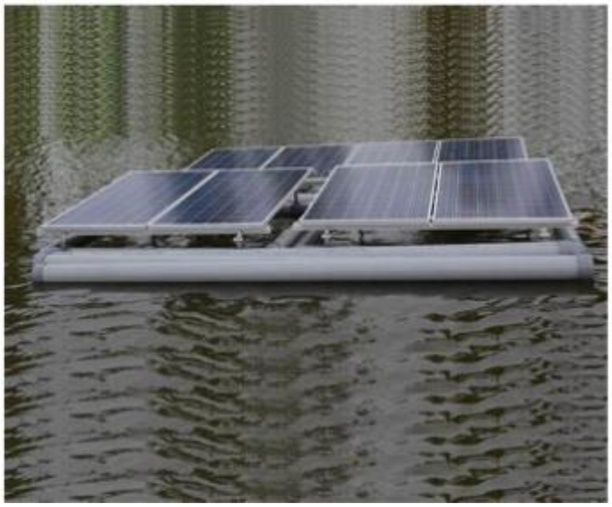

Figure3. Floating Solar panel

V. CONCLUSION

AC charging, DC charging, Battery Swapping, and employing power electronics were all discussed in this paper as methods of charging the batteries of electric vehicles in various ways. The EVCS is designed with a variety of energy sources in mind. Optimized for cost-effectiveness are the charging station's capacity and charging facilities, as well as the battery storage system and network reinforcement. The model also determines the best way to run the diesel generator and battery storage system. The model includes parametric uncertainty for all of the aforementioned tasks. According to the findings, there are still a number of unsolved research problems that merit further investigation. For charge scheme assessments, a common evaluation methodology is needed. The purpose of this standardisation is to ensure that published research results may be reproduced and reused. Research resources can be more effectively utilised if the results of previous studies are made available to the public. In order to support system-level performance planning and trade-off in an effective manner, some general analytical results and theories for PHEV charging are required. The use of expensive computing in performance evaluations should be reduced as a result of these theories.

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Charging scheme designs and evaluations must also take into account a realistic communication network model.

VI. References

[1]. PENG-YONG KONG,(1), (Senior Member, IEEE), AND GEORGE K. KARAGIANNIDIS(2) , (Fellow, IEEE). Charging Schemes For Plug-In Hybrid Electric Vehicles In Smart Grid. November 8,2016.

[2]. MUHAMMAD ZULQARNAIN ZEB 1 , KASHIF IMRAN 1 , ABRAIZ KHATTAK1 , ABDUL KASHIF JANJUA 1 , ANAMITRA PAL 2 , MUHAMMAD NADEEM 1 , JIANGFENG ZHANG 3 , AND SOHAIL KHAN 4. Optimal Placement Of Electric Vehicle Charging Stations In The Active Distribution Network. April 22, 2020.

[3]. Georgios E. Sfakianakis,(1), Student Member, IEEE, Jordi Everts,(2) Member, IEEE, and Elena A. Lomonova, Senior Member, IEEE. Overview of the Requirements and Implementations of Bidirectional Isolated AC–DC Converters for Automotive Battery sssCharging Applications. 2015.

[4]. F. Sanchez-Sutil a,(1), J.C. Hernández a (2) C. Tobajas b (3). Overview of electrical protection requirements for integration of a smart DC node with bidirectional electric vehicle charging stations into existing AC and DC railway grids. 2015.

[5]. Femina Mohammed Shakeel(1), Om P. Malik, LF IEEE(2), Vehicle-To-Grid Technology in a Micro-grid Using DC Fast Charging Architecture. 2017.

[6]. Femina Mohammed Shakeel (1), Om P. Malik, LF IEEE(2), Vehicle-To-Grid Technology in a Micro-grid Using DC Fast Charging Architecture. 2019

[7]. Zhengxian Chen. The Combination of Battery Swapping System and Connected Vehicles Technology in Intelligent Transportation. 2020.

[8]. Yang Wanga(1), Kexing Laib,(2) , Fengyun Chena(3), Zhengming Lia(4) , Chunhua Huc(5). Shadow price based co-ordination methods of micro grids and battery swapping stations. 2019.

[9]. K. Sankaraditya Vikas (1), B. Raviteja Reddy(2). S.G. Abijit. (3), M.R. Sindu.(4). Controller of charging Electric Vehicles at workplaces using solar energy. April,6, 2019.

[10]. Tetsumi Harakawa,(1), Takahiro Tujimoto,(2), Efficient Solar Power Equipment for Electric Vehicles.