ICEST-2K24 [International Conference on Engineering, Science and Technology]
In Association with
International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN - 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)

An Overview of Charging Station for Charging the Electric Vehicles

Faruk Sayyad, Mayur Patil, Monali Salgare
Department of Electrical Engineering, S. B. Patil College of Engineering, Indapur, Maharashtra, India

ABSTRACT
As a cleaner mode of transportation, plug-in electric vehicles (PEV) have attracted the attention of the world towards them. PEV's are advantageous over conventional vehicles as they reduce environmental impact and also use of conventional fuels. Though PEVs are considered to be our future, still their market is low. It faces number of challenges such as availability of charging stations, cost of vehicle and charging station, battery management system, etc. people can charge their vehicles at their home during night time. But people living in urban areas where population is high, charging vehicle at home is not possible. Also for long distance driving, charging stations are required. Our approach is to study the charging station and related parameters and optimize the problem of charging station location.
Keywords: Charging station, Cost, Electric-vehicles, Optimization.

I. INTRODUCTION

Nowadays, transportation becomes an integral part of human life. This transportation includes public transport, goods transport, and private transport. Due to globalization and vast competition among the manufacturers, a middle-class family can easily afford different types of transport facility. Simultaneously, the demand for fuel is also increased to fulfill the requirements. Majority of the fossil fuel is utilized for transportation and thus their availability is reducing day-by-day. Because of this, the prices of fuels are increases rapidly. Vehicles release hazardous gases such as carbon monoxide, nitrogen oxide, etc., which causes a rise in the global warming affect and diminishes the health of the human beings. Currently, the greenhouse gas effect, global warming, and health issues are the major problems in the world [1]. The transport sector accounts for about 23% of global energy related GHG emissions. This circumstance brings a need for elective energy sources and hence the whole world is looking for it.

In recent years, the technology is enriched to have number of EVs. As green transportation, EVs have dragged the attention of the world and regarded as an effective solution to meet energy and environmental challenges. EVs are advantageous over conventional vehicles in many aspects. EVs do not require conventional fuel for their operation, thus they reduce the use of conventional fuels. They also reduce the impact on the environment as well as human beings.Thus, the transportation sector is moving toward electrification due to the emerging energy and environmental issues.

The development of EVs is considered an important tool to mitigate carbon emissions. Also the improvement of power electronics and battery technology help to come up with the industry of EVs [2]. The rapid development and mass production of batteries have also resulted in remarkable interest toward the growth of electric vehicles. BEV produce no emissions.Mass production of total electric vehicles capable of travelinglonger distances results in a need for electric service stations. These charging station should fulfill the charging requirement of EVs. Also the charging of EV should be done as fast as time taken by car to fill the fuel.

Even if EVs are viewed as our future, still their interest is low. Cost is one of the major reasons behind this situation. Because the cost of EVs, the cost of battery and its management, charging cost, establishment, and running expense of charging point are the influencing parameters. Numerous nations in the world are taking endeavors to raise EVs. The government of India is also inspiring people to utilize EVs by offering them subsidies and tax reductions. EVs are well established in developed nations in the last decades whereas developing nations have plans to build the EVs.

II. RELATED WORK

Charging of EV can be differentiated into the following types –

- Destination charging – in this type, EV is charged at its destination place, for example, home, working environment, etc.
- Urgent charging – when state of charge of battery decreases to a certain value, EV comes, recharge, and leave the charging point soon [3].

Number of researchers in the world are doing research in the field of electric vehicles. Most of them is related with the finding of location of charging station.Reference [4] proposed four methods to find the optimal location of the charging station for a city. These methods are - Iterative MILP, Greedy Approach, Effective MILP and Chemical Reaction Optimization. Each of the method has its specific mathematical formulation and solved using different software applications such as MATLAB, CPLEX and YALMIP. The results are demonstrated using different tests. The results are compared with each method in terms of solution quality and time required for computation. Method 1 and 3 takes more computational time but their solutions are good. All methods are deterministic except Method IV is probabilistic in nature.

Based on the traveling salesman problem, [5] paper proposes a new optimal EV route model considering thefast-charging and regular-charging. The proposed model aims to minimize thetotal distribution costs of the EV route. The proposed method satisfies the constraints like battery capacity, charging time and delivery/pickupdemands, and the impact of vehicle loading on the unit electricityconsumption per mile. To solve the proposed model, a learnable partheno-genetic algorithm is used. A test is conducted on the 36-node and 112-node systems, and the results verify thefeasibility and effectiveness of the proposed model and solutionalgorithm.

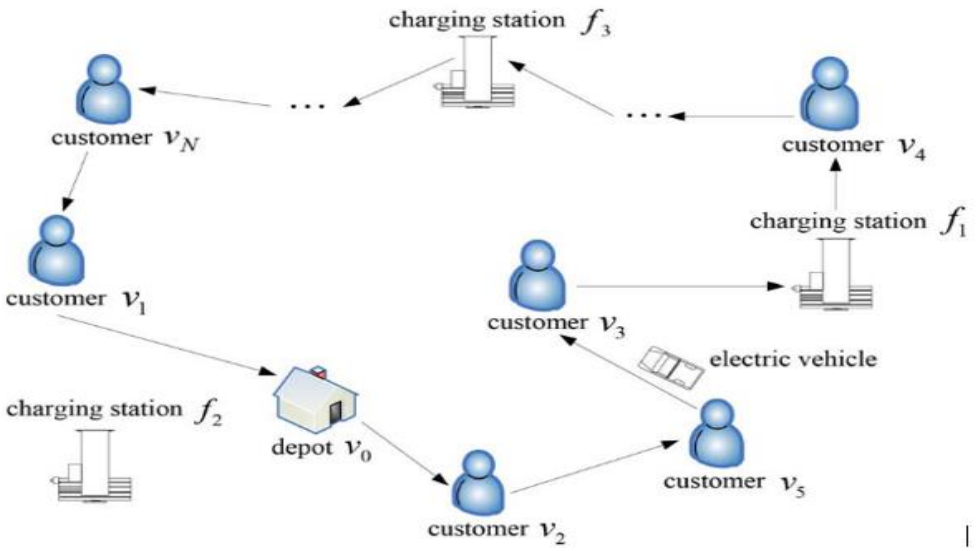

Figure1:

plug-in hybrid vehicles (PHEVs) may cause the impacts on the performance of the power system, such as overloading, reduction in efficiency, power quality, and voltageregulation particularly at the distribution level. Reference [6] presents a Coordinated charging of PHEVs which is a suitable solution to these problems. In this paper, the relationship between feeder losses, load factor, and load variance is studied and three optimal charging algorithms are developed which minimize the impacts of PHEV charging on the connected distribution system. Mathematical formulation and algorithm are developed for Maximum Load Factor, Minimizing Load Variance and Load Variance and Load Factor Relationship.

III.PARAMETERS RELATED TO CHARGING STATION

- State of Charge (SoC): state of charge of battery means the level of charge of that battery. It is related to its capacity. A driver of an EV should considers whether the state of charge of the EV is sufficient for the desired journey. If not, they will consider how to recharge the EV as quickly as possible. For this, charging navigation system should be available which improves the reliability of using EV and increases the comfortless [7].
- driving styles:driving style has a great impact on battery performance and aging of EVs. Reference [8] presents the real-world driving data from the I-80 highway, CA, USA. Authors differentiate the driving style into three categories namely - aggressive, mild, and gentle driving. The aggressive driving style demands higher average power from the battery compared to the mild and gentle driving style.
- Charging demand: from a distribution system perspective, electric vehicle charging demand is still unidentified quantity which may vary by space and time. Reference [9] represents the mathematical model is based on the fluid dynamic traffic model and the M/M/s queueing theory. Firstly, the arrival rate of discharged vehicles at a charging station is predicted by the fluid dynamic model. Then, charging demand is forecasted by the M/M/s queueing theory with the arrival rate of discharged vehicles.

A. EV Charging in Different Environments

- Residential Charging: EV Charging solution vendors provide easy to install EV chargers for individual houses, housing societies, and residential buildings. Home chargers are well integrated with proper safety features for people and electric vehicles. These chargers are compact, lightweight, have attached AC input cables and DC output cables, and provide flexibility to be used as portable chargers or to be wall-mounted. These chargers have more than 95% conversion efficiency, lowering the total cost of ownership of battery-powered vehicles.
- Public Charging: Public charging stations use AC Type 2 chargers, which are suitable for general applications such as workplaces, businesses, malls, hotels, and public commercial charging. These systems are robust and durable and can be managed by a centralized management software. EV charging solutions installed in public places offer simple plug-and-play devices and charge all the type 2 compatible vehicles. The admin can use RFID tags for user authentication and remotely manage the applications and energy costs through the software associated with these chargers.
- Fleet Charging: EV Fleet charging solutions require a DC charger to support all types of vehicles and charging needs. These fast DC chargers come with cutting-edge technologies in hardware design and application software. They also allow seamless integration with payment platforms and are capable of firmware and software up-gradation over-the-air. These DC chargers can accommodate 30KW – 300 KW of EVs.

B. Public Charging Costs

Many people charge their electric car at public charging stations. They can be free, pay-as-you-go or subscription-based, with prices set by networks or property owners. Some automakers, such as Hyundai, Nissan and Tesla may provide complimentary public charging at certain chargers. The industry is moving toward a fee structure based on kWh used, rather than by the time it takes to charge the car.Drivers in California may expect to pay 30 cents per kWh to charge on Level 2, and 40 cents per kWh for DC fast charging. At these rates, the same Nissan LEAF with a 150-mile range and 40-kWh battery would cost about $12.00 to fully charge (from empty to full) using Level 2, and $16.00 with DC fast charging.

- Cost to Charge at Home: Charging costs depend on your electric car's battery size and the local price of electricity. Most electric utilities offer special time-of-use (TOU) rates that greatly reduce costs by billing less for electricity used during off-peak hours. Contact your electric utility to find out more. Find out how simple home charging is for current electric car drivers.While electricity costs vary, the average price in California is about 18 cents per kilowatt hour (kWh). At this price, charging an electric car such as the Nissan LEAF with a 40-kWh battery with a 150-mile range would cost about $7 to fully charge. Meanwhile, fueling a 25-mpg gas vehicle at a gas price of $3.70 per gallon would cost about $22 for enough gas to drive approximately 150 miles. Saving money on fuel is just one of the many benefits of driving electric.
- public charging costs: Many people charge their electric car at public charging stations. they can be free, pay-as-you-go or subscription-based, with prices set by networks or property owners. some automakers, such as Hyundai, Nissan and tesla may provide complimentary public charging at certain chargers. the industry is moving toward a fee structure based on kwh used, rather than by the time it takes to charge the car-drivers in California may expect to pay 30 cents per kwh to charge on level 2, and 40 cents per kwh for dc fast charging. at these rates, the same Nissan leaf with a 150-mile range and 40-kwh battery

would cost about $12.00 to fully charge (from empty to full) using level 2, and $16.00 with dc fast charging.several apps and online tools will help you locate public charging, including plug share's international database.

IV. ACKNOWLEDGMENT

The authors would like to thank the referees for helpful suggestions in improving the paper.

V. REFERENCES

[1]. Z. Liu, W. Zhang, X. Ji, and K. Li, "Optimal planning of charging station for electric vehicle based on particle swarm optimization", in Proc. Innov. Smart Grid Technol.-Asia, Tianjin, China, pp. 1–5 2012.

[2]. Zhipeng Liu, Fushuan Wen, Gerard Ledwich, "Otimal Planning of Electric-vehicle Charging Stationss in Distribution Systems", IEEE transactions on power delivery, 2013.

[3]. Huimiao Chen, Zechun Hu, Haocheng Luo, Jujie Qin, Ram Rajagopal, Hongcai Zhang, "Design and Planning of a Multiple-charger Multiple-port Charging System for PEV Charging Station", IEEE Transaction on Smart Grid, 2017.

[4]. A. Y. S. Lam, Y. Leung, and X. Chu, "Electric vehicle charging station placement: Formulation, complexity, and solutions", IEEE Trans. SmartGrid, 5 (6); pp. 2846–2856, Nov. 2014.

[5]. Hongming Yang, Songping Yang, Yan Xu, Erbao Cao, Mingyong Lai,and Zhaoyang Dong, "Electric Vehicle Route Optimization Considering Time-of-Use Electricity Price by LearnablePartheno-Genetic Algorithm," IEEE TRANSACTIONS ON SMART GRID, 2015.

[6]. Eric Sortomme, Mohammad M. Hindi, S. D. James MacPherson, and S. S. Venkata, "Coordinated Charging of Plug-In Hybrid ElectricVehicles to Minimize Distribution System Losses", IEEE TRANSACTIONS ON SMART GRID, VOL. 2, NO. 1, MARCH 2011.

[7]. Qinglai Guo, Shujun Xin, Hongbin Sun, Zhengshuo Li, and Boming Zhang, "Rapid-Charging Navigation of Electric Vehicles Based on Real-Time Power Systems and Traffic Data", IEEE TRANSACTIONS ON SMART GRID, VOL. 5, NO. 4, JULY 2014.

[8]. Mehdi Jafari,Antonio Gauchia, Kuilin Zhang, and Lucia Gauchia, "Simulation and Analysis of the Effect of Real-WorldDriving Styles in an EV Battery Performanceand Aging", IEEE TRANSACTIONS ON TRANSPORTATION ELECTRIFICATION, VOL. 1, NO. 4, DECEMBER 2015.

[9]. Sungwoo Bae and Alexis Kwasinski, "Spatial and Temporal Model of Electric VehicleCharging Demand", IEEE TRANSACTIONS ON SMART GRID, VOL. 3, NO. 1, MARCH 2012.