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Research Article

An Analytical Study of Charging Stations for Electric Vehicles in Mumbai Region

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Abstract: This case study explores the potential demand for EV charging station (CS) infrastructure as well as its difficulties in the context of Mumbai. With a surge in privatization, liberalization, and the expansion of distributed and renewable energy sources. Finding charging stations for electric vehicles is a significant problem for drivers that calls for the development of a network of smart charging infrastructure. To ensure EV adoption and to address some of the inherent risks, such as battery cost and degradation, economic risks, lack of charging infrastructure, risky maintenance of EVs, problems with its integration in the smart grid, range anxiety, auxiliary loads, and motorist attitude, it is crucial to choose the location for installing charging stations.

Keywords: Electric Vehicle, Charging Stations, Charging Infrastructure, Smart Charging

INTRODUCTION

The fastest growing and the most advanced Education and IT centre in recent time. Mumbai is the first largest metropolitan city in India. The major capital establishment in India is from the education sector, manufacturing section and the Information sector (IT). The megacity needs to be mega planned and cost-effective manner. The megacity plans are published. The municipal corporation of Mumbai is planning to develop a smart connect structure for public transport and private transport. Mumbai is a well planned and well-structured city. Need to develop the EV segment infrastructure for Mumbai. The mobile app and the charging station tracking system are in Mumbai.

OBJECTIVES OF THE STUDY

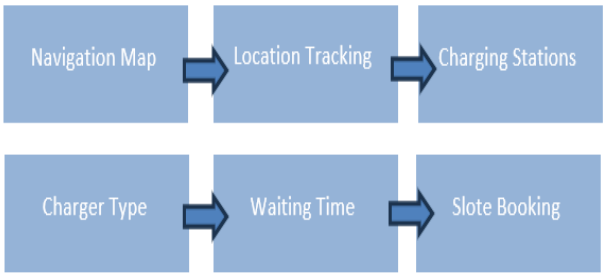
- Charging levels (L1, L2 & L3) wise segregation of charging stations
- Number of charging station are installed in a state
- Number of public private partnership (PPP)
- Type of charging available
- Number of battery swapping station
- Applications available to locate the charging station
- Major leader/companies for installing charging station or charging systems

LITERATURE REVIEW

In an electric vehicle, there are different multiple players involved that can bring the change in the assiduity. Presently, government programs have a major part in the Indian electric vehicle industry. Non-availability of the charging stations in the Mumbai corporation area. It will improve the distance range and help people to charge their vehicles in very less time. On average, 4 wheelers electric vehicles need 4-5 hr. to charge full and with the help of the advanced charging stations and the chargers, it will require 30-45 min with the help of the charging slot booking application consumer reduces the waiting time. The construction of the cost of the charging station.

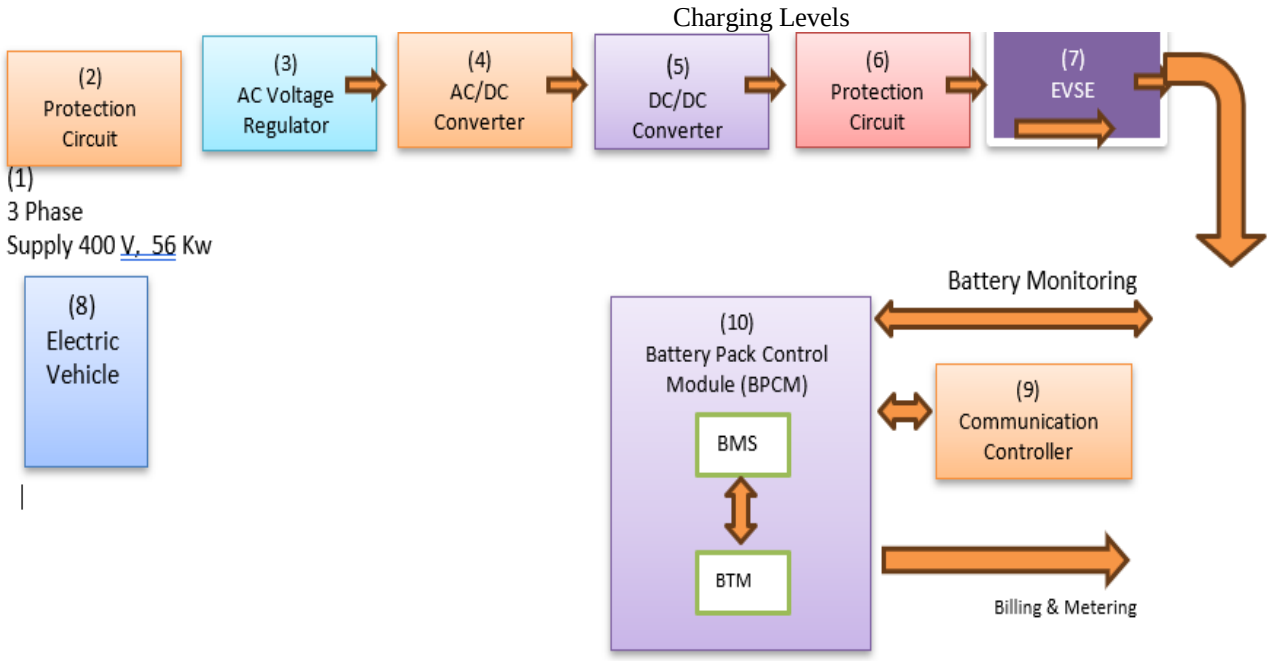
Algorithm for charging station slot booking

The charging station selection traces the live location of the vehicle and taps the range available with it. It covers the limits of the charging stations. And also, it communicates with the other devices that update the traffic and finds the shortest and traffic-less path. With the help of it, drivers can book the charging slot in the advance to avoid the traffic and waiting time.



Charging Infrastructure

At present Mumbai needs to provide additional charging infrastructure to boost the adoption of Electric vehicle by Mumbai customers. The lack of charging stations in the Mumbai will put customers under anxiety, as the vehicle driving range is not sufficient as per the requirement and the vehicle may not run long distance without charging stations at frequently intervals on the road ways.



Layout of EV Charging Stations-

RESEARCH METHODOLOGY

As of last update in 2023, several companies in India were providing EV charging stations using both private and Public-Private Partnership (PPP) formats. However, it's important to note that the EV charging infrastructure landscape is continuously evolving, and new companies may have entered the market since then. Here are some prominent companies that were involved in offering EV charging solutions in India.

1. Tata Power: Tata Power is one of India's leading power companies and has a significant presence in the EV charging infrastructure sector. They offer charging stations for electric vehicles across various locations and have been actively involved in PPP projects with government bodies.
2. ChargePoint India: ChargePoint is a global EV charging network company that expanded its operations to India. They provide charging solutions for both private and commercial customers and have collaborated with multiple stakeholders to deploy EV charging stations.
3. ABB India: ABB is a multinational corporation specializing in electrification, automation, and digitalization solutions. They have a presence in India's EV charging infrastructure market, offering a range of charging solutions for different applications.
4. Delta Electronics India: Delta Electronics is a global company with expertise in power and thermal management solutions. They have expanded their operations to provide EV charging solutions in India and have participated in PPP projects.
5. Magenta Power: Magenta Power is an Indian company that offers EV charging infrastructure solutions for commercial and residential applications. They have been actively working to expand their charging network in the country.
6. 6.Exicom Power Solutions: Exicom is an Indian company specializing in power and energy solutions. They have been involved in deploying EV charging stations in partnership with various organizations and government agencies.

INCENTIVES PROVIDED BY MAHARASHTRA GOVERNMENT.

Capital Subsidy:

The Maharashtra government offered capital subsidies to private entities, individuals, and businesses for setting up EV charging stations. The subsidy amount varied depending on the type and capacity of the charging station.

Electricity Tariff Incentives:

Electricity tariffs for EV charging stations were set at lower rates to make the operation of charging stations more cost-effective for operators. These reduced tariffs aimed to attract more investment in the EV charging infrastructure sector.

Land Allocation:

In some cases, the Maharashtra government allocated land at subsidized rates for the installation of public EV charging stations. This measure was aimed at making it easier for private companies and entrepreneurs to find suitable locations for charging infrastructure.

Support for PPP Projects:

The government supported Public-Private Partnership (PPP) projects for the deployment of EV charging stations in the state. These partnerships helped leverage private sector expertise and resources while aligning with the government's vision of promoting sustainable mobility.

Green Building Incentives:
For commercial and residential complexes that incorporated EV charging infrastructure as part of their green building initiatives, the government provided additional incentive and benefits.

Waiver of Permit Fees:
The Maharashtra government waived or reduced permit fees for the installation of EV charging stations to simplify the process for private entities and reduce upfront costs.

Fast-Track Approvals:
To streamline the approval process, the government established a fast-track mechanism for granting licenses and permits for EV charging station installations.

Public-Private Collaboration for Infrastructure Development:
The Maharashtra government actively collaborated with private companies and electric utilities to develop a robust and widespread EV charging network across the state.

RECOMMENDATIONS

Based on the analysis of the current inadequacies in charging infrastructure for electric two-wheelers in Mumbai and Thane, the following suggestions are made to multiple stakeholders to improve charging infrastructure and accessibility. These recommendations are crucial if the metro city aims to successfully transition to green electric vehicles (EVs):

Government and Policy Makers

1) Policy Incentives and Support: • Providing financial incentives such as subsidies, grants, or tax breaks to companies and individuals investing in charging infrastructure. • Developing a comprehensive regulatory framework that mandates the inclusion of EV charging stations in new commercial and residential projects. • Encouraging PPP (Public–private – Partnership) models to pool resources and expertise for the rapid deployment of charging stations. • Simplifying the permitting process for setting up charging stations to reduce bureaucratic delays.
2) Urban Planning and Zoning • Implementing zoning regulations that allocate specific areas for the development of charging infrastructure. • Integrating EV charging infrastructure into smart city projects to ensure cohesive urban planning and efficient resource allocation.

Municipal Corporations

1) Public Charging Stations: • Identifying strategic locations and prioritizing high-traffic areas such as shopping malls, public parking lots, transportation hubs, and tourist attractions for the installation of charging stations. • Upgrading existing public infrastructure to support the additional power load required for EV charging stations. • Encouraging the use of renewable energy sources, such as solar power, for charging stations to further enhance environmental benefits.

Citizens and EV Users

1) Community Engagement
   Participating in feedback mechanisms to report issues and suggest improvements for existing charging infrastructure.

   Demand for more charging stations in residential areas and public places through community groups and local governance meetings.

SCOPE OF STUDY

Based on the results of the current study focusing on the charging infrastructure and accessibility for electric two-wheelers in Mumbai and Thane, several avenues for further research can be explored, such as a longitudinal study to assess the long-term impact of the implemented strategies and interventions aimed at improving charging infrastructure. This study could track changes in EV adoption rates, charging station usage patterns, and overall environmental outcomes over an extended period. User Satisfaction levels and overall experience of electric two wheeler users with the charging infrastructure can be investigated. This research could delve deeper into factors influencing user satisfaction, such as charging station reliability, waiting times, ease of use, and payment methods.

Exploring emerging technologies and innovations in EV charging infrastructure, such as fast-charging solutions, wireless charging, and smart grid integration. Assess the feasibility and effectiveness of implementing these technologies to enhance charging accessibility and efficiency, is another possibility. These further studies would contribute to a deeper understanding of the challenges and opportunities surrounding EV charging infrastructure and support ongoing efforts to promote sustainable urban mobility.

ACKNOWLEDGMENTS

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CONCLUSION

1. After the overall study of EV and the charging infrastructure we observed that Growing Network: Maharashtra has been witnessing a steady increase in the number of EV charging stations across the state. Major cities like Mumbai, Pune, Nagpur, Nashik and Aurangabad have seen substantial growth in charging infrastructure.
2. Public and Private Charging Points: Both public and private entities have been actively installing EV charging stations. Public charging points are usually located in prominent places like shopping malls, parking lots, and fuel stations, while

private charging points are often found in residential and commercial complexes.

3. Charging Speeds: Different types of charging stations are available, offering varying charging speeds. Slow chargers (AC) are more commonly found in residential areas, while fast chargers (DC) are installed at public locations for quicker charging.
4. Government Initiatives: The Maharashtra state government has been implementing various initiatives to promote electric vehicles and support the establishment of charging infrastructure. Incentives and subsidies are often provided to encourage the adoption of electric vehicles and the expansion of charging networks.
5. Charging Station Maps: Several online platforms and mobile applications offer maps and real-time information about EV charging stations across Maharashtra. These maps help users find nearby charging points and check their availability.
6. Charging Station Operators: Multiple companies and organizations have entered the charging infrastructure space, leading to diverse operators managing various charging stations.

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