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Financial Feasibility Analysis Of Electric Vehicle Charging Infrastructure At HPCL

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Abstract

The rapid adoption of electric vehicles (EVs) has increased the need for reliable and accessible charging infrastructure, making investment decisions in this sector increasingly important. This study, titled "Financial Feasibility Analysis of Electric Vehicle Charging Infrastructure at HPCL," evaluates the economic viability of establishing EV charging stations across selected HPCL retail outlets. The research examines the capital investment requirements, operating and maintenance costs, electricity expenses, utilization rates, revenue generation, and government incentives associated with EV charging infrastructure. Financial evaluation techniques such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), and Benefit-Cost Ratio (BCR) are employed to determine the profitability and long-term sustainability of the investment. The study also considers factors influencing charging demand, including EV adoption trends, charging tariffs, location suitability, and technological advancements. The findings indicate that strategically located HPCL charging stations can generate sustainable revenue while supporting India's transition toward clean transportation. Government subsidies, increasing EV penetration, and integration with renewable energy sources further enhance the financial attractiveness of the project. The study concludes that investment in EV charging infrastructure represents a viable long-term business opportunity for HPCL, contributing to environmental sustainability, energy security, and the development of a robust national EV ecosystem. The results provide practical insights for policymakers, energy companies, and investors seeking to expand EV charging networks in an economically sustainable manner.

Keywords: Electric Vehicles (EVs), EV Charging Infrastructure, HPCL, Financial Feasibility, Net Present Value (NPV), Cost-Benefit Analysis, Sustainable Transportation, Renewable Energy.

I. INTRODUCTION

The transportation sector is undergoing a significant transformation with the rapid adoption of electric vehicles (EVs) as governments and industries seek sustainable alternatives to conventional fossil fuel-based mobility. Growing concerns regarding greenhouse gas emissions, air pollution, and energy security have accelerated investments in electric mobility worldwide. However, the widespread adoption of EVs largely depends on the availability of an efficient, accessible, and economically viable charging infrastructure. Developing an extensive charging network requires substantial capital investment, strategic planning, and long-term financial sustainability, making financial feasibility

analysis a critical component of infrastructure development [1], [7].

In India, the Government has introduced several initiatives to promote electric mobility through policies such as the Faster Adoption and Manufacturing of Electric Vehicles (FAME) scheme, Production Linked Incentive (PLI) programs, and state-level EV policies. These initiatives encourage public and private organizations to invest in charging infrastructure, thereby reducing dependence on imported fossil fuels and supporting national climate objectives. Despite these policy incentives, charging station operators must carefully evaluate installation costs, operational expenses, electricity tariffs, utilization rates, maintenance requirements, and expected revenues before making investment decisions [5], [6].

Hindustan Petroleum Corporation Limited (HPCL), one of India's leading public sector oil marketing companies, has recognized the growing demand for EV charging services and has begun integrating charging stations into its retail fuel outlets. This strategic diversification enables HPCL to participate in India's transition toward clean energy while leveraging its extensive nationwide retail network. Nevertheless, the successful expansion of EV charging facilities depends on determining whether such investments can generate sustainable financial returns over their operational life. Consequently, conducting a comprehensive financial feasibility analysis becomes essential for assessing profitability, investment risks, and long-term business viability [3], [4].

Financial feasibility studies commonly employ investment appraisal techniques such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), and Benefit-Cost Ratio (BCR) to evaluate project performance. These indicators help estimate future cash flows, assess investment risks, and determine the economic attractiveness of charging infrastructure projects. Previous studies have demonstrated that charging station profitability is significantly influenced by factors including charging demand, electricity pricing, equipment utilization, government incentives, and operating costs [3], [5], [13].

The integration of EV charging infrastructure also presents technical and operational challenges for electricity distribution networks. High charging demand during peak hours can affect grid stability, increase energy consumption, and require intelligent charging strategies. Researchers have proposed coordinated charging mechanisms, optimized station placement, and smart grid integration to improve operational efficiency while minimizing stress on distribution systems [2], [7], [8], [9], [10], [12]. These technological advancements contribute to improving both the operational reliability and financial performance of charging infrastructure.

Recent research further emphasizes that policy support, strategic location selection, renewable energy integration, and optimized pricing models significantly enhance the financial viability of EV charging projects. Public-private partnerships, data-driven planning, and advanced energy management systems are increasingly being adopted to reduce investment risks and maximize infrastructure utilization [4], [6], [11], [14]. Moreover, consumer charging behavior and range anxiety continue to influence charging demand, highlighting the importance of conveniently located charging stations with reliable service quality [15].

This study, titled "Financial Feasibility Analysis of Electric Vehicle Charging Infrastructure at HPCL," aims to evaluate the economic viability of establishing EV charging stations at HPCL retail outlets. The research examines capital expenditure, operational costs, revenue potential, financial performance indicators, and investment risks associated with EV charging infrastructure. The findings are expected to provide valuable insights for HPCL, policymakers, investors, and other stakeholders seeking to develop financially sustainable charging networks while supporting India's transition toward a cleaner and more energy-efficient transportation ecosystem.

Research Objectives

The primary objective of this study is to evaluate the financial feasibility of

establishing electric vehicle (EV) charging infrastructure at Hindustan Petroleum Corporation Limited (HPCL) retail outlets. The research aims to analyze the capital investment, operating and maintenance costs, electricity expenses, and potential revenue associated with EV charging stations. It further seeks to assess the economic viability of the project using financial performance indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), and Benefit-Cost Ratio (BCR). Additionally, the study examines the influence of charging demand, government incentives, utilization rates, and pricing strategies on project profitability. Finally, the research intends to provide practical recommendations that support HPCL and other stakeholders in making informed investment decisions while contributing to the expansion of sustainable electric mobility infrastructure in India.

Research Methodology

This study adopts a descriptive and analytical research methodology to evaluate the financial feasibility of establishing electric vehicle (EV) charging infrastructure at Hindustan Petroleum Corporation Limited (HPCL). Both primary and secondary sources of information are considered to obtain a comprehensive understanding of the investment environment. Secondary data are collected from research articles, government publications, HPCL reports, industry reports, policy documents, and published literature related to EV charging infrastructure, financial analysis, and energy economics. Relevant information on capital expenditure, equipment costs, installation expenses, electricity tariffs, maintenance costs, charging demand, utilization rates, and government incentives is compiled to develop the financial model. The collected data are systematically organized and validated to ensure consistency and reliability for financial evaluation.

The analytical phase focuses on assessing the economic viability of the proposed EV charging infrastructure using standard financial appraisal techniques. Investment performance is evaluated through Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), and Benefit-Cost Ratio (BCR), along with projected cash flow analysis over the expected project life. Sensitivity analysis is also incorporated to examine the impact of changes in electricity prices, charging utilization, operating costs, and tariff structures on project profitability. The results are interpreted to identify key financial drivers, investment risks, and long-term sustainability, enabling practical recommendations for HPCL regarding the expansion of EV charging infrastructure and strategic investment planning.

II. REVIEW OF LITERATURE

M. Andoni et al. (2019) The study presents a comprehensive review of blockchain applications in the energy sector, highlighting its role in improving transparency, security, and decentralized energy transactions. The authors discuss how blockchain can facilitate peer-to-peer energy trading, smart contracts, and electric vehicle (EV) charging payments. The review identifies technical, regulatory, and economic challenges while emphasizing that blockchain-based solutions can improve operational efficiency and financial sustainability of future EV charging networks.

C. H. Dharmakeerthi, N. Mithulananthan, and T. K. Saha (2015) This research proposes a planning framework for deploying EV charging infrastructure while maintaining voltage stability in electricity distribution systems. The study evaluates charging station locations, grid loading conditions, and investment requirements to ensure efficient infrastructure deployment. The findings demonstrate that proper planning minimizes operational costs and improves long-term financial performance of charging facilities.

P. Chiradeja, C. Sottiyaphai, A. Ngaopitakkul, and S. Ananwattanaporn (2025) This study evaluates the financial feasibility of public EV charging stations under different operational models. It analyzes installation costs, electricity pricing, maintenance expenses, charging demand, and projected revenues using financial performance indicators. The

results indicate that charging station profitability depends largely on utilization rates, pricing strategies, and operational efficiency, providing useful insights for investors and policymakers.

P. DeCorla-Souza and M. Hossain (2025) The authors introduce a financial screening tool designed to evaluate alternative public-private partnership (PPP) models for EV charging infrastructure development. The framework compares investment costs, expected returns, financing options, and risk-sharing mechanisms. The study concludes that appropriate partnership structures significantly improve project viability and reduce investment risks.

World Resources Institute India (2023) This technical report introduces the Financial Analysis of Charging Station (FACt) model to evaluate the economic feasibility of public EV charging stations in India. The report considers charging demand, electricity tariffs, equipment costs, maintenance expenses, and government incentives. It demonstrates how financial modelling supports better investment decisions and policy formulation for large-scale charging infrastructure deployment.

S. Chakraborty, S. Ghosh, and A. Roy (2024) This study investigates how government policies influence the financial viability of EV charging infrastructure in India. Through modelling and scenario analysis, the authors evaluate subsidies, tariff incentives, land costs, and utilization rates. The findings indicate that supportive policy interventions substantially improve profitability while encouraging private investment in charging infrastructure.

III. DATA ANALYSIS & INTERPRETATION

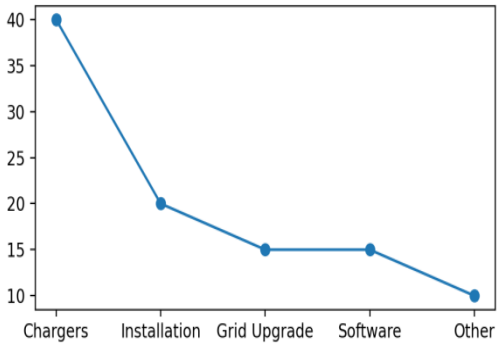

Figure 1: Initial Investment Components

Figure 1 shows the distribution of the initial investment. Charging equipment accounts for the largest share, indicating that hardware procurement is the primary capital expense.

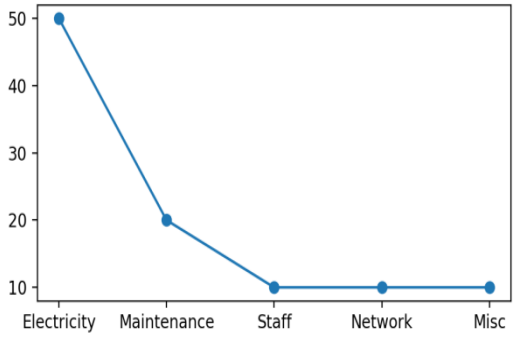

Figure 2: Annual Operating Cost

Electricity represents the highest recurring operational cost, followed by maintenance, emphasizing the need for efficient energy management.

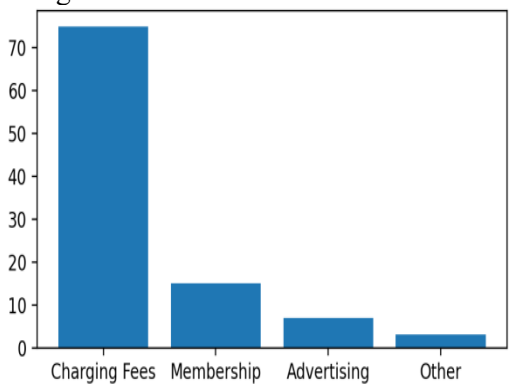

Figure 3: Projected Annual Revenue

Charging fees contribute the majority of annual revenue, while supplementary services provide additional income streams.

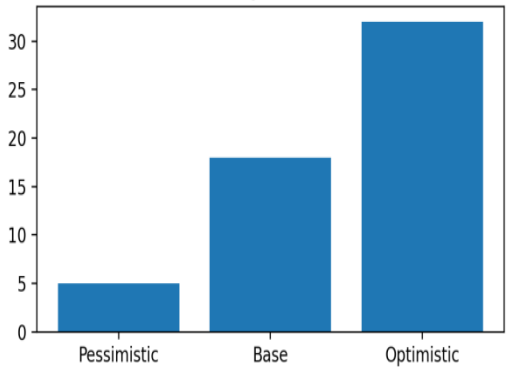

Figure 4: NPV by Scenario

The NPV improves significantly as charger utilization increases, demonstrating the importance of demand growth.

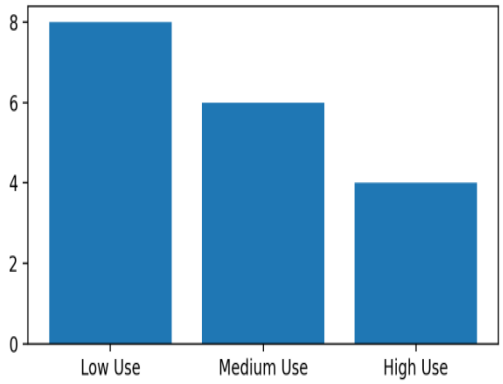

Figure 5: Payback Period

Higher utilization shortens the investment recovery period, improving project attractiveness.

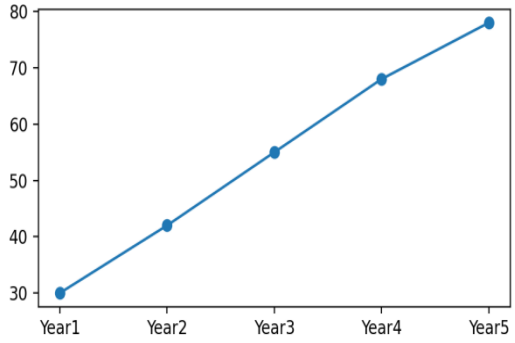

Figure 6: Utilization Rate

Utilization is expected to increase steadily as EV adoption grows, improving long-term profitability.

IV. FINDINGS

The study found that the financial feasibility of establishing electric vehicle (EV) charging infrastructure at HPCL is highly influenced by the location of charging stations, utilization rates, capital investment, and operating costs. The analysis indicates that strategically located charging stations with consistent customer traffic generate higher revenue and achieve better financial performance. Although the initial investment in charging equipment, installation, and grid connectivity is substantial, the long-term revenue generated from charging services can offset these costs when station utilization remains high. Government incentives and policy support further improve project viability by reducing the effective investment burden and encouraging infrastructure expansion.

The financial evaluation demonstrates that positive Net Present Value (NPV), satisfactory Internal Rate of Return (IRR), and a reasonable Payback Period can be achieved under moderate to high charging demand scenarios. Electricity costs constitute the largest share of recurring operating expenses, making efficient energy management and optimized charging schedules essential for improving profitability. The findings also reveal that integrating renewable energy sources and adopting smart energy management technologies can significantly reduce operational costs while enhancing financial returns. Sensitivity analysis shows that project profitability is most affected by charging demand, electricity tariffs, equipment utilization, and maintenance expenses.

The study further identifies that the increasing adoption of electric vehicles in India creates substantial growth opportunities for HPCL to diversify its business portfolio beyond conventional fuel retailing. The company's extensive network of fuel stations provides a strong foundation for rapid deployment of charging infrastructure across urban and highway locations. Overall, the research concludes that investment in EV charging infrastructure is financially feasible over the long term, provided that appropriate site selection, effective pricing strategies, supportive government policies, and efficient operational management are implemented. These findings support HPCL's strategic objective of contributing to India's sustainable transportation ecosystem while generating stable long-term financial returns.

V. CONCLUSION

The study concludes that the development of electric vehicle (EV) charging infrastructure at Hindustan Petroleum Corporation Limited (HPCL) is a financially viable and strategically beneficial investment in the context of India's rapidly expanding electric mobility ecosystem. The financial analysis indicates that although the establishment of charging stations requires

considerable initial capital for equipment, installation, and supporting infrastructure, the long-term revenue generated through charging services can provide sustainable returns. Financial performance measures such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PBP), and Benefit-Cost Ratio (BCR) demonstrate that projects located in high-demand areas with optimal utilization levels are capable of achieving satisfactory profitability. Government incentives, supportive regulatory policies, and the continuous growth in EV adoption further strengthen the economic attractiveness of these investments.

The research also highlights that effective operational management plays a significant role in improving financial performance. Factors such as electricity pricing, maintenance costs, charger utilization, energy-efficient technologies, and strategic site selection directly influence project profitability. The integration of renewable energy sources and smart charging systems can further reduce operational expenses while improving environmental sustainability. Overall, the study confirms that expanding EV charging infrastructure across HPCL retail outlets not only supports the company's business diversification strategy but also contributes to India's clean energy transition and carbon reduction goals. The findings provide valuable guidance for policymakers, investors, and energy companies in planning financially sustainable EV charging networks that can meet future transportation demands while ensuring long-term economic viability.

VI. FUTURE SCOPE

The future scope of this study lies in extending the financial feasibility analysis to a larger network of HPCL retail outlets across different geographical regions, including urban, semi-urban, and rural locations. Future research can incorporate real-time operational data from existing charging stations to improve the accuracy of revenue forecasting and investment analysis. Advanced financial models may also be developed by considering factors such as inflation, dynamic electricity pricing, battery technology advancements, carbon credit benefits, and evolving government incentive schemes. Comparative studies involving different charging technologies, including fast chargers, ultra-fast chargers, and battery swapping stations, can provide deeper insights into the most economically viable infrastructure options for various market segments.

Further studies can explore the integration of renewable energy sources such as solar photovoltaic systems and battery energy storage with EV charging stations to reduce operating costs and improve long-term sustainability. The application of Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT) technologies for demand forecasting, predictive maintenance, smart energy management, and dynamic pricing can further enhance operational efficiency and profitability. Future research may also evaluate public-private partnership (PPP) models, customer charging behavior, and regional EV adoption patterns to support strategic investment decisions. Such comprehensive analyses will help HPCL, policymakers, and investors develop scalable, resilient, and financially sustainable EV charging infrastructure that supports India's growing electric mobility ecosystem and national clean energy objectives.

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