

COMMERCIALIZATION OF FOUR-WHEELER ELECTRIC VEHICLES CHARGING STATION IN BANGLADESH: CHALLENGES AND OPPORTUNITIES

N.A. Jahan¹, M.S. Hossain¹, and S.B. Alam²

¹University of Liberal Arts Bangladesh, Center for Sustainable Development, Bangladesh

²Rancon Infrastructures and Engineering Ltd, Bangladesh
nayma.akther@ulab.edu.bd*

ABSTRACT

There are several potential and difficulties associated with the commercialization of electric vehicles (EVs), especially in developing nations like Bangladesh. This study examines Bangladesh's present EV technology commercialization situation, highlighting significant obstacles and prospects. Using a case study of an electric charging station in Dhaka city. Electric vehicles (EVs) are pulling momentum in this age of global warming due to their environmentally friendly nature. This technology has potential, and challenges associated with commercialization, especially in Bangladesh. This study examines the present situation of Bangladesh's EV technology and market along with the challenges and opportunities of commercialization of this niche market. The study uses qualitative data from secondary sources like various reports, policy guidelines, market data, etc., and four case studies of EV dealers and Charging station companies. The theoretical base was a combination of the 7p model and the goldsmith business model for commercialization. As the market is still in its niche phase the study carefully observed the potential future action for commercialization. It was found that EVs have a potential future market due to the manufacturer of cars shifting to EVs. However, the challenge remains in accommodating vehicles with proper infrastructure (charging stations). To tackle this shift, it is high time to develop EV charging infrastructures to be installed for a smooth transition. The major challenges for this include financial barriers, energy supply, and policy gaps. The opportunities are environmental betterment, technological advancement, and potential for the local market. For commercializing the EV sector competitive prices with traditional fuel-driven cars are necessary along with awareness of the economic and environmental benefits of proper planning. The study recommended that there is a need to spread accurate knowledge among the end users for the adoption of EVs

and policymakers and industry stakeholders' recommendations to support the development of Bangladesh's EV sector.

Keywords: Bangladesh Market, Commercialization, Electric Vehicles, Electric Charging Stations, Opportunities

1. Introduction

The global automotive sector is undergoing a revolutionary change due to the rise of electric cars (EVs), favorable legislation, and technological advancements. This shift is necessary to slow down global warming, cut greenhouse gas emissions, and advance sustainable development. For poor nations like Bangladesh, the commercialization of EVs presents a unique set of opportunities and challenges. The need to combat climate change and lessen reliance on fossil fuels is causing a significant upheaval in the global automobile industry. Nearly three-quarters of the transportation sector's 24% global CO₂ emissions from fuel combustion are attributed to road cars, according to the International Energy Agency (IEA) (IEA, 2021). Thus, it is believed that switching to electric vehicles (EVs) is essential to meeting the goals outlined in the Paris Agreement, which seeks to keep global warming well below 2 degrees Celsius above pre-industrial levels. Countries can greatly reduce their greenhouse gas emissions by implementing electric vehicle adoption, thereby aiding in the global effort to address climate change.

The EV revolution is primarily being propelled by technological developments in battery science, energy efficiency, and renewable energy integration. The most popular kind of battery used in electric vehicles (EVs), lithium-ion batteries, has had a nearly 90% decrease in price over the last ten years (Bloomberg NEF, 2020). A wider variety of consumers may now afford and use EVs thanks to this substantial cost reduction. Moreover, developments in battery energy density and charging infrastructure have enhanced the efficiency and usability of electric vehicles (EVs), positioning them as a competitive substitute for traditional internal combustion engine (ICE) automobiles.

Another important factor in hastening the adoption of EVs is supportive laws and policies. To lower the initial cost of EVs for customers, several nations have introduced tax credits, grants, and subsidies. For example, Norway provides significant tax breaks for electric vehicle purchases, which will result in over 54% of new car sales in 2020 being EVs (IEA, 2024). Automakers are also being pressured to invest in EV technology and increase the range of EVs they offer by government regulations like fuel economy requirements and emission standards.

Bangladesh is at a crossroads where the country's rapidly growing urban population and increasing greenhouse gas emissions from cars might have a significant impact on the country's economic and

environmental conditions if it were to move entirely to electric vehicles (EVs). Bangladesh, one of the most populous nations on earth, has serious problems with urbanization and environmental deterioration. Car emissions are a major source of air pollution, and Dhaka, the capital, routinely ranks among the world's most polluted cities (World Health Organization, 2019). The number of registered vehicles in Bangladesh rose from 1.5 million in 2010 to over 4 million in 2020, according to research by the Bangladesh Road Transport Authority (BRTA), indicating the country's significant development in vehicular traffic (BRTA, 2020).

In addition to posing a risk to public health, the rise in car emissions also increases Bangladesh's overall greenhouse gas emissions. Roughly 13% of Bangladesh's CO₂ emissions come from the transportation sector, with road transportation contributing the most to these emissions (International Council on Clean Transportation, 2018). Making the switch to electric vehicles (EVs) is a workable way to reduce these pollutants and enhance urban air quality. According to a 2020 World Bank research, Bangladesh might see a 30% reduction in CO₂ emissions from the transportation sector by 2030 if EV adoption becomes mainstream.

The adoption of EVs brings Bangladesh benefits and challenges in terms of the economy. Market penetration of EVs is severely hampered by their high initial cost, which is mostly due to import taxes and battery prices. On the other hand, EV and component production locally can boost the local economy and lessen reliance on imports. By creating collaborations with foreign manufacturers and offering incentives for local production, the government may play a crucial role in creating an environment that is favorable for the manufacturing of electric vehicles. To further assist the expansion of the EV market, a strong infrastructure for charging is also necessary. PPPs, or public-private partnerships, are a useful approach for funding and building the required infrastructure. The availability of charging infrastructure is crucial for increasing EV adoption. EV charging infrastructure is classified into three levels based on power rate, voltage, current, and installation location, with Levels 1 and 2 being slow chargers and Level 3 being fast chargers. By the end of 2018, around 5.2 million charging stations for light-duty vehicles were installed globally, with the majority being slow, private chargers. Public charging stations included 144,000 fast chargers and 395,000 slow chargers. In 2019, several plans were announced to expand charging infrastructure, focusing mainly on private sector chargers with various capacities, and to a lesser extent, on publicly accessible and highway chargers (Al-Hanahi et al., 2021).

Furthermore, Bangladesh's move to EVs is consistent with the country's national goals as stated in the Vision 2041 plan and its dedication to sustainable development. Bangladesh can lessen its need

for imported fossil fuels, increase energy security, and give its people access to a cleaner, healthier environment by encouraging EVs. Potential economic gains include increased competitiveness in the global clean technology market, technical innovation, and the development of jobs in new industries.

This is exploratory research that examines the opportunities and barriers of four-wheeler electric vehicle (EV) charging stations in Bangladesh. The study is done using a thematic analysis method from the interviews and case study documents. It explored the various stages of commercialization of the companies under study using technology commercialization models (7P and the Goldsmith technology commercialization model) to gain insights into EV charging infrastructure. The four-wheeler electric vehicle (EV) market in Bangladesh is still a niche market, with only a handful of companies actively involved. The findings indicate that only one company has reached the maturity stage of the Goldsmith technology commercialization model. In summary, introducing electric vehicles (EVs) and charging stations to the Bangladeshi market presents a valuable opportunity to address environmental challenges, enhance economic stability, and contribute to global climate change efforts. By leveraging technological advancements, implementing supportive regulations, and making strategic investments, Bangladesh can position itself as a leader in the transition to sustainable transportation.

The goal of this study is to investigate these trends and offer a thorough grasp of Bangladesh's EV market. The study answers the following queries:

1. What is the present scenario of electric vehicles in Bangladesh?
2. What are the main obstacles to EV charging station commercialization in Bangladesh?
3. What prospects are there for market expansion?
4. How can stakeholders in industry and legislators support this shift?

2. Literature Review

Globally the uptake of electric vehicles has risen by almost 130 % from 2012 to 2024 (IEA, 2021). The rise of electric vehicles (EVs) has primarily been driven by China, with the country leading the global EV market with a 72% growth in 2017. Despite only 2% of EVs being adopted nationally, China's robust market performance has contributed to its strong and balanced position.

Electric vehicles, particularly electric motorcycle conversions, can reduce transportation emissions and boost the power industry in Indonesia, using the Goldsmith commercialization model to identify technology commercialization strategies. (Habibie, A., & Sutopo, W. 2020). In recent years, electric mobility has experienced a widespread resurgence in transportation sectors, with innovative products

attracting new businesses. Despite government initiatives, some failed, highlighting the challenges in promoting widespread electric vehicles (Ziegler & Abdelkafi, 2022).

Norway's electric vehicles have seen a significant increase, accounting for 52.2% of newly registered passenger cars in 2020, driven by incentives like tax exemptions, reduced parking fees, and free charging stations. Governments have embraced electric vehicles (EVs) as a regular tool during the pre-commercial stage of technology's life cycle, having helped EVs enter the market with the aid of demonstration projects. Raising public awareness of new technology is the primary goal of high-profile demonstrations, which would result in the widespread use of new items in public spaces and media promotion (Liu et al., 2020). Bangladesh aims to cut carbon emissions by 21.85% by 2030, contributing only 0.21% of the world's emissions. With an average yearly growth rate of 7.52%, the country is introducing electric vehicles, which have 77.63% lower yearly emissions than traditional fossil fuel-powered vehicles. Hybrid car imports have increased by 154% in FY21. In order to stimulate local assembly and manufacturing of energy-efficient automobiles, Bangladesh is pushing the usage of hybrid vehicles such as the Nissan X-Trail, Honda Grace, and Toyota Aqua. Tax reductions and lower registration fees are also being proposed. To help industry, a fund called the "National Energy Efficient Vehicle Production Fund" will be established (Sachee, 2024).

2.1. Global Perspective on EV Commercialization

Policies pertaining to the environment, developments in battery technology, and rising consumer awareness have all contributed to the worldwide adoption of EVs. The adoption of electric vehicles (EVs) has increased significantly in nations like China and Norway because of substantial infrastructure development and strong government incentives. According to the International Energy Agency (IEA), sales of electric vehicles (EVs) surpassed three million worldwide in 2020, with Europe and China dominating the market (IEA, 2021). Government initiatives are essential for hastening the adoption of EVs. Promoting EV sales has been successful with the help of incentives including tax rebates, subsidies, and strict pollution standards. For example, in 2020, almost 50% of new car sales in Norway were electric vehicles (EVs), fueled by generous subsidies and a vast network of charging stations (IEA, 2021). On the other hand, with lower taxes and subsidies for the development of charging stations and EV deployment, the Indian government is placing a higher priority on environmentally friendly ecosystems and cutting carbon emissions in the transportation sector (Pareek, Sujil, Ratra, & Kumar, 2020).

2.2. EV Market and Policy in Bangladesh

The Bangladeshi government has established the Electric Vehicle (EV) Charging Guideline to combat climate change and promote energy efficiency. The guide aims to establish a safe, reliable, and affordable infrastructure for electric vehicles, create jobs for small business owners, and prepare electricity distribution systems for EV charging (MoPEMR, 2022). In Bangladesh, the situation regarding electric vehicles (EVs), especially four-wheelers, is still in its early phases, with little infrastructure development and uptake. The bulk of EVs on the road as of 2023 are two- and three-wheelers, like electric rickshaws, with the market for four-wheeler EVs still being relatively modest (BRTA, 2022). Bangladesh's interest in electric vehicles (EVs) is expanding due to the government's commitment to reducing greenhouse gas emissions and improving air quality, despite challenges such as high EV costs and inadequate charging infrastructure (MoPEMR, 2021). It has announced several initiatives targeted at encouraging the use of electric vehicles (EVs), including plans to provide charging infrastructure in major cities and tax advantages for importing EVs. Private sector initiatives are also beginning to emerge; businesses such as Nitol Motors and Rahimafrooz are investigating prospects in the EV industry, including the possibility of local assembly and production. The establishment of a reliable charging infrastructure and the accessibility of reasonably priced EV options for consumers is crucial for the expansion of four-wheeler EV use in Bangladesh.

The installation of four-wheeler charging stations, and the marketing of electric vehicles (EVs) are critical to Bangladesh's transition to a sustainable transportation system. Especially in highly populated urban regions like Dhaka, the transportation industry is one of the biggest sources of air pollution and greenhouse gas emissions in the nation. (World Bank, 2020) estimates that in Bangladesh's largest cities, car emissions make up around 60% of all air pollution, worsening public health problems and accelerating climate change. The World Bank highlights the need for a reliable charging infrastructure for electric vehicles (EVs) to reduce environmental effects, but the lack of sufficient charging stations could hinder adoption in Bangladesh due to potential anxiety (World Bank, 2020). Commercializing EV charging stations in Bangladesh offers economic and environmental benefits. Building a network can boost economic expansion, generate jobs, and reduce trade imbalances. It also promotes regional EV component assembly, diversifying Bangladesh's industrial base. As demand for EVs grows globally, Bangladesh can establish itself as a strong competitor in the regional market, bolstering its economy.

2.3. Technological Advancements and Economic Impacts

The EV market depends on technological developments in battery efficiency and cost reduction. (Bloomberg NEF, 2019) reports that EVs

become financially feasible due to reduced lithium-ion battery costs, with solid-state batteries expected to improve performance and price with improved energy density and charging times. According to (Azevedo et al.,2018), electric vehicles can significantly reduce reliance on imported fuels, create jobs, and promote technological innovation, while also lowering oil import costs and strengthening energy security.

3. Methodology

Technology commercialization is a complex process that involves translating scientific research or technological innovations into marketable products or services and customers play an important role here. Kotler's (2016) product concept, customers would choose goods with the best quality, functionality, or novel characteristics. Numerous startups have discovered the hard way that a new or enhanced product won't always succeed unless it's priced, distributed, and appropriately marketed and sold. This study employs a methodology integrating the 7P Marketing Mix framework with the Goldsmith Technology Commercialization Model to create a comprehensive approach.

Understanding the 7P Marketing Mix Framework: The 7P framework is an extension of the traditional 4P model (Product, Price, Place, Promotion) and includes three additional elements (People, Process, and Physical Evidence). This extended model is particularly useful in the service and technology sectors where customer experience and service delivery are critical. The seven principles of marketing give a comprehensive strategy for providing customers with value by addressing every important facet of a company's offering. The product should be priced to strike a balance between affordability and profitability, and it should be updated or launched to better suit client needs. Accessibility is ensured by efficient distribution channels (place), and value is communicated through promotion rather than features alone. People—all employees included—are essential to developing the brand, thus the procedure ought to guarantee successful and efficient service delivery. Promotional materials and other tangible evidence support the product's worth and help to create a holistic approach that meets customer expectations.

The Goldsmith Technology Commercialization Model Integration: A thorough road map for technology commercialization is offered by the Goldsmith Model, which places a strong emphasis on risk mitigation, market analysis, and strategic planning. It starts by accidentally spotting market possibilities where technology may address pressing problems. Next comes concept development and testing, which iterates the product according to user feedback. A thorough business plan that adheres to the 7P framework directs the commercialization approach. Launching the product, gaining early users, and scaling in response to demand are the steps in entering the

market. Sustained market success is ensured by ongoing product lifecycle management, which includes marketing tweaks and technological advancements. Maintaining a competitive edge requires handling legal issues and protecting intellectual property, and success is gauged by indicators like revenue growth, market share, ROI, and customer happiness (Khofiyah et al., 2021; Goldsmith, 1991).

Integration of 7P and Goldsmith Model: The Goldsmith model's incorporation of the 7P framework offers a reliable mechanism for technology commercialization. The Goldsmith model offers a methodical and systematic approach to introducing technology to the market, while the 7P framework makes sure that every facet of the marketing mix is considered.

Strategic Alignment: To guarantee a cogent strategy, the 7P components can be aligned with the Goldsmith model's stages. For example, concentrate on the "Place" and "Promotion" components of the 7P framework during the Goldsmith model's "Market Entry and Penetration" stage.

Iterative Process: The commercialization of technology is a continuous process. Changes to the Goldsmith model's stages and 7P elements should be based on feedback from the market.

Risk Management: To reduce risks connected to each of the 7P aspects, applying the Goldsmith model emphasizes strategic planning. For instance, careful market research and consumer input can be used to manage pricing risks.

This methodology combines the theoretical aspects of marketing with practical strategies for technology commercialization, providing a structured approach for practitioners and researchers alike. This study's research methodology is based on a qualitative approach containing a Literature review from academic journal articles and reports, relevant documents, and a case study investigation of two companies that are actively involved in the marketing of electric (EVs) charging solutions in Bangladesh and a thorough literature assessment of secondary sources. To summarize the body of research on EV adoption, the literature review has focused on the potential and problems that exist in developing nations, especially in Bangladesh. The theoretical underpinnings and contextual understanding of the issues impacting EV commercialization will be provided by this review, which will consult peer-reviewed journals, industry reports, and government publications. The importance of policy frameworks, technological developments, market readiness, and the creation of charging infrastructure are important topics that need to be investigated (Rahman & Mia, 2020; IEA, 2021).

In addition to the literature analysis, the case study technique will entail a thorough investigation of two organizations that have led the way in Bangladesh's EV commercialization efforts: a native organization and an international one. The selection of these case studies will be

predicated on their strategic significance and inputs to the electric vehicle ecosystem, encompassing the advancement of charging infrastructure and tactics for market penetration. Semi-structured interviews with important stakeholders, organizational report analysis, and field observations will all be used to gather data. The objective is to ascertain the optimal methodologies, obstacles, and tactical modifications that these establishments have implemented to effectively navigate the distinct market circumstances in Bangladesh. This study aims to provide a comprehensive understanding of the commercialization process by combining findings from the literature review and case studies. The electric vehicle (EV) market in Bangladesh is still in its early stages, facing several challenges at the policy level that hinder its commercialization. This study aims to engage key companies involved in the EV sector to gather their insights and perspectives on the future of EV commercialization in the country. To facilitate this, we will present three detailed case studies that highlight different aspects of the EV landscape. Through these case studies, we hope to illuminate the opportunities and obstacles that these companies encounter and to gather valuable foresight that can guide the development of effective policies and strategies for a thriving EV market in Bangladesh.

3.1. Data Sources

In our study, we utilize two types of data sources. For primary data, we conduct interviews with companies actively engaged in the electric vehicle (EV) sector. This firsthand information provides valuable insights into their experiences and perspectives.

For secondary data, we reference a variety of sources, including journal articles, government publications, and conference proceedings. These resources enrich our understanding of EV technology and the commercialization process, allowing us to gain a comprehensive view of the current landscape.

3.2. Data Analysis

This exploration research examines the opportunities and barriers associated with four-wheeler electric vehicle (EV) charging stations. We conducted a thematic analysis of narratives from interviews and documents obtained from various case study companies. Our study explores the different stages these companies are at in the commercialization process, utilizing technology commercialization models to guide our analysis. This approach enables us to gain insights into the challenges and potential pathways for advancing EV charging infrastructure.

4. Results and Discussion

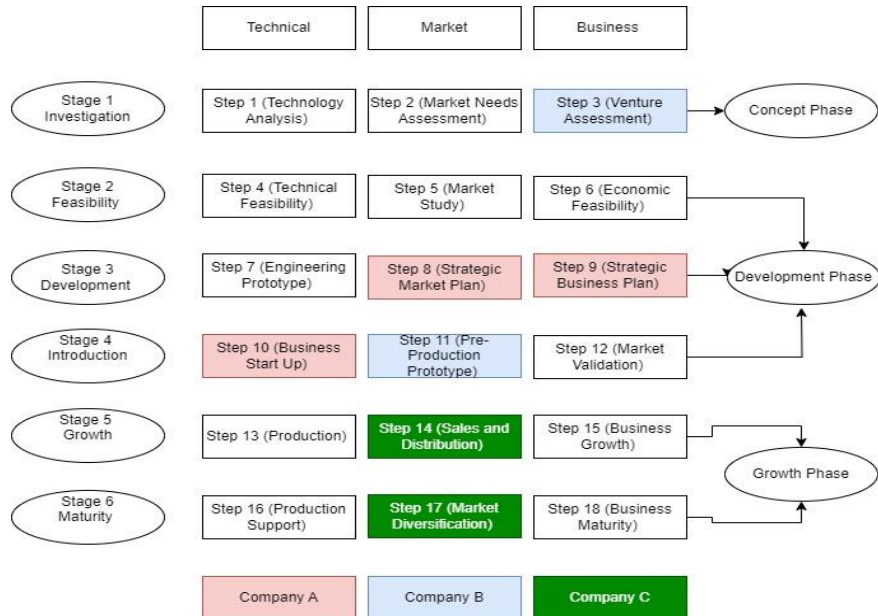


Figure 1: Various Stages of Companies in the Bangladeshi EV Market based on the Studied Cases. (Source: Authors adapted from Khofiyah et al., 2021.)

Case Study 1: Company A stands as a pioneering entity in the burgeoning electric vehicle (EV) market in Bangladesh. As the first and foremost owner and operator of EV charging stations in the country, it is at the forefront of a sector that, while globally established, is still in its nascent stages in Bangladesh. This case study explores the challenges and opportunities facing it, the current state of the EV market, and strategic recommendations for advancing the sector.

Current Market Landscape (7 Ps of Marketing Model) The EV market in Bangladesh is currently limited and slow to develop despite global advancements in EV technology. The Managing Director of Company A identifies several key issues impeding local adoption: high price competitiveness, as EVs are often seen as luxury items and cater primarily to affluent individuals; insufficient charging infrastructure, with a lack of EV charging stations creating barriers for potential owners; and a lack of effective promotion and information dissemination, as it has yet to implement a comprehensive marketing strategy to educate the public about the benefits of EVs.

Goldsmith Commercialization Model Analysis: According to the Goldsmith commercialization model, it has successfully navigated the concept phase and is now in the development phase. The company has completed the first two stages—feasibility and development—and is currently in the business startup step of the third stage of development. However, the market's immaturity poses a challenge, and it lacks a concrete plan to scale its operations.

Current Strategies and Market Outreach: At present, its strategy primarily involves word-of-mouth engagement with potential clients and EV manufacturers, such as Audi, Mercedes-Benz, and Tata. This approach has yielded limited results due to the underdeveloped nature of the EV market in Bangladesh.

Future Market Projections: The EV market in Bangladesh is projected to mature by 2030, largely dependent on government intervention. Key factors that could drive this growth include the implementation of supportive government policies, such as tax reductions on EVs, and increased investment in charging infrastructure, which would lower vehicle costs and expand the charging network. Additionally, as the production of internal combustion engine (ICE) vehicles decreases, consumers may increasingly turn to EVs as a viable and necessary alternative, further accelerating the market's development.

Benefits of EVs: Electric vehicles (EVs) offer several significant advantages over traditional internal combustion engines (ICE) vehicles. They are highly efficient, with a 30-kW battery EV capable of covering 180-200 km on a single charge and require only 20-25 minutes for a full recharging, depending on driving conditions. Additionally, EVs have lower maintenance costs due to fewer moving parts and the absence of oil changes. Environmentally, EVs produce zero carbon emissions, which helps reduce air pollution and contributes to a smaller carbon footprint.

Case Study 2: According to representatives from Company C, their electric vehicle (EV) equipped with a 22-kW battery capacity can achieve an impressive range of up to 300 kilometers on a single full charge. This extended range underscores its commitment to providing practical and convenient EV options for consumers. Additionally, it plans to support individual customers by offering dedicated charging stations, enhancing accessibility and ease of charging for their vehicle owners. In contrast, another Japan-based EV car manufacturer, which also features a 22-kW battery, delivers a range of 200-250 kilometers per charge. While slightly less than Company C's offering, this range still represents a significant step forward in EV technology and usability. The difference in range between the two brands highlights the varying efficiencies and technologies employed in their battery systems and vehicle designs.

7P analysis: This company has focused on high-end clients for its market penetration. Their commitment to providing the clients with luxury and brand value has been their promotion where according to the 7P model product, people, physical evidence, and promotion are used.

Goldsmith analysis: According to this analysis, Company C, being a well-known brand especially for the high-end consumers, could easily reach a mature stage as they already have a strong sales and distribution chain, along with clients preferring luxury and brand value for a premium price. As EV is a new technology people want to own them as

they create an impression of both tech-savvy and environmentally concerned citizens. According to the goldsmith model company C has achieved market diversification in the context of Bangladesh. They provide EV charging stations to client houses.

Case Study 3: Company B, a new entrant in the electric vehicle market, offers an EV with a range of 100 kilometers on a full charge. However, its charging time is significantly longer compared to competitors like Mercedes-Benz and Honda, requiring at least 2 hours to fully charge the battery. This extended charging duration may impact on the convenience and appeal of Palki Motors' EVs, especially when compared to the quicker charging times and longer ranges provided by established brands.

7P Analysis: This company has focused more on the product, price, and people to get into the market, but they haven't explored the promotion of vehicles and charging stations that much.

Goldsmith Model analysis: According to the Goldsmith model this company has started their prototype which puts them in the introduction phase in terms of technology. In terms of business, they have started charging stations to be promoted but at a very early stage.

Challenges in EV Commercialization

Infrastructure Deficits: One major obstacle is the absence of a suitable infrastructure for charging. Rural areas are underserved by the concentration of charging stations in urban areas. The Bangladesh Power Development Board (BPDB) claims that there aren't nearly enough public charging stations in the country to encourage the mass use of EVs.

Policy Gaps: There are insufficient incentives and comprehensive policies to encourage the adoption of EVs. The current policies are unclear and disjointed. For instance, there are tax breaks available for importing electric vehicles (EVs), but there is no established legislative framework to encourage regional production or the development of charging infrastructure.

Economic Restrictions: Potential purchasers are discouraged by the high initial cost of EVs and the scarcity of financing options. High import costs are also caused by a lack of local manufacturing. According to a study by Rahman and Mia (2020), import taxes and levies drive up the cost of electric vehicles (EVs) in Bangladesh by 20–30% when compared to conventional cars.

Technical and Knowledge Barriers: Both customers and service providers lack technical know-how and understanding of EV technology. The upkeep and acceptance of EVs are hampered by this gap. Education campaigns and training programs are required to inform stakeholders about the advantages and functionality of electric vehicles.

Challenges with Energy Supply: The nation's electrical grid is already

stressed, and the extra weight from EVs may make matters worse. In order to encourage the adoption of EVs, Bangladesh must modernize and increase its power-producing capacity.

Opportunities in EV Commercialization

Environmental Benefits: EVs help reduce greenhouse gas emissions significantly, which is in line with Bangladesh's obligations under the Paris Agreement. According to research by the World Bank from 2020, switching to electric vehicles might cut CO₂ emissions in cities by as much as 30%.

Technological Developments: Costs can be lowered and the viability of EVs increased with advances in battery technology and the possibility of local manufacture. The creation of solar-powered charging stations may also offer a long-term solution to the problems associated with energy supply.

Market Potential: Given the size and growth of the population, there is a lot of room for market expansion, particularly with the help of infrastructure development and supportive policies. The Bangladesh Road Transport Authority (BRTA) reported that the country's registered vehicle count is growing at a rate of 8% per year.

Economic Opportunities: Local EV and component production can boost the local economy and generate job opportunities. To increase the capacity of local production, the government can provide incentives for foreign direct investment (FDI) in the EV industry.

Regional Integration: Given that China and India are nearby nations with highly developed EV sectors, Bangladesh stands to gain from regional cooperation with them. Technology transfer, collaborative ventures, and the growth of local supply chains can all be facilitated by collaboration.

5. Conclusion and Implications

The adoption of EVs and charging stations will require a multifaceted strategy, including tax breaks, subsidies, and low-interest loans to make EVs more accessible, combined with scrappage programs for older vehicles. Building charging infrastructure requires investments in a nationwide network of charging stations, which can be backed by a public-private partnership. Production of vehicles may be increased by supporting local manufacturing through partnerships with local automotive companies, incentives, and Special Economic Zones (SEZs); at the same time, technical skills should be strengthened through specialized training and cooperation with academic and vocational training institutions. It's indispensable to have a strong policy framework, supervised by a committed organization, with well-defined objectives and incentives. Public awareness campaigns can also encourage wider adoption of EVs by emphasizing their advantages and the incentives that are offered through a variety of media channels. In

Bangladesh, the commercialization of electric vehicles (EVs) poses notable prospects as well as obstacles. Notwithstanding the obstacles posed by policy gaps, economic restraints, and insufficient infrastructure, there is significant potential due to market expansion, technology developments, increased cost of fuels, and environmental advantages. Bangladesh can leverage EV technology to promote sustainable development and economic expansion by tackling these issues with focused policies and investments. Policymakers, business stakeholders, and the general public must work together to facilitate the switch to electric vehicles. Bangladesh has the potential to lead the electric vehicle (EV) market in South Asia and can serve as a model for other developing nations if it adopts the appropriate policies and makes the necessary investments.

References

- Khofiyah, N. A., Sutopo, W., Hisjam, M., & Ma'aram, A. (2021). A Framework of Performance Efficiency Measurement in Technology Transfer Office (TTO) for Acceleration of Commercialization Technology. <https://doi.org/10.46254/an11.20210408>
- Al-Hanahi, B., Ahmad, I., Habibi, D., & Masoum, M. a. S. (2021). Charging infrastructure for commercial electric vehicles: challenges and future work. *IEEE Access*, 9, 121476–121492. <https://doi.org/10.1109/access.2021.3108817>
- Azevedo, I. M., Morgan, G., & Morgan, F. (2018). The Transition to Electric Vehicles: The Role of Policy and Market Forces. *Environmental Science & Technology**, 52(16), 8913-8922.
- BloombergNEF. (2019). Battery Pack Prices Fall as the Market Ramps Up with the Market at \$156/kWh in 2019. Retrieved from [BloombergNEF](<https://about.bnef.com/>).
- Booms, B. H., & Bitner, M. J. (1981). Marketing strategies and organization structures for service firms. *Marketing of Services*, 47(3), 47-51.
- BRTA. (2020). Annual Vehicle Registration Report. Bangladesh Road Transport Authority. Retrieved from BRTA. (2022). Annual Vehicle Registration Report. Bangladesh Road Transport Authority. Retrieved from
- Goldsmith, R. E. (1991). The Goldsmith Technology Commercialization Model: A Process for Successfully Commercializing Technology. *Journal of Product Innovation Management*, 8(3), 212-220.
- Habibie, A., & Sutopo, W. (2020b). A literature review: Commercialization Study of Electric Motorcycle Conversion in Indonesia. *IOP Conference Series Materials Science and Engineering*, 943(1), 012048. <https://doi.org/10.1088/1757-899x/943/1/012048>
- IEA (2024), Electric car sales, 2012-2024, IEA, Paris <https://www.iea.org/data-and-statistics/charts/electric-car-sales-2012-2024>, Licence: CC BY 4.0
- IEA. (2021). Global EV Outlook 2021. International Energy Agency. Retrieved from [IEA](<https://www.iea.org/reports/global-ev-outlook-2021>).
- Kotler, P., & Keller, K. L. (2016). *Marketing Management* (15th ed.). Pearson Education. Retrieved from <https://www.edugonist.com/wp->

- content/uploads/2021/09/Marketing-Management-by-Philip-Kotler-15th-Edition.pdf
- Lin, S. M. (2011). Strategic marketing management in the heavy lifting industry. *Journal of Marketing Development and Competitiveness*, 5(7), 35-42.
- Liu, X., Sun, X., Li, M., & Zhai, Y. (2020). The effects of demonstration projects on electric vehicle diffusion: An empirical study in China. *Energy Policy*, 139, 111322. <https://doi.org/10.1016/j.enpol.2020.111322>
- MoPEMR (2021). National Action Plan for Electric Vehicle Development in Bangladesh.
- MoPEMR (2022). Electric Vehicle Charging Guideline, retrieved from https://sreda.portal.gov.bd/sites/default/files/files/sreda.portal.gov.bd/page/2f04d85f_e1bb_4596_b37f_89cd63d91567/2023-01-08-04-07-5f99fb7e7a4c24fd0c70ec16f9436b04.pdf
- Palmer, A. (2004). *Introduction to Marketing: Theory and Practice*. Oxford University Press.
- Rahman, M., & Mia, A. (2020). Challenges and Prospects of Electric Vehicle Adoption in Bangladesh. *Journal of Sustainable Development**, 13(2), 45-55.
- Sachee. A.R (2024), Launch of Electric Vehicles in Bangladesh: Hitting the Road to Achieve the Dream of Zero Carbon Footprint retrieved from <https://idlc.com/mbr/article.php?id=511#:~:text=The%20all%2Delectric%20vehicle%20market,in%20FY21%20has%20been%20observed>
- S. Pareek, A. Sujil, S. Ratra and R. Kumar, "Electric Vehicle Charging Station Challenges and Opportunities: A Future Perspective," 2020 International Conference on Emerging Trends in Communication, Control and Computing (ICONC3), Lakshmanagarh, India, 2020, pp. 1-6, doi: 10.1109/ICONC345789.2020.9117473.
- World Bank. (2020). *The Future of Electric Vehicles in Developing Countries: Opportunities and Challenges*. World Bank Publications.
- World Health Organization. (2019). *Ambient Air Pollution Database*. WHO.
- Ziegler, D., & Abdelkafi, N. (2022). Business models for electric vehicles: Literature review and key insights. *Journal of Cleaner Production*, 330, 129803. <https://doi.org/10.1016/j.jclepro.2021.129803>