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Comparative Analysis of Electric Vehicle Policies and Charging Infrastructure: Global and Pakistani Perspectives

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ABSTRACT

This study critically examines Pakistan's electric vehicle (EV) charging infrastructure through SWOT and PESTLE analytical frameworks, situating the national context within global policy and technological trends. The analysis identifies key strengths, including the National EV Policy (2020), the government's target of 30% EV adoption by 2030, lower charging costs compared to conventional fuels, and growing private sector engagement. However, challenges such as the limited and uneven distribution of charging stations, a lack of universal connector standards, weak consumer awareness, and insufficient technical expertise hinder widespread adoption. Opportunities lie in integrating renewable energy sources such as solar-powered microgrids, fostering public–private partnerships, and generating employment through EV manufacturing and services. At the same time, high upfront costs, dependence on imported vehicles and batteries, and risks of workforce displacement in the fossil fuel sector represent major threats. Politically, inconsistent policy enforcement and provincial–federal coordination gaps hinder progress, while legally, regulatory voids regarding safety, standardization, and private participation remain unaddressed. Environmentally, EV adoption aligns with Pakistan's climate commitments to reduce emissions by 50% by 2030, yet battery disposal poses an emerging hazard. Overall, the study highlights the importance of coherent policy implementation, investment in localized technologies, and inclusive

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infrastructure planning to accelerate Pakistan's transition to sustainable electric mobility. Pakistan, particularly Punjab, faces severe smog conditions each year from September to November. During this period, air quality deteriorates drastically, leading to widespread health concerns, reduced visibility, and compromised mobility. The situation often disrupts daily life, including transportation, education, and economic activities, while posing serious risks to public health. The recurring smog crisis in Pakistan, particularly in Punjab, can be attributed to multiple factors; however, one of the key contributors is emissions from fossil fuel–based vehicles. While official statistics for 2025 are not publicly available, the most recent data from CEIC (2020) reported 11,336,000 registered vehicles in Punjab, up from 10,559,000 in 2019. This steady increase in vehicular numbers, without corresponding improvements in fuel quality, emission controls, or the promotion of cleaner transportation alternatives, significantly contributes to deteriorating air quality during the smog season (September–November).

Keywords: Electric Vehicles, Charging Infrastructure, Pakistan, Policy Analysis, Sustainable Mobility.

Background and Purpose of the Study

Helping Hand for Relief & Development (HHRD) Pakistan, through its Research and Development (R&D) and Monitoring, Evaluation, Accountability, and Learning (MEAL) departments, has consistently undertaken studies on critical humanitarian and development issues to generate evidence-based insights for organizational programming and policy advocacy. These research efforts have served as effective instruments for strengthening project planning, refining strategic directions, and highlighting the relevance and impact of current and future interventions. In continuation of this tradition, HHRD has initiated a study on the emerging field of electric mobility, with a particular focus on electric vehicle (EV) policy frameworks and charging infrastructure. Recognizing that sustainable transport is central to addressing climate change, reducing reliance on fossil fuel imports, and meeting international environmental commitments, this study explores global EV policy trends and their applicability to Pakistan. International experiences—such as China's strong state-led expansion of charging networks, Japan's collaborative industry–government approach, and the European Union's incentive-driven strategies—demonstrate how coordinated policies can accelerate adoption and consumer trust. By comparison, Pakistan's EV infrastructure remains underdeveloped, with roughly 250 charging stations concentrated in urban centres as of 2024, lacking standardization and integration with renewable energy sources. The purpose of this study is to provide a comparative analysis that situates Pakistan's EV transition within global perspectives. It aims to identify lessons from international best practices, assess existing gaps in Pakistan's policy and infrastructure, and generate recommendations for scaling electric mobility in a sustainable, inclusive, and climate-resilient manner. The study directly contributes to the advancement of the Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action), by emphasizing renewable integration, low-emission transport systems, and resilient urban planning. Through this initiative, HHRD's R&D and MEAL departments intend not only to build a body of knowledge that supports evidence-based advocacy but also to inform future programming in the energy and environment sector. In doing so, the study reinforces HHRD's commitment to contributing to national and global dialogues on sustainable development while promoting policy and institutional change for environmentally responsible transport solutions in Pakistan.

Introduction

The escalating need for conventional energy sources has led to multiple outcomes that

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negatively impact the environment. Resources are depleted, and CO2 is released in high amounts, causing the greenhouse effect and undesirable global warming. Clean energy resources and related technologies have been developed to mitigate these problems (Mastoi et al., 2022). Although technological advancements have significantly reduced greenhouse gas emissions from transportation, about one-quarter of these emissions come from the sector (Napoli, Polimeni, Micari, & Alaimo, 2019). Due to the above reasons, the research and adoption of electric vehicles (EVs) deserve considerable attention. By emitting very low or no tailpipe emissions and making very little noise, electric vehicles significantly reduce traffic congestion and contribute to a healthier living environment. The automotive industry is transitioning to zero-emission vehicles (Bräunl et al., 2020). Approximately 1.5 million new battery electric vehicles (BEVs) were added to the global fleet in 2019, bringing the total number of BEVs in use globally to around 4.8 million (Martins et al., 2021).

Pakistan has already been declared the seventh most vulnerable country because of climate change. Burning more fossil fuels, including oil, may further exacerbate the situation (Ullah et al., 2019). According to the Pakistan Economic Survey 2021 report, Pakistan intends to set a cumulative, ambitious conditional target of an overall 50% reduction in its projected emissions by 2030. To reach the target, Pakistan aims to shift to 60% renewable energy and 30% electric vehicles by 2030. As a result, not only will carbon emissions decrease, but also other hazardous compounds, such as Sulphur Dioxide (SO2), Nitrogen Dioxide (NO2), and particulate matter (PM), including PM10 and PM2.5, will decrease in the atmosphere due to a decrease in the burning of fossil fuels.

International Electric Vehicle Policy Trends

The global transition to electric vehicles (EVs) is gaining momentum, with a staggering 14 million new EVs registered, bringing the world's total to 40 million. This represents a whopping 3.5 million increase from 2022, reflecting a robust 35% year-on-year growth and a six-fold increase since 2018. Remarkably, weekly registrations in 2023 surpassed 250,000, even exceeding the total annual registrations observed in 2013. EVs also captured a significant share of the car market in 2023, accounting for around 18% of all cars sold globally. Battery electric vehicles (BEVs) dominated the electric car market, making up roughly 70% of the total EV stock in 2023. China held a commanding position in the global electric vehicle (EV) market in 2023, capturing a massive 60% share of new registrations, which translates to approximately 8.1 million new electric vehicles. In the US, new EV registrations were 1.4 million, increasing by more than 40% compared to 2022. Although the relative annual growth in 2023 was slower than in the previous two years, the demand for EVs remained strong. In Europe, new EV registrations neared 3.2 million in 2023, increasing by 20% compared to 2022.

National Electric Vehicle Policy of Pakistan

Electric Vehicle technology, as it does not use oil, can help reduce Pakistan's oil import bill, which is the most significant part of the country's imports. This is important because the rising trade deficit is slowing down Pakistan's economic growth. EVs also present an opportunity to create a new industry, which can lead to more environmentally friendly businesses, new job opportunities, and a healthier economy. Currently, electric vehicles (EVs) are expensive because the technology is relatively new, and the cost of battery materials is high. However, in the future, as production increases, costs are expected to decrease. This policy focuses on electric vehicles (EVs) for two- and three-wheelers, as well as heavy commercial vehicles, such as buses and trucks. It suggests a gradual shift to electric vehicles (EVs) without harming the current automotive industry, which

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employs approximately 3 million people and generates a substantial amount of government revenue. The policy aims to create a cleaner environment and encourages the local assembly of electric vehicles (EVs). Both new companies and current auto manufacturers will receive incentives to produce electric vehicles (EVs) in Pakistan.

Method and Procedure

The research utilized a combined analytical framework that integrated the use of both the SWOT (Strengths, Weaknesses, Opportunities, and Threats) and the PESTLE (Political, Economic, Social, Technological, Legal, and Environmental) analytical approaches to give an overall assessment of the electric vehicle (EV) charging infrastructure in Pakistan. Secondary Data Secondary data is used to study how oil financing is made out of the national budget. Government policies (e.g., EV Policy 202025, climate commitments). Reporting of various international organizations, think tanks, and academic literature, data on industry players provided by private charging companies, and automotive stakeholders. Stakeholder Consultations, Consultations with the policymakers, EV entrepreneurs, utility providers, and environmental experts. Getting knowledge about regulatory obstacles, market viability, and infrastructural requirements. SWOT Analysis: Internal strengths and weaknesses were singled out (e.g., policy incentives, infrastructure gaps). Environmental opportunities and threats were evaluated (e.g., renewable integration, import dependency). PESTLE Analysis: wider situational influences were considered to gain representation of macro-level factors: Political: consistencies in policy, government incentives, international climate obligations. Economic: Cost competitiveness and oil import reduction, and affordability barriers. Social: Adoption trends, urban-rural disparity, social awareness. Technological: Standards, Research and Development capabilities, capabilities to smart charge. Legal: codes of urban planning, regulatory frameworks, tariffs. Environmental: Ability to reduce emissions, renewable connections, and battery waste. Verification of Results: Results obtained in the study of SWOT and PESTLE have been cross-checked. The integrated model was able to provide the capturing of all internal capacities and external environments in a holistic manner.

Results & Discussions

The results are presented in four layers: (i) Comparative international practices, (ii) Comparative Policy Analysis, (iii) SWOT analysis, and (iv) PESTLE analysis of Pakistan's EV charging infrastructure.

Comparative Insights

China, with its intensive state-centered growth and the obligatory EV-to-charger ratio of 1:8, proves that a strong government can speed up infrastructure construction and alleviate the range anxiety in major cities in a short period of time. The case of Japan explains the significance of premature industry-government collaboration in that the nationwide fast-charging system (NCS) was established based on the partnership between policy makers and automakers, making them both accessible and consumer-confidence worthy. The European Union points to the importance of regional integration and climate-related policy goals, where municipal subsidies made possible high volumes of rollouts, as in France, subsidizing more than 12,000 charge points. Pakistan, on the other hand, is working on an expanded infrastructure, comprising approximately 250 infrastructure facilities in 2024, which are mostly concentrated in urban areas and not standardized, lacking dose integration with renewable energy. Such comparisons indicate that Pakistan should be able to speed up its transition by emulating the regulatory challenge in China, the collaborative approach of Japan, and the incentive-based mechanisms of the EU in accordance with its local socio-economic and energy realities. The international example of China, Japan, and the European Union shows that effective

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regulation, industry-government cooperation, and incentive schemes are the main forces of successful EV infrastructure development. In the case of Pakistan, the hybrid approach composed of the use of regulatory enforcement, partnerships, and targeted subsidies is likely to compensate for the existing deficiency of the infrastructure and speed up the shift to sustainable electric mobility.

Comparative Policy Analysis

A network of charging infrastructures has been established in China by various stakeholders, such as the central government, the local governments within the country, and the utility companies. The rapid increase in the number of charging points is witnessed in China, and in the 88 designated pilot cities funded by the central government, Shanghai, Beijing, and Shenzhen have been ranked at the top. Within the frameworks of the program, these cities will be expected to include one charge point per eight electric vehicles, with no charge point located more than 1km away, at any single point within the city's center (NDRC, 2015).

Global Best Practices

This awareness and increased range and efficiency of electric motors and batteries have enabled EVs to be produced that are more efficient and with longer range (Sun & Wang, 2019). In addition, the innovations of newer ways of making batteries more efficient and advanced have enabled EVs to have an even better battery life, therefore, becoming more appealing to EV users (Zeng et al., 2019). That technology has encouraged large automobile companies to take an interest in developing electric cars (EVs). Another factor that has contributed to the rising trend is the support accorded by governments all over the world in the form of policies and incentives that encourage the adoption of EVs (Wang & Zhao, 2017).

Lessons for Pakistan

The transportation industry has been attributed to consuming a staggering 30 percent of the entire energy consumption in Pakistan. In 2022- 2023, 14.97 Mtoe of energy was used. The transportation of gasoline costs Pakistan USD 1.3 billion monthly, and therefore, it is an important source of revenue (Kiraz et al., 2022). The demand for fuel increases proportionately along with the steep increase in motor cars and motorcycles. Pakistan can reduce its reliance on foreign fossil fuels by adopting electric vehicles (EVs) in locally generated electricity. Besides more energy security, this cushions the country against the unpredictable trends in global oil prices. The role of an electric vehicle (EV) plays is critical in the net-zero emissions scenario, which is highlighted by the Net Zero Emissions (NZE) by 2050 scenario. The transportation industry will have to undergo a serious transformation to achieve the Paris Agreement goal of a net-zero emissions target that includes a 45 percent reduction in emissions by 2030 and zero emissions by 2050 (Net Zero Roadmap, 2023). In pursuit of NZE, the electrification of transportation with EVs is an opportunity that will revolutionize Pakistan. There are no toxic tailpipe gases from EVs. This leads to cleaner air within cities, especially regarding air pollutants like carbon monoxide CO and fine particles like PM2.5. In addition, EVs reduce the overall contribution of greenhouse gases that cause climate change and global warming dramatically (Zulfiqar et al., 2024).

Electric Vehicles Charging Infrastructure in Pakistan

By 2024, the charging infrastructure of Pakistan against electric vehicles (EVs) is slowly taking shape with the help of both government and private players. There are over 250 electric vehicle (EV) charging stations in Pakistan, but they are mainly found in urban centers of Karachi, Lahore, and Islamabad, as well as along major thoroughfares, such as M-1 and M-2 (Dawn, 2024). This process has received a boost from the creation of

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favorable policy climates by public sector institutions, including the Ministry of Climate Change and NEPRA. In contrast, GO Petroleum and Tesla Industries, and other private companies have provided quick-charging stations to address the growing demand (The Express Tribune, 2024).

Availability and Accessibility

In Pakistan, the availability of EV charging stations has remained low and is not evenly spread out, posing as an inhibitor to the expansion of electric mobility in Pakistan. Most of the EV charging facilities are concentrated in big cities, including Islamabad, Lahore, and Karachi, and do not cover the smaller towns and rural regions. They described the distribution of EVs as such that it inhibits their consumption outside of large metropolitan cities, as well as making long-distance transportation nearly unsupported (Ahmed et al., 2021).

Cost of Charging Ports

In Pakistan, an electric car is cheaper to recharge compared to the cost of regular gasoline and diesel. The price range at all charging stations on average costs between PKR 30 and PKR 50 per kilowatt-hour (kWh), which is 40-50 percent cheaper when compared to gasoline (Dawn, 2024). Such a difference in pricing acts as a major incentive to consumers to switch to electric vehicles (EVs), considering the volatile nature of fuel prices. As per a report by the Pakistan Council of Renewable Energy Technologies (PCRET), repeated charges using electric vehicles can reduce transportation expenditures down to 60 percent each month for city-dwellers However, the fact that EVs are very expensive to purchase and have limited access to fast charging is still a problem when it comes to the affordability of middle-class and rural populations (PCRET, 2023). EV charging infrastructure should be strategically linked with renewable energy sources, such as solar and wind power, to further minimize CO_2 emissions and reduce reliance on fossil fuels for electricity generation. This integration will enhance the sustainability of the EV ecosystem and contribute to long-term energy security.

Impact on Employment in the Fuel & Auto Industry

The growth of the electric vehicle (EV) charging system in Pakistan is likely to cause some paradigmatic changes in the fuel and auto sector that will have an implication on the job structure. The fuel sector and non-renewable labor, especially oil processing and petrol workforces, risk job redundancies because of the reduction in demand for non-renewable energy. When countries shift to clean energy, they are faced with job losses initially in the old sectors (International Labor Organization 2022). Nevertheless, they can make up in the form of green jobs in a controlled fashion. In Pakistan, the petroleum industry employs thousands of other people in distribution and retail processes, where EVs may decrease employment in these sectors, unless they are accompanied by retraining strategies (Pakistan Economic Survey, 2022).

SWOT Analysis of Pakistan's EV Charging Infrastructure

Pakistan has a few strengths and weaknesses, as well as opportunities and threats, when it comes to EV charging infrastructure. Some of its major assets include advantageous government policies, such as the goal to reach 30% EV adoption in 2030. Moreover, reduced charging prices, which lie within the PKR 30-50/kWh spectrum, make the use of EVs more affordable than conventional combustion engines. Moreover, the expanding private sector involvement, especially that of GO Petroleum and Tesla Industries, is an indication that the market is gaining confidence in the sector. Although there are strong points, evidenced in the limited and unequal distribution of charging stations with a

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heavy bias in urban areas, not considering the rural locations, it has its share of shortcomings. A lack of general standards around charging connectors gives rise to technical inefficiencies, and consumer awareness lags, and technical skills are inadequate to make mass adoption possible. In the opportunity sub-sector, Pakistan can be advantaged by incorporating micro live micro grids as a solution to the lack of power and load shedding, and in the provision of jobs in the EV manufacturing, servicing, and infrastructure planning. A lack of notable shortage of skilled manpower in Pakistan to support the adoption and maintenance of Electric Vehicles (EVs). To address this gap, it is essential to introduce specialized technical diplomas and training programs in EV-related skills within technical colleges and vocational institutions. This will ensure the availability of a qualified workforce to sustain and expand EV infrastructure and services nationwide. Also, a large opportunity exists in partnerships between the government and a business entity to extend the fiber-based networks nationwide. Nevertheless, scalability in the EVs sector is threatened by the cost of entry prices that are prohibitive in the hands of middle- and low-income earners. In addition, the lack of appropriate reskilling policies leaves the workforce in the fossil fuel industry at risk of job displacement. Lastly, high reliance on imported EVs and batteries will pose a threat to sustainability and energy independence.

PESTLE Analysis of Pakistan's EV Charging Infrastructure

A PESTLE analysis can help you understand the bigger political, economic, social, technological, legal, and environmental factors that contribute to the EV charging infrastructure in Pakistan. Politically, the National EV Policy (2020) and the climate pledges of Pakistan are an indicator of good policy; however, political stability and lack of uniform enforcement are some major threats to EV adoption in Pakistan. The need to have effective provincial federal coordination is also required for ensuring the equitable development of infrastructure across regions. Economically, EV charging is cheaper (4050%) than petrol or diesel in the long term, resulting in viable savings to the consumer population and the possibility of Pakistan reducing its hefty oil import bill of USD 1.3 billion every month. Nonetheless, the high EV upfront costs still act as an impediment to the middle-income household. The sector also presents a possibility of green industrialization in terms of the part and component assembly of EVs. While adoption has so far been limited to the urban elites, the rural and low-income population remain out of it in a socially unequal approach. The issue of gender and accessibility is also present since the charging stations are commonly not designed safely and inclusively. Low public consciousness is an additional factor due to which anxiety and reluctance in the transition to EV develop. Pakistan is technology-challenged because there is no unification of charging connectors or protocols, and domestic research and development of battery manufacturing and recycling to close the gap. Still, there are chances to bypass when using such advanced technologies as smart charging, vehicle-to-grid (V2G) systems, and integration of solar. Major regulatory gaps are in the areas of standardization/safety measures and private sector frameworks. Low enforcement of urban planning codes also creates impediments to the development of EV-ready infrastructure, and importation use creates issues of intellectual property and tariffs. In environmental terms, EV use would further assist Pakistan in hitting its goal to reduce emissions by 50 percent by 2030 and would offer potential to transition to renewable sources in the charging landscape. But improper battery disposal would bring new environmental hazards, unless well controlled.

Discussion

The evidentiary analysis shows that the level of EV charging infrastructure in Pakistan is

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still at its early stages compared to the world leaders. Programs in Pakistan continue to be hodgepodge with a heavy concentration in the urban centers instead of country-wide infrastructural development as in China or the public-private synergy in Japan. Such segmentation contributes to the presence of range anxiety, which is one of the factors that has been a prohibitive factor in previous studies (Ahmed et al., 2021). The SWOT analysis also shows that, although there are cost advantages and policy frameworks to support its adoption, structural weaknesses (lack of standardization, poor coverage, and low awareness) pose a risk in the long-term adoption. Our results are consistent with findings elsewhere internationally that indicate that EV uptake is mainly enabled by infrastructure density and visibility (Mnzel et al., 2019). The opportunities exist in aligning the EV adoption with the renewable energy growth of Pakistan. Solar-powered microgrids, notably in rural settings, will not only cut down on fossil fuels but also deal with the issue of load-shedding. Further, global experiences indicate that regulation, as well as financial benefits and industry partnerships, can be used to hasten adoption. As an example, Japan has introduced a collaborative charging model, which can be transformed in Pakistan through rallying the local automakers, oil marketing companies, and the energy sector. In terms of employment, despite an inevitable short-term loss of employment opportunities in the fossil fuels industry, EVs can be viewed as a promising source of new jobs in assembly, soft-qubit integration, and recycling of batteries, provided it is supported by training. This transition is in line with the commitment of Pakistan, under the climate and Sustainable Development Goals (SDGs), to SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action). In summary, the paper points out that Pilot SP can change the paradigm of EVs in Pakistan by ramping up the charging infrastructure via open partnerships between the government and the private sector, keeping it inclusive, and ensuring that the investment in EVs is in tandem with investment in renewable energy. Pakistan will perhaps lose to its targets of 2030 without such integrative actions, even though the policy outlook is good. The major factors enhancing the use of electric vehicles, considering a PESTLE outlook, are the political commitment (National EV Policy) and economic savings through less fuel import. But the widest threats are the legal-regulatory loopholes and technological reliance on overseas vendors. The existence of social barriers in the form of low awareness and access to supplies creates a necessity to address inclusive planning. Cross-country comparisons with China, Japan, and the EU show that Pakistan has much to do and that it should further shift to implementation structures, especially in the form of public-private partnerships and charging on renewables. The results support the international literature that policy, certainly, the density of infrastructure, and consumer incentives are the most potent drivers of EV adoption. To conclude, the Pakistan route to achieving its 2030 EV goal would be conditioned (i) by the creation of effective, uniform, and accessible charging infrastructure; (ii) the interconnection of EV adoption and RE investment and national industry.

Table 3.1 SWOT and PESTLE Analysis of Pakistan's EV Charging Infrastructure

SWOT Factors	Key Points	PESTLE Dimensions	Key Points
Strengths	• Supportive EV Policy (30% fleet target by 2030) • Lower charging cost than petrol/diesel • Emerging private-sector	**Political**	• National EV Policy 2020 • Climate commitments under the Paris Agreement • Policy inconsistency due to instability

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SWOT Factors	Key Points	PESTLE Dimensions	Key Points
	investment		
Weaknesses	• Limited and uneven charging distribution • Lack of universal standards/connectors • Weak consumer awareness, limited expertise	**Economic**	• Charging is 40–50% cheaper than fuel • High upfront EV costs • Potential reduction in oil import bill • Local EV assembly opportunities
Opportunities	• Integration with renewable energy microgrids • Green job creation in the EV ecosystem • Public–private partnerships for fast charging	**Social**	• Urban elite early adopters • Rural and low-income groups excluded • Gender and safety concerns at charging points • Low awareness causing range anxiety
Threats	• High EV costs limit middle-class adoption • Job losses in the fossil fuel sector without reskilling • Import dependency for EVs and batteries	**Technological**	• No standardized connectors/protocols • Limited domestic R&D (battery, recycling) • Potential for smart charging & V2G integration
		Legal	• Gaps in regulation & safety standards • Weak urban EV-ready codes • Import tariffs & IP dependency
		Environmental	• Supports emission reduction targets • Renewable charging reduces grid stress • Risk of hazardous battery waste

Table 3.2 Only Punjab Punjab-focused analysis.

Vehicle emissions per liter of fossil fuel in Punjab: Analysis

S #	Class	Vehicles	Fuel	Annual km/veh	km per litter	Liters /veh/year	Total litres/year/M	CO2 (tonnes/yr)	NOx (tonnes/yr)	PM2.5 (tonnes/yr)	CO (tonnes/yr)	HC/VOC (tonnes/yr)
1	Mot	7,9	pet	10,00	40	250	1,98	4,58	1,68	69.43	34,71	6,943

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	orcycles	35,200	rol	0			4	2,578	6.2		7	
2	Cars	2,267,200	petrol	12,000	12	1000	2,267	5,237,232	1,927.1	79.35	39,676	7,935
3	LCVs/Vans	566,800	diesel	30,000	7	4285.71	2,429	6,510,103	2,793.5	303.64	24,291	1,822
4	Trucks	453,440	diesel	50,000	4	12500	5,668	15,190,240	6,518.2	708.50	56,680	4,251
5	Buses	113,360	diesel	50,000	3.5	14285.71	1,619	4,340,069	1,862.3	202.43	16,194	1,215
Total		**11,336,000**		**152,000**	**67**	**32,321**	**13,968**	**35,860,221**	**14,787**	**1,363**	**171,558**	**22,166**

EV Financial impact and reduction of CO2 emission impact per year, Punjab registered Vehicles- Analysis

S#	Class	Vehicles	Annual km/veh	Baseline liters/yr/million	Baseline CO2 (t/yr)	EV kWh/yr/Million	EV CO2 Low (t/yr)	EV CO2 Central (t/yr)	EV CO2 High (t/yr)	Fuel cost baseline (Rs/yr)/million	Energy cost EV Low Tariff (Rs/yr)/million	Energy cost EV High Tariff (Rs/yr)/million
1	Motorcycles	7,935,200	10,000	1,984	4,582,578	3,174	1,364,854	1,587,040	1,904,448	524,933	126,963	196,793
2	Cars	2,267,200	12,000	2,267	5,237,232	5,169	2,222,763	2,584,608	3,101,530	599,924	206,769	320,491
3	LCVs/Vans	566,800	30,000	2,429	6,510,103	4,251	1,827,930	2,125,500	2,550,600	663,132	170,040	263,562
4	Trucks	453,440	50,000	5,668	15,190,240	34,008	14,623,440	17,004,000	20,404,800	1,547,307	1,360,320	2,108,496
5	Buses	113,360	50,000	1,619	4,340,069	6,802	2,924,688	3,400,800	4,080,960	442,088	272,064	421,699

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Total	**11,336,000**	**152,000**	**13,968**	**35,860,221**	**53,404**	**22,963,675**	**26,701,948**	**32,042,338**	**3,777,384**	**2,136,156**	**3,311,042**

Table 3.3 Emissions per 1 Liter of Fuel (approximate averages)

Petrol (Gasoline)	Diesel
CO_2: ~2.31 kg	**CO_2:** ~2.68 kg
CO: 10–25 g	**CO:** 5–15 g
NOx: 0.5–1.2 g	**NOx:** 0.8–1.5 g
Particulate Matter (PM2.5): 0.02–0.05 g	**Particulate Matter (PM2.5):** 0.05–0.2 g
Unburned Hydrocarbons (HC/VOCs): 2–5 g	**Unburned Hydrocarbons:** 0.5–1.0 g

Table 3.4 Financial impact (operating energy cost only)

Today (petrol + diesel): ≈ Rs 3.777 trillion/yr			All-EV (electricity): ≈ Rs 2.136–3.311 trillion/yr	
Annual savings	**Easy math used**	**CO_2 emission impact**	**Annual CO_2 cut**	**Easy math used**
≈ Rs 1.641 trillion (at ~Rs 40/kWh)	Savings = 3.777 − 2.136 = 1.641 trillion (low tariff)	Today (tailpipe CO_2): ≈ 35.86 million tons/yr (Mt)	≈ 12.90 Mt (cleaner grid case)	35.86 − 22.96 = 12.90 Mt (low grid EF)
≈ Rs 0.466 trillion (at ~Rs 62/kWh)	Savings = 3.777 − 3.311 = 0.466 trillion (high tariff)	All-EV (accounting for grid CO_2): ≈ 22.96–32.04 Mt/yr	≈ 9.16 Mt (central case)	35.86 − 26.70 = 9.16 Mt (central)
			≈ 3.82 Mt (dirtier grid case)	35.86 − 32.04 = 3.82 Mt (high grid EF)

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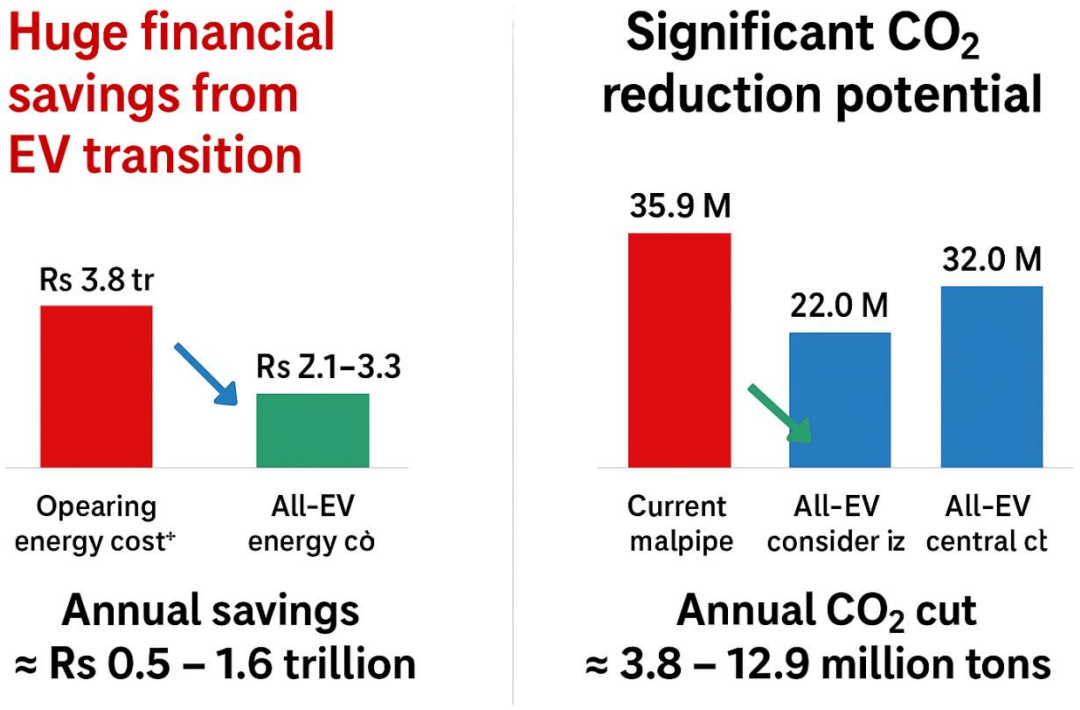

Figure 3.1: EV Transition: Financial & Environmental Benefits Generated by the researcher

The comparative study of fuel-based and electric vehicles (EVs) reflects the financial and environmental benefits of the transition to EV adoption in Pakistan. Table 3.3 indicates that both petrol and diesel release a lot of greenhouse gases, but diesel has a slightly higher rate of carbon dioxide (CO 2) emission per liter of fuel burned (2.68 kg -1 vs. 2.31 kg -1 of petrol). Nevertheless, petrol engines produce much more carbon monoxide (1025 g vs. 515 g), hydrocarbons (25 g vs. 0.5g), and less nitrogen oxides (0.81.5 g vs. 0.51.2 g) and PM (0.050.2 g vs. 0.020.05 g). This implies that neither of the fuels is clean, with petrol having a propensity to contribute to urban air pollution, with CO and hydrocarbons, with diesel contributing larger proportions to smog and health risks, with NOx and particulate emissions. Table 3.4 further underlines the case of EVs in the economy and climatic conditions. At the present rate, Pakistan is consuming petrol and diesel to the tune of approximately 3.777 trillion a year. To the extent that the whole fleet of vehicles is replaced with EVs, the cost of operation would go down to between Rs 2.136 and 3.311 trillion, based on electricity charges. This would save by one to one trillion rupees a year (in higher tariffs) and 1.641 trillion rupees (in lower tariffs). Regarding emissions, the present use of fossil fuels generates approximately 35.86 million tons of CO2 each year. Switching to EVs would decrease this load by 3.82 to 12.90 million tons/year, again depending on how clean the electricity grid is. A cleaner grid situation has the most significant decrease, and a coal-intensive grid has the smallest environmental advantage, but still has better efficiency than a fuel-driven situational setup. Simply put, EV transition can offer two benefits: relieving Pakistan of its financial responsibility by decreasing the amount of money spent every year on energy, and lowering CO2 emissions to help reach its climate objectives. Nonetheless, the net

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positive environmental impact will strongly rely on the decarbonization of the power grid and the adoption of EVs.

Conclusions

In countries such as Pakistan, where automobile emissions are one of the chief factors leading to environmental degradation, electric cars (EVs) are the key to ensuring a more environmentally friendly and green future. Economic and environmental advantages of switching to electric vehicles (EVs) in the long run are outweighing the significant challenges that face the process of transitioning out of the traditional engines and vehicles, these challenges being expensive upfront costs, availability and quality of infrastructure, and popular ignorance. Countries all over the world are becoming more committed to reducing greenhouse gas emissions, and one of the solutions to that is the EV, which is becoming highly popular as a means of transport that is environmentally friendly. The issue, however, is that everybody should be involved in making such a vision real, including legislators and energy suppliers, as well as personal businesses or people themselves. By adopting these policies, Pakistan would be in a much better position to achieve its climate promises, to diversify its energy sources that no longer help the country pursue its own national interest, and to end up having a transportation system with the potential of being inclusive and sustainable for its population. Transition to electric vehicles is a strategic economic opportunity as well as an environmental necessity.

Recommendations

The following recommendations are proposed to accelerate the use of EVs in Pakistan:

Mandatory installation of customized EV charging ports in all residential and commercial high-rise buildings, as well as parking plazas. These ports should be integrated with a digital payment system to facilitate vehicle charging during office hours and allow public access during off-hours. This approach will save time, promote efficient use of infrastructure, and encourage cashless transactions.

Implementation of a nationwide Electric Vehicle (EV) policy, supported by strict enforcement measures, is expected to generate a significant financial impact while ensuring a substantial reduction in CO_2 emissions. To maximize effectiveness, the policy should include subsidized rates for EV imports and incentives for local manufacturers. This dual approach will not only accelerate the transition toward sustainable transportation but also strengthen domestic production capacity, reduce dependency on fossil fuels, and contribute to Pakistan's climate commitments.

To address the shortage of skilled manpower in Pakistan's Electric Vehicle (EV) sector, it is essential to introduce specialized technical diplomas and certification programs in EV-related skills within technical colleges and vocational institutions. Building local expertise in areas such as EV maintenance, battery technology, charging infrastructure, and manufacturing will ensure a sustainable workforce, reduce reliance on foreign expertise, and support the long-term growth of the EV industry.

Establish an EV charging infrastructure capable of supporting many vehicles, including fast chargers across the country, and not just in large cities and on highways, to eliminate range anxiety and promote long-distance EV travel.

Provide specific financial incentives such as subsidies, tax waivers, cheap loans, and infrastructure to reduce the costs of EVs with a focus on reaching middle-class, rural dwellers, and ensuring accessibility to robust charging points both in town and rural areas.

A detailed strategy of EV infrastructure must be created by the government, which should state the objectives, timetables, and scope of work.

A centralized map of all the available charging stations will be created to ensure they are more accessible.

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Synergies between governmental and privately-owned companies should be promoted to install more charging facilities, even in remote regions that have low access to electricity.

Other measures, including tax exemptions or subsidies to address charger installation, are recommended.

National standards on EV connectors, charging procedures, and safety regulations ought to be set up and standardized with different brands and versions of electric vehicles in a bid to achieve compatibility and similarity.

The lower tax, low registration fee, and subsidized purchasing can also be offered to EV buyers so that the purchase of electric vehicles can be promoted.

Develop an attractive package where leasing electric cars or providing concessional loans may be offered to middle- and low-income populations.

The implementation of solar-powered microgrids and other renewable energy sources, as part of the electric vehicle (EV) charging systems, should be promoted.

The vocational courses in electric mobility that would prepare technicians and mechanics to work in EVs must be promoted.

Through the incorporation of inclusive urban planning and the design standards of the stations, it must make the charging stations safe and accessible to all people, including the elderly, women, and persons with disabilities.

Invest in local research on battery technologies, effective charging solutions, and EV assembly products to make the country less dependent on imports in the innovation sector.

Oil and petroleum companies should be mandated to retrain and retain their workforce in alternative sectors, particularly EV-related industries, once the nationwide EV policy is implemented. This measure will help mitigate large-scale unemployment, support a just transition for affected workers, and reduce the risk of poverty among individuals dependent on the fossil fuel sector for their livelihoods.

References

Ahmad, R., Haq, M. A. U., & Mehmood, I. (2025). ASSESSING INFRASTRUCTURE-LED RECOVERY OF RESILIENT HOUSING DEVELOPMENT IN THE MODEL VILLAGE OF THE HHRD, CHAK PATIYAT, RAJANPUR. Journal for Current Sign, 3(3), 577-597.

Ahmed, R., Tariq, S., & Yousaf, H. (2021). "Urban Concentration of Electric Vehicle Charging Infrastructure in Pakistan: Challenges and Prospects". Journal of Energy Infrastructure Development, 5(2), 45–59.

Akhter, J., Ahmed, S., Hayat, M. Y., Kiran, S., & Haq, M. A. U. (2025). The Impact of Work and Family Responsibilities on the Academic Performance of Part-Time Postgraduate Students in Rawalpindi, Pakistan. Dialogue Social Science Review (DSSR), 3(8), 197-208.

Alhazmi, Y.A., Mostafa, H.A., Salama, M.M.A. (2017). "Optimal Allocation for Electric Vehicle Charging Stations Using Trip Success Ratio". Int. J. Electr. Power Energy Syst. 91, 101–116.

Ali, T., & Farooq, M. (2024). "Public Perception and Informational Barriers in EV Infrastructure Usage in Pakistan". International Journal of Sustainable Transport Systems, 12(1), 60–75.

Alternative Energy Development Board. (2023). Electric Vehicle Policy and Implementation Report 2023.

Amjad, M., Ahmad, A., Rehmani, M. H., & Umer, T. (2018). "A Review of EVs charging: From the Perspective of Energy Optimization, Optimization Approaches, and Charging Techniques". Transportation Research Part D: Transport and Environment, 62, 386–417.

Asian Development Bank. (2022). Greening Pakistan's Transport Sector: Sustainable infrastructure and EV roadmap.

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DIALOGUE SOCIAL SCIENCE REVIEW

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https://doi.org/10.5281/zenodo.17611939

Bräunl, T., Harries, D., McHenry, M., et al. (2020). "Determining the Optimal Electric Vehicle DC-charging Infrastructure for Western Australia". Transp. Res. Part D 84, 102250.

Business Recorder. (2023, December 18). "Private Firms Ramp up EV Charging Stations in Pakistan".

Cai, W., Wu, X., Zhou, M., Liang, Y., & Wang, Y. (2021). "Review and Development of Electric Motor Systems and Electric Powertrains for New Energy Vehicles". Automotive Innovation, 4(1), 3–22.

Clemente, M., Fanti, M.P., Ukovich, W. (2014). "Smart Management of Electric Vehicles Charging Operations: The Vehicle-to-Charging Station Assignment Problem". IFAC Proc. Vol. 47 (3), 918–923.

Dawn (2024, January 10). "Over 250 EV Charging Stations Operational in Pakistan".

Engineering Development Board. (2020, June). "Electric Vehicle Policy 2020-2025 (Draft): 2–3 Wheelers & Heavy Commercial Vehicles". Ministry of Industries and Production, Government of Pakistan.

Express Tribune (2024, February 22). "EV Charging Network Expands Across Pakistan".

Government of Pakistan, Ministry of Finance (2021).

Hall, D., & Lutsey, N. (2017). "Emerging Best Practices for Electric Vehicle Charging Infrastructure. The International Council on Clean Transportation". (ICCT): Washington, DC, USA, 54.

Haq, M. A. U., & Khan, H. (2025). Exploring the Role of Parental Barriers in Hindering Inclusive Education in South Punjab, Pakistan. ACADEMIA International Journal for Social Sciences, 4(2), 2269-2277.

Haq, M. A. U., & Rafiq, N. (2025). Analysis of the institutional barriers to inclusive education for diverse student needs in Pakistan. The Critical Review of Social Sciences Studies, 3(2), 372–382.

International Energy Agency (2023). "Global EV Outlook 2023: Catching up with Climate Ambitions".

International Energy Agency. (2023). "Net Zero Roadmap: A Global Pathway to Keep the 1.5° C Goal in Reach". Paris: IEA.

International Labour Organization. (2022). "World Employment and Social Outlook 2022: The Role of Green Jobs in Sustainable Development".

Khan, A., & Javed, N. (2022). "Designing Inclusive EV Infrastructure: Accessibility Issues in Pakistani Urban settings". Journal of Mobility and Urban Development, 8(4), 33–48.

Kiraz, G., Bali, J., & Forness, P. (2022). Chapter 14. "In 2 Maccabees According to the Syriac Peshitta Version with English Translation".

Lutsey, N. (2017). "Integrating Electric Vehicles Within U.S. and European Efficiency Regulations". International Council on Clean Transportation.

Malik, Z., & Shahid, M. (2022). "Range Anxiety and Infrastructure Mapping for EV Users in Pakistan: Policy Gaps and Technological Needs". Renewable Energy Policy Review, 6(1), 22–36.

Martins, L.S., Guimarães, L.F., Junior, A.B.B., et al. (2021). "Electric Car Battery: An Overview of Global Demand, Recycling and Future Approaches Towards Sustainability". J. Environ. Manag. 295, 113091.

Mastoi, M. S., Zhuang, S., Munir, H. M., Haris, M., Hassan, M., Usman, M., & Ro, J. S. (2022). "An In-depth Analysis of Electric Vehicle Charging Station Infrastructure, Policy Implications, and Future Trends". Energy Reports, 8, 11504–11529.

Mohanty, P. K., Pradhan, R., Jena, P., & Padhy, N. P. (2025). "Charging Innovation". Electric Vehicle Charging Infrastructures and Their Challenges, 25.

Münzel, C., Plötz, P., Sprei, F., & Gnann, T. (2019). "How Large is the Effect of Financial Incentives on Electric Vehicle Sales? —A Global Review and European Analysis". Energy

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DIALOGUE SOCIAL SCIENCE REVIEW

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https://doi.org/10.5281/zenodo.17611939

Economics, 84, 104-493.

Napoli, G., Polimeni, A., Micari, S., & Alaimo, C. (2019). "Optimal Electric Vehicle Charging Stations in a Highway Network: Part 2 – The Italian Case Study". Journal of Energy Storage, 26, 101015.

NEPRA (National Electric Power Regulatory Authority) (2023). "Electric Vehicle Policy Update and Regulatory Framework".

News International (2023, November 5). "Public-Private Partnerships to Power Pakistan's EV Growth".

Noor-A-Rahim, M., Liu, Z., Lee, H., Khyam, M. O., He, J., Pesch, D., Moessner, K., Saad, W., & Poor, H. V. (2022). "6G for Vehicle-to-everything (V2X) communications: Enabling Technologies, Challenges, and Opportunities". Proceedings of the IEEE, 110(6),

Pakistan Council of Renewable Energy Technologies (PCRET) (2023). "Monthly Progress Report on Electric Mobility and Renewable Integration in Urban Transport". Ministry of Science and Technology, Government of Pakistan.

Pakistan Economic Survey (2022). "Chapter 12: Energy". Ministry of Finance, Government of Pakistan.

Rehman, S., Akhtar, F., & Saeed, L. (2023). "Technical Standardization in EV Charging Stations: A Missing Link in Pakistan's Energy Policy". South Asian Journal of Energy Innovation, 9(3), 89–104.

Sun, X., Li, Z., Wang, X., & Li, C. (2019). "Technology Development of Electric Vehicles: A Review". Energies, 13(1), 90.

Ullah, N., Arshad, N., Khan, B. T., Javed, M. A., Arslan, M. M., & Qureshi, M. H. (2019). "Electric vehicles in Pakistan: Policy recommendations Volume I Cars". Energy Inst., Lahore Univ. Manage. Sci., Lahore, Pakistan, Tech. Rep.

United Nations Development Programme (2023). "Sustainable Energy Transition in Pakistan: Opportunities and Challenges".

Wang, S., Li, J., & Zhao, D. (2017). "The Impact of Policy Measures on Consumer Intention to Adopt Electric Vehicles: Evidence from China". Transportation Research Part A: Policy and Practice, 105, 14–26.

Zeng, X., Li, M., Abd El-Hady, D., Alshitari, W., Al-Bogami, A. S., Lu, J., & Amine, K. (2019). "Commercialization of Lithium Battery Technologies for Electric Vehicles". Advanced Energy Materials, 9(27).

Zulfiqar, M., Farooq, A., Usmani, Z., Zia, U. U. R., Ullah, S., & Babar, Z. B. (2024). "Pakistan's Electric Vehicle Market: Challenges, Opportunities, and Future Pathways". The Engineering Proceedings, 75(1), 15.