



USAID
FROM THE AMERICAN PEOPLE

PAKISTAN: ELECTRIC VEHICLES AND BATTERIES MARKET ASSESSMENT



PAKISTAN: ELECTRIC VEHICLES AND BATTERIES MARKET ASSESSMENT

————— CONDUCTED BY —————

**Lahore University of Management Sciences (LUMS) on behalf of
USAID**

PAKISTAN: ELECTRIC VEHICLES AND BATTERIES MARKET ASSESSMENT

CONTRACT INFORMATION

This program is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the terms of its requisition number REQ-391-21-000008.

PREPARED BY

Naveed Arshad
Nauman Ahmad Zaffar
Mohammad Abubakr Javed
Malik Muhammad Arslan

FOR MORE INFORMATION

LUMS Energy Institute, Syed Babar Ali School of Science and Engineering, Lahore University of Management Sciences, Sector-U, Phase-2, DHA, Lahore, 54792.
E-mail: naveedarshad@lums.edu.pk | Website: <https://lei.lums.edu.pk/>

SUBMITTED ON

August 06, 2021

DISCLAIMER

This document is prepared for the United States Agency for International Development (USAID) mission in Pakistan by Lahore University of Management Sciences on Contract No. AID-720-391-21-P-00012. The contents are not the responsibility of USAID, and do not necessarily reflect the views of the United States Government.

ACKNOWLEDGMENTS

The authors are grateful to the United States Agency for International Development (USAID) mission in Pakistan, particularly Jeffrey Humber, Kamran Niazi, Donald McCubbin, Sarah Parvez, Nadeem Habib, Imran Ahmed, and Rabia Bukhari for exceptional support and feedback.

It is also important to mention valuable support from LUMS in developing this report. In particular, we would like to thank Zumer Zia, M. Huzaifa Qasmi, and Hajra Bilal for supporting this work.

We would also like to acknowledge and thank the contributions made by more than 100 individuals and entities that we interacted with during the preparation of this report.

CONTENTS

1 INTRODUCTION TO THE VEHICLES AND BATTERIES MARKET IN PAKISTAN **10**

2 ASSESSMENT OF EV AND BATTERY POLICIES & REGULATIONS IN PAKISTAN **14**

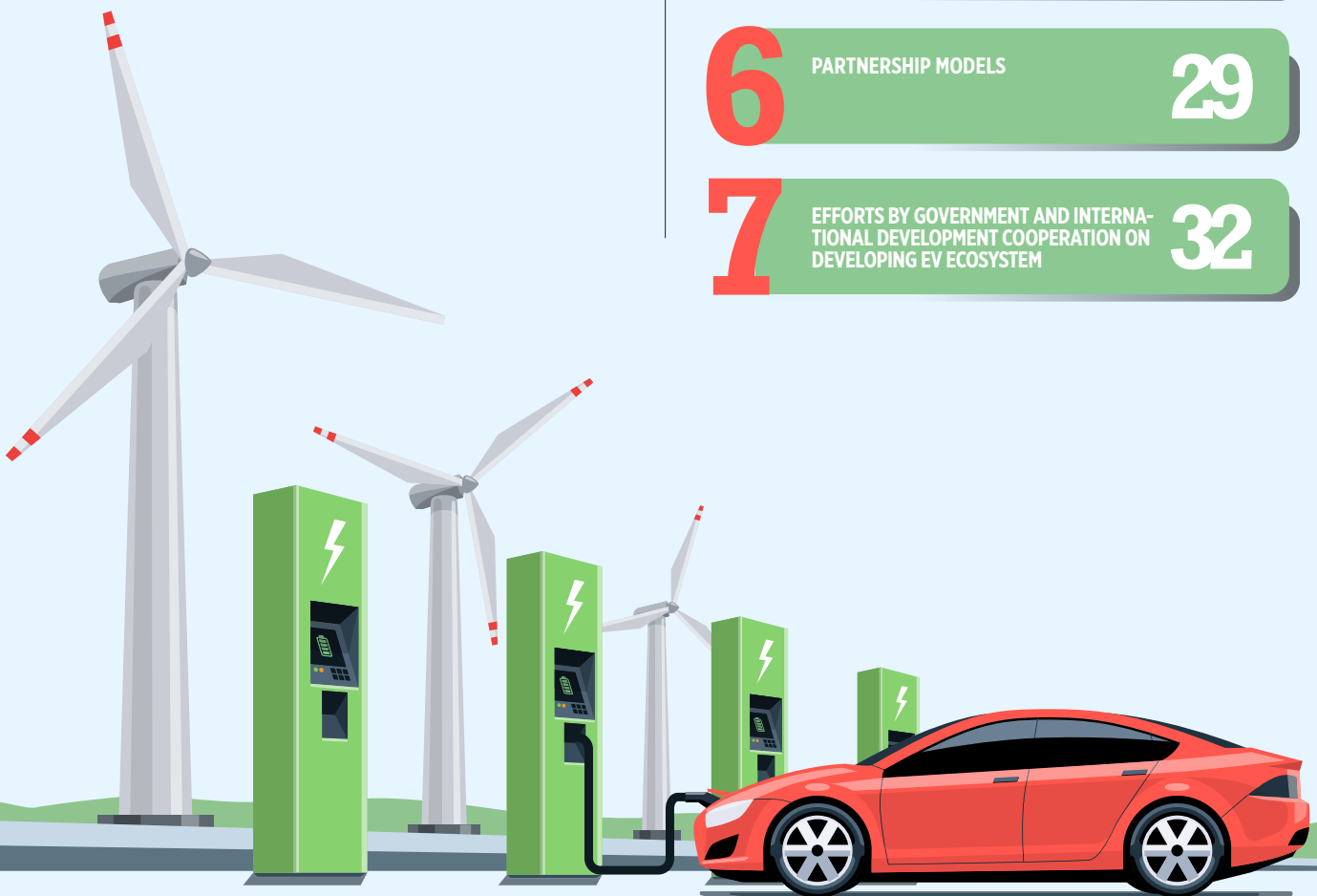
3 CHARACTERISTICS OF THE CURRENT AND FUTURE EV AND BATTERY MARKETS IN PAKISTAN **17**

4 FACTORS FOR SUCCESS IN THE MARKET **23**

5 INVESTMENT OPPORTUNITIES IN THE SHORT, MEDIUM AND LONG-TERM IN THE MARKET FOR EVS AND BATTERIES **25**

6 PARTNERSHIP MODELS **29**

7 EFFORTS BY GOVERNMENT AND INTERNATIONAL DEVELOPMENT COOPERATION ON DEVELOPING EV ECOSYSTEM **32**



List of Figures

Figure 1:	Total Registered Vehicle in Pakistan
Figure 2:	Current and Forecasted Power Demand and Supply

List of Tables

Table 1.1:	Indigenous Vehicle Production Numbers
Table 2.1:	Approved Incentives for Passenger Cars
Table 2.2:	Approved Incentives for Two & Three-Wheelers and Heavy Transport Vehicles (HTVs)
Table 3.1:	Current Electric Two-Wheeler Market in Pakistan
Table 3.2:	Current Electric Three-Wheeler Market in Pakistan
Table 3.3:	Current Electric Car Market in Pakistan
Table 3.4:	Current Electric HTV (Buses/Trucks) Market in Pakistan
Table 3.5:	Current Battery Market in Pakistan
Table 3.6:	Current Charging Infrastructure Market in Pakistan



LIST OF ACRONYMS

ACD	Additional Custom Duty	LSEV	Low Speed Electric Vehicle
AGM	Absorbed Glass Mat	LTV	Light Traffic Vehicle
AIDEP	Automotive Industry Development and Export Policy	MaaS	Mobility-as-a-Service
AREP	Alternative and Renewable Energy Policy	MoCC	Ministry of Climate Change
B2B	Business-to-Business	MoIP	Ministry of Industries and Production
BaaS	Battery-as-a-Service	MoST	Ministry of Science and Technology
BERC	Bangladesh Energy Regulatory Commission	MoU	Memorandum of Understanding
BMS	Battery Management System	MW	Megawatt
BoI	Board of Investment	MWh	MegaWatt Hour
BRT	Bus Rapid Transit	NCEV	National Center for Electric Vehicles
BRTA	Bangladesh Road Transport Authority	NDRMF	National Disaster Risk Management Fund
BTS	Base Transceiver Station	NEECA	National Energy Efficiency and Conservation Authority
CAPEX	Capital Expenditures	NEMMP	National Electric Mobility Mission Plan
CBU	Completely Built Unit	NEPRA	National Electric Power Regulatory Authority
CD	Custom Duty	NHA	National Highway Authority
CKD	Completely Knocked Down	NTDC	National Transmission & Despatch Company
CNG	Compressed Natural Gas	OEM	Original Equipment Manufacturer
EaaS	Energy-as-a-Service	OPEX	Operating Expenses
ECC	Economic Coordination Committee	PAPAAM	Pakistan Association of Automotive Parts & Accessories Manufacturers
EDB	Engineering Development Board	PBIT	Punjab Board of Investment and Trade
EIA	Environmental Impact Assessment	PHEV	Plug-in Hybrid Electric Vehicle
eTRU	Electric Transport Refrigeration Unit	PPP	Public-Private Partnership
EU	European Union	PSQCA	Pakistan Standards & Quality Control Authority
EV	Electric Vehicle	PSX	Pakistan Stock Exchange
FAME	Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles	PV	Photovoltaic
FDI	Foreign Direct Investment	R&D	Research and Development
FED	Federal Excise Duty	RD	Regulatory Duty
FY	Fiscal Year	SBP	State Bank of Pakistan
GDP	Gross Domestic Product	SEZ	Special Economic Zone
GHG	Greenhouse Gas	SKD	Semi Knocked Down
GoP	Government of Pakistan	SME	Small and Medium Enterprise
GST	General Sales Tax	STZ	Special Technology Zone
GWh	GigaWatt Hour	STZA	Special Technology Zones Authority
HACP	Honda Atlas Cars Pakistan	TAG	Tecno Auto Glass Limited
HEV	Hybrid Electric Vehicle	ToT	Transfer of Technology
HTV	Heavy Transport Vehicle	ToU	Time-of-Use
ICE	Internal Combustion Engine	TWh	TeraWatt Hour
IMC	Indus Motor Company	UNDP	United Nations Development Programme
JICA	Japan International Cooperation Agency	UPS	Uninterruptible Power Supply
JV	Joint Venture	USAID	United States Agency for International Development
KP-BoIT	Khyber Pakhtunkhwa Board of Investment and Trade	USD	United States Dollar
KPK	Khyber Pakhtunkhwa	VAT	Value Added Tax
kWh	KiloWatt Hour	VC	Venture Capital
LESCO	Lahore Electric Supply Company	WB	World Bank
Li-Ion	Lithium-ion	WTH	Withholding Tax
LRK	Sri Lankan Rupee		

EXECUTIVE SUMMARY

Pakistan is the 5th most populous country in the world and correspondingly has a large number of vehicles. The country has almost twenty-four million two and three-wheelers, four million passenger cars, and half a million buses and trucks. Presently, there are few electric vehicles (EVs) in the country, with almost two thousand all-electric passenger cars and around a dozen fast charging stations. The manufacturing of EVs and their parts is a nascent industry in the country. However, EVs are getting popular due to high petroleum prices and recently announced incentives by the Government of Pakistan (GoP) on promoting the adoption of electric means of transportation. The incentives by the GoP and the high interest of the general public in EVs have opened a new untapped market for the EV value chain in the country.

Electric Vehicle Targets, Policy, Incentives, and Support: The internal combustion engine (ICE) dominated transport sector of Pakistan has witnessed a significant increase in annual vehicular sales for the past several years. This has resulted in a notable rise of the gasoline import bill and has further aggravated air quality challenges associated with vehicular emissions. Owing to these challenges, the GoP has set targets to increase the segment-wise annual sales of EVs ranging between 30-50% of the total annual vehicle sales. To encourage EV adoption and indigenous manufacturing, the GoP has announced a set of incentives and tax breaks as summarized below:

1. EV specific parts like batteries, motors, motor control units, and others can be imported at 1% custom duty (CD) compared to the 25% CD for non-EV specific parts.
2. All indigenously manufactured EVs can be sold at 1% general sales tax (GST) compared to the standard 17% GST.
3. Duty-free import of machinery and hardware has been allowed to establish EV and EV specific parts manufacturing facilities.
4. The corporate income tax has been abolished for companies

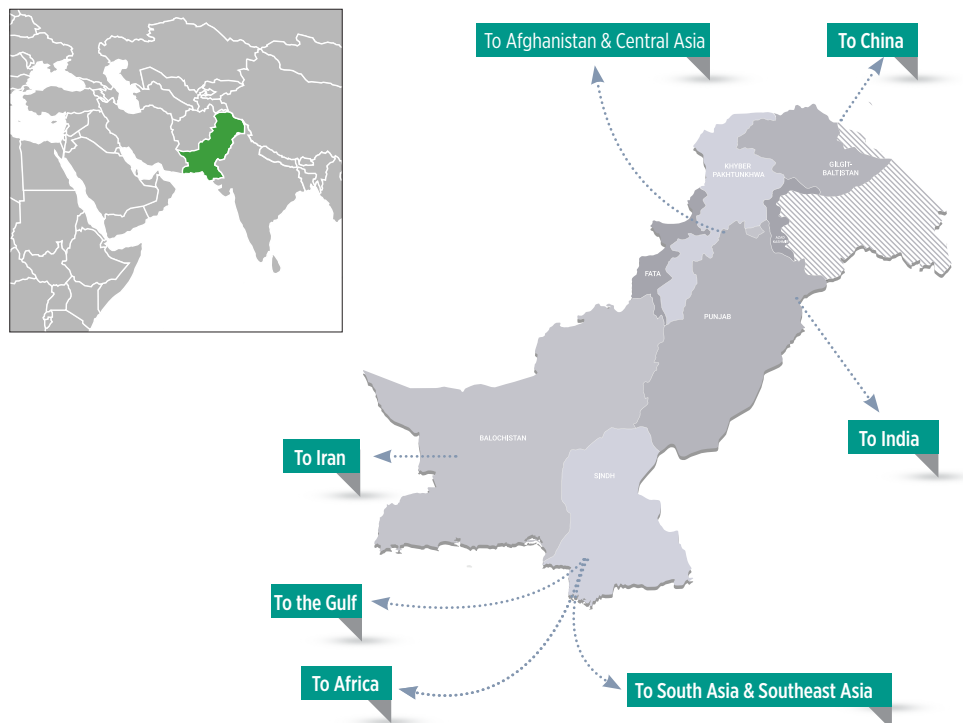
manufacturing EVs and EV specific parts.

5. The provincial governments have been directed to reduce the rates for registration of EVs and yearly token tax on these vehicles.

In addition to the above mentioned incentives and tax breaks, the GoP offers other facilities like prompt provisioning of electricity connections for charging stations and reduced electricity rates. These efforts by the GoP are supplemented by many international development cooperation agencies like USAID, World Bank, Asian Development Bank, United Nations Development Program, and others. These agencies assist in many technical areas, such as developing EV penetration scenarios, charging infrastructure deployment, financing, and standardization.

State of Electricity Supply and Demand: Pakistan has sufficient electricity generation capacity to meet all EV charging requirements in the short to medium-term. For instance, in 2019 Pakistan had 202 TWh of annual electricity generation capacity, whereas it utilized only 128 TWh. In 2025, due to many forthcoming electricity generation facilities, the country is expected to have 293 TWh of electricity generation capacity but is projected to utilize only 202 TWh. This leaves enough generation capacity to transition the transport sector to EVs without compromising the energy demands of other sectors.

Battery Market: Batteries are a key component of EVs. The EV penetration targets by the GoP will require 60-80 GWh of battery storage capacity. Additionally, Pakistan also has other sizable markets for stationary battery storage. Many consumers install uninterruptible power supply (UPS) systems to ensure reliable provisioning of electricity. Presently, the country has an estimated 2.8 million UPSs with approximately 6 GWh of battery storage capacity. Another significant storage need of the country is in the telecommunication sector. With a projected 17% annual increase in number of telecommunication towers,



KEY FACTS ABOUT PAKISTAN

POPULATION
225 million

TOTAL AREA
881,913 km²

GDP (NOMINAL)
USD 298 billion

MEDIAN AGE
22.8 years

¹ We consider the following four EV segments in this report: two-wheelers, three-wheelers, cars and HTVs (buses and trucks).

the country will have more than one hundred thousand such towers by 2025, requiring more than 3.5 GWh of battery storage capacity. The GoP has also set a target to increase the share of renewable (solar and wind) generation to 30% in the national energy mix by 2030. The bulk of this renewable addition, amounting to a total of ~7,300 MWp, will result in a further increase in demand for batteries to address intermittency associated with generation from renewable sources. Another market that needs battery storage is reefer trucks which require 144 MWh for operating 3,000 refrigerated containers currently functioning in Pakistan. Thus, based on the needs of multiple segments, Pakistan will need battery storage capacity of about 100 GWh in the next ten years. Currently, indigenously manufactured lead-acid batteries are widely used but the country needs new battery technologies for emerging needs.

Modes of Investment and Partnership Models in the EV Market: Most current and prospective EV market players are newly established companies and startups that require financial support and technological collaborations to meet international standards and projected demand. This creates a large room for various forms of investments and partnerships with indigenous and international companies. These investments and partnerships can occur in different modes such as venture capital funds, equity investment, transfer-of-technology, equity-for-technology, brand name licensing, joint venture, and foreign direct investment. Many international conglomerates in the ICE-based vehicular value chain have successfully tapped into various segments of the transport sector through these models of investment and collaboration with Pakistani companies and business groups.

Regional Export Opportunities from Pakistan: The strategic geographic location of Pakistan in South Asia provides many advantages. It offers a direct land route to China, Afghanistan, Iran and India and a short land route to Central Asia through Afghanistan. Pakistan also provides a convenient sea route to Africa, Persian Gulf, and South Asian countries. Most countries in these regions share similar characteristics of the transport sector with Pakistan, providing a valuable opportunity to export EVs and other associated components from Pakistan.

Key Market Success Factors: Certain key factors and characteristics of the vehicles' market in Pakistan make it different from the markets in the developed world. Understanding the following such factors and characteristics is needed to succeed in the emerging EV market in Pakistan:

1. **Segment Specific Characteristics** must be considered for EVs. Based on the experience of ICE-based vehicles, the two and three-wheeler segments are highly price sensitive. Therefore, most automobile manufacturers focus on lowering the cost by developing simple and no-frills products in this segment. In the passenger car segment, the lower-end vehicles are typically no-frills and hence low cost. To keep the prices low, such cars have smaller engine capacities and do not offer sophisticated infotainment systems, plush seats, climate control features, etc. However, the customers of the high-end vehicles are less price savvy and are willing to pay a premium on luxury and high-tech features.
2. **Customized Financing Schemes** are needed to reduce the upfront purchase price of EVs. Financing schemes need to be designed so that the down payment of EVs is less than their ICE-based equivalents and periodic installments are less than the savings accrued from lower driving cost per mile of EVs.
3. **Segment Specific Placement and Development of Charging Infrastructure** is required for faster EV adoption. Unlike a gasoline station that serves all types

of vehicles, each EV segment follows a different charging standard. In addition to charging standard, the charging needs may also be different. Therefore, adequate penetration of charging infrastructure based on the requirements of each segment is a fundamental condition for EV acceptance among the general public.

4. **3S** i.e., Sales, Service and Spare parts, are frequently required once vehicles age. In Pakistan, most vehicles are used for 2-3 decades before being taken off the road. Therefore, a widely established 3S network ensures convenient availability of vehicular parts as well as repair services. This also increases the resale value of used vehicles, which is an important factor influencing purchase decisions.

Short-term Investment Opportunities: In the short term of next three years, various opportunities in EVs and batteries market are available in Pakistan. With better unit economics, commercial vehicles of all kinds are the first contenders for transition to EVs. This includes all sizes of commercial vehicles that move passengers and cargo within cities. Opportunities in public transport, including domestic buses with around 250 km of range, are also open for transition to EVs. The market for personal passenger vehicles, that includes two-wheelers, sport utility vehicles (SUVs), sedans and high-end luxury two-wheelers, also has substantial investment opportunities. Low-speed electric vehicles (LSEVs), available under USD 10,000, form an important vehicular segment with considerable opportunities for investment. The establishment of charging infrastructure in cities and along the length of motorways and highways will also accelerate due to the charging requirements of a growing number of EVs, thus providing another business opportunity.

A large market is open for EV batteries and other storage needs. Finally, to meet the demands of the EV industry, a market of high-efficiency motors, motor control units, electronics, and software is also emerging. Smart mobility platforms that meet the needs of EVs and solve local transport challenges is also among the first set of opportunities.

Medium-term Investment Opportunities: In the medium term of next three to five years, EV prices are expected to drop. With an established network of charging stations, EV penetration will be ubiquitous. This will open up the EV market for all passenger vehicle segments. Medium range EV buses having a range of 450 km will provide connectivity to cities and towns farther away from one another.

Long-term Investment Opportunities: In the long-term horizon spanning five to ten years, there will be an opportunity for battery cell manufacturing in Pakistan to meet the growing needs for storage in EVs and other industries. Two-wheeler market is the largest vehicular market in Pakistan today and many companies are vying for it. The two-wheeler market is highly price sensitive and will hugely grow when EV prices reach parity with ICE-based equivalents. Finally, like the rest of the world, long distance transport of freight and passengers will open up with long range EVs and faster charging technologies.

Conclusion: Pakistan stands out as an attractive emerging market for EVs in the developing world. Presently, the EV value chain provides a level playing field for the new or existing market players. Like the shift to compressed natural gas (CNG) operated vehicles, history shows that the Pakistani market enthusiastically embraces the 'Jones Effect' after crossing the initial technology adoption curve. Therefore, the early entrants may be best positioned to reap the benefits of a large market in Pakistan and export prospects in regional countries.

INTRODUCTION

Pakistan has a population of almost 225 million with a sizable road-transport sector ^[1]. According to The World Factbook by the CIA, Pakistan has the 22nd largest road network in the world ^[15]. National Highway Authority (NHA) estimates the total length of the road network in Pakistan to be 263,775 km, of which 12,131 km comprises of highways, motorways, expressways, and other strategic routes ^[2]. Due to limited air and rail coverage, their share for domestic travel is negligible compared with road-transportation.

Almost 62% of Pakistan's population are city dwellers and 40% of this segment resides in 26 metropolises of 300,000 residents or more. Mass transit is available in five large cities only. Due to the absence of mass transit in most cities, most people depend on personal transport vehicles like two-wheelers and passenger cars, while three-wheelers, vans, and buses are the only modes of commercial transport.

INTRODUCTION TO THE VEHICLES AND BATTERIES MARKET IN PAKISTAN



1.1 SIZE OF THE ROAD-TRANSPORT SECTOR IN PAKISTAN

The per capita income typically determines the number and types of vehicles in a given country. The per capita income of Pakistan is ranked 129th in the world at USD 1,542. Consequently, two-wheelers have the largest share among all vehicle segments due to their significantly lower purchase price. Similarly, three-wheelers also enjoy a strong foothold in the transport sector due to lower upfront price and lack of last mile connectivity by buses and mass transit. Cars are mainly owned by the high-income segment of the population since, upfront price and driving expense of most cars are beyond the economic means of most of the population. While buses offer limited spatial coverage for local commute, they are the preferred mode of public transport for domestic travel. Pakistan also has a sizable market for trucks of varying sizes that are utilized for local and domestic freight transport. *Figure 1* shows the cumulative number of registered vehicles in the country during 2020, classified into vehicular categories:

two-wheelers, three-wheelers, cars, buses, and trucks ^[6].

Vehicle Manufacturing: Presently, Pakistan has a well-developed automotive manufacturing and assembling industry that focuses primarily on ICE-based vehicles. Almost all two and three-wheelers are indigenously manufactured in Pakistan. Most vehicles in the passenger cars' segment are indigenously built except hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and high-end luxury vehicles. Most buses are imported into the country, while most trucks are locally produced other than large trailer trucks. *Table 1.1* shows the annual production numbers of indigenously manufactured vehicles ^[7].

Vehicle Exports: Major export markets from Pakistan are Central Asia, South Asia, Southeast Asia, and Africa. These markets have a similar transportation landscape as that of Pakistan, which makes them ideal for export.² There is also considerable untapped potential for vehicular export from Pakistan due to its strategic geographical location.

FIGURE 1: TOTAL REGISTERED VEHICLES IN PAKISTAN (IN MILLIONS)



²Appendix 1.1 shows annual vehicle export numbers ^[7].

TABLE 1.1: INDIGENOUS VEHICLE PRODUCTION NUMBERS

Year	Two-Wheelers	Three-Wheelers	Cars	Buses	Trucks	Tractors
2015-16	2,060,385	57,675	218,948	1,394	6,648	33,982
2016-17	2,473,687	84,300	217,973	1,339	9,097	47,799
2017-18	2,761,747	109,651	264,418	1,056	9,350	71,894
2018-19	2,437,871	118,450	244,196	1,139	6,130	49,902
CAGR(%) ³	8.3	22.5	7.4	4.0	6.7	2.13

Vehicle Imports: Most automobiles imported in Pakistan as completely built units (CBUs) are often luxury or high-end vehicles. The majority of other vehicles are imported in the form of completely knocked down (CKD) or semi knocked down (SKD) kits, assembled in the country with some indigenously manufactured auto parts. In 2018, the GoP banned the import of used vehicles for promoting local manufacturing. As a result, vehicle import numbers witnessed a sharp decline and the number of indigenously built vehicles increased.⁴

1.2 SIZE OF THE BATTERIES MARKET IN PAKISTAN

In addition to the large size of the transport sector, Pakistan also has a vast market for batteries that is primarily dominated by lead-acid batteries. Presently, battery storage is used in Pakistan in the following key applications:

a. **Uninterruptible power supplies (UPSs)** have achieved widespread penetration in residential and commercial sectors to provide power backup when the electricity supply from the grid is unavailable. Despite having surplus generation capacity, Pakistan has a weak electricity distribution network resulting in frequent power cuts. All UPSs store energy from the grid in batteries and

act as power reserves during periods of power unavailability. According to an estimate, there are almost 2.8 million UPSs in Pakistan, with each UPS having an average name plate storage capacity of 2 KWh, totaling 6 GWh^[5].

- b. **Solar PV** installations have witnessed exponential growth in residential and commercial/industrial sectors to cater the unreliable provision of electricity from the grid and its rising tariff. Most solar PV installations are accompanied by battery storage solutions to store surplus energy and also act as UPS during power shortfall. Presently, the installed solar PV capacity in the country is almost 202 MWp and Alternative and Renewable Energy Policy 2019 of the GoP aims to increase the renewable (solar and wind) share to 30% in the overall national energy mix^[10]. The bulk of this renewable addition, amounting to a total of ~7,300 MWp, will be catered through solar PV technologies, resulting in a further increase in demand for batteries to address intermittency associated with generation from renewable sources.
- c. **Base transceiver stations (BTSs)** employ energy storage solutions in the form of batteries to provide backup during the time of power shortfall. The telecommunication sector in Pakistan

KEY FACTS ABOUT THE TRANSPORT SECTOR IN PAKISTAN

131
Vehicles per 1000 people

53%
households own two-wheelers

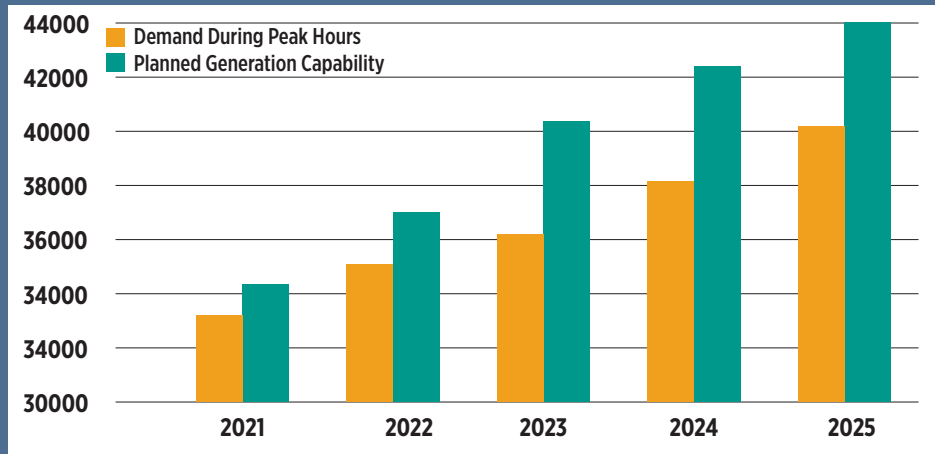
9%
households own cars

Transport sector contributes almost **13%** of Pakistan's GDP

Transport sector contributes almost **5%** of the overall employment

³ CAGR: Compound annual growth rate.
⁴ Appendix 1.2 shows annual vehicle import numbers^[11].

FIGURE 2: CURRENT AND FORECASTED POWER DEMAND AND SUPPLY (IN MW)



is a sizeable market for batteries. As of 2020, there are almost 47,000 BTSs in Pakistan. Presently, all BTSs in the country employ an estimated 164 MWh of lithium-ion battery capacity and 1.6 GWh of Absorbed Glass Mat (AGM) battery capacity. BTS installations are expected to reach 103,000 units by 2025 due to rapid growth in the telecommunication sector in Pakistan, creating an accelerated demand of ~3.5GWh of lithium-ion battery capacity [7].

- d. **Electric vehicles'** share in the annual vehicular sales is targeted to reach 30-50% by 2030. This requires 60-80 GWh of storage capacity in the form of batteries over the next 9 years.
- e. **Reefer trucks** transport temperature-sensitive goods such as vegetables, fruits, meat, seafood, medicines, etc. Reefer trucks contain a refrigerated unit to maintain the temperature. Almost 3,000 reefer trucks in Pakistan require about 144 MWh of battery storage capacity to operate the refrigerating units. With a growing population, the demand for battery storage for reefer trucks is anticipated to grow proportionally.

1.3 ELECTRICITY SUPPLY AND DEMAND SCENARIOS FOR SUPPORTING EV CHARGING

Since 2016, rigorous generation capacity

expansion has resulted in an ample generation capacity in Pakistan. In 2019, Pakistan had 202 TWh of annual energy generation capacity, utilizing only 128 TWh. By 2025, due to many forthcoming power generation projects, the country is expected to have 293 TWh of energy generation capacity but is projected to utilize only 202 TWh. This leaves enough excess capacity to transition to EVs without compromising the demands of other sectors. Figure 2 shows current and forecasted power demand and supply in Pakistan [3].

Pakistan's existing transmission capacity is almost 22,000 MW, which is projected to reach 26,000 MW by 2024. However, around 99% of the time, the transmission capacity is not constrained as the transmission system touches its peak capacity only during certain hours of summer months. Therefore, the existing and planned transmission network has sufficient capacity to support charging requirements under almost all projected EV adoption scenarios.⁵

For the distribution network, time-of-use (ToU) pricing can serve as an effective tool in promoting vehicular charging during off-peak hours. Implementation of ToU pricing models can significantly limit the burden on the distribution network due to vehicular charging. The National Electric Power Regulatory Authority (NEPRA) plans to provide special EV charging tariffs which would be cheaper than regular electricity tariffs and utilize ToU pricing to optimize the EV load on

⁵Appendix I.3 shows planned transmission capacity expansion projects under the jurisdiction of NTDC [9].

the distribution system.

1.4 ENVIRONMENTAL DRIVERS OF ELECTRIC MOBILITY IN PAKISTAN

The Global Climate Risk Index ranks Pakistan as the 5th most vulnerable country due to climate change ^[11]. According to a report by IQAir-AirVisual, key cities of Pakistan: Gujranwala, Faisalabad, Lahore, and Peshawar, have been ranked among the 30 most polluted cities in the world ^[12]. Similarly, according to a report by the United Nations Development Programme (UNDP), Pakistan is the 7th most vulnerable country to climate change due to which it is projected to lose around USD 3.8 billion and 0.6 % of its GDP annually ^[13].

In Pakistan, the environmental challenges associated with the road-transportation have a high significance due to several reasons. Pakistan is reliant upon euro 2 fuel standards which have excessively higher emission content. The GoP has issued directives to shift to euro 5 fuel standards from August 2020, which is underway ^[14],⁶

In addition, old vehicles having poor hydrocarbon conversion efficiency are prevalent on roads. Many two-wheelers and three-wheelers in Pakistan employ 2-stroke engines with lower efficiency than relatively new 4-stroke engines. Keeping in view the sheer size of the two-wheeler and three-wheeler segments, they result in exorbitantly higher emissions than other vehicle categories.⁷ Furthermore, catalytic converters are not prevalent, especially in the two-wheeler, three-wheeler, and Heavy Transport Vehicle (HTV) segments. A combination of the aforementioned factors and characteristics of Pakistan's transport sector result in the release of pollutants in higher concentrations.⁸ Due to zero emissions from EVs, the air quality in cities will improve substantially. Furthermore, based on the electricity generation mix of Pakistan, overall well-to-wheel emissions will reduce by 70%.

1.5 ECONOMIC DRIVERS OF ELECTRIC MOBILITY IN PAKISTAN

Pakistan is seeking to become self-reliant and currently suffers from a trade deficit in large part due to the import of petroleum products.⁹ Gasoline (petrol) is the most commonly used fuel in Pakistan for transportation purposes, especially for two-wheelers, three-wheelers, and passenger cars, whereas HTVs use diesel as the primary fuel. As of FY 2019-20, almost 70% of gasoline (petrol) requirements are met through import, while 35% of the diesel used in Pakistan is imported. The GoP has introduced a set of policy directives to reduce this dependence on imported fuel and its corresponding impact on forex reserves.

The transport sector in Pakistan is the largest consumer of petroleum, followed by the energy sector.¹⁰ There has been an increasing presence of HEVs in Pakistan, particularly in the segment for passenger vehicles. Still, to fully realize the increased efficiency of electrified transport, the focus is on the introduction of all-electric vehicles. There are almost 2,000 passenger EVs on roads as of mid-2021, with less than a dozen fast-charging stations. A transition towards electric means of transportation will result in a substantial decrease in the import bill for petroleum and overall emissions in the country due to higher hydrocarbon conversion efficiency of EVs.



⁶ Appendix 1.4 shows the emission profile of euro 1-6 compliant gasoline (petrol) and diesel ^[24].

⁷ Appendix 1.5 shows a comparison of mean emissions by different vehicle categories in Pakistan ^[14].

⁸ Appendix 1.6 shows per capita emissions in Pakistan from the transport sector compared with other regional countries.

⁹ Appendix 1.7 shows the value of total imports, import of petroleum and trade deficit for FY 2017-18, 2018-19 and 2019-20 ^{[28],[29],[4]}.

¹⁰ Appendix 1.8 shows the percentage share of different sectors in the consumption of petroleum in Pakistan ^[20].

INTRODUCTION

The ICE-based transport sector of Pakistan is a key contributor towards deteriorating air quality and rising trade deficit due to burgeoning demand for petroleum. To this end, the GoP decided to kick-start EV value chain in the country by incentivizing electric mobility through a range of incentives, regulations, and policies.

ASSESSMENT OF EV AND BATTERY POLICIES & REGULATIONS IN PAKISTAN



2.1 EV PENETRATION TARGETS BY PRIME MINISTER'S COMMITTEE ON CLIMATE CHANGE

The Prime Minister's Committee on Climate Change, during its first meeting on May 17, 2019, approved mandatory EV penetration targets^[8]. The committee further directed development of an incentive package to stimulate EV penetration in the country aggressively.

2.2 EV POLICY AND REGULATION

To achieve the EV penetration targets, the GoP approved the 'Electric Vehicle & New Technology Policy 2020-2025' in April 2020.¹¹ The Electric Vehicle & New Technology Policy 2020-2025 aims at promoting non and low hydrocarbon-based technologies for transportation purposes through incentives for end-users and manufacturers. The policy aims to reduce emissions from the transport sector and create an indigenous industrial base to develop the EV value chain.

In contrast to offering direct consumer subsidies, the policy provides rebates, tax breaks, and other concessions to encourage the adoption of environment-friendly vehicles. The policy provides incentives for EVs, HEVs, PHEVs, and alternative fuel vehicles. Vehicular categories addressed by the policy include two-wheelers, three-wheelers, cars, buses, and trucks. Policy incentives are extended to stimulate new investment

in the development of next-generation technologies, automotive parts manufacturing, facilitating new entrants in the respective industry, and the development of charging infrastructure. Requisite interventions by relevant government departments/agencies, particularly in developing EV standards, are also highlighted in the policy.

2.3 APPROVED POLICIES AND INCENTIVES FOR TWO & THREE-WHEELERS, PASSENGER CARS, AND HEAVY TRANSPORT VEHICLES

The Economic Coordination Committee (ECC) approved recommendations for electric two and three-wheelers and HTVs in December 2020 and for passenger cars in June 2020. *Table 2.1* and *2.2* present the incentives for various vehicular types that have been approved by the ECC, the federal cabinet, vetted by the National Assembly of Pakistan, and included in the official notifications of the Finance Acts of 2020-21 and 2021-22. Following the notifications, a number of companies across all vehicular segments have started their operations. Many companies have received manufacturer license for starting indigenous production.

GENERAL INCENTIVES FOR DIFFERENT TYPES OF VEHICLES

- Indigenous development of parts and components to be reviewed after 2 years of the announcement of policy.

¹¹ <http://engineeringpakistan.com/electric-vehicle-policy/>

TABLE 2.1: APPROVED INCENTIVES FOR PASSENGER CARS

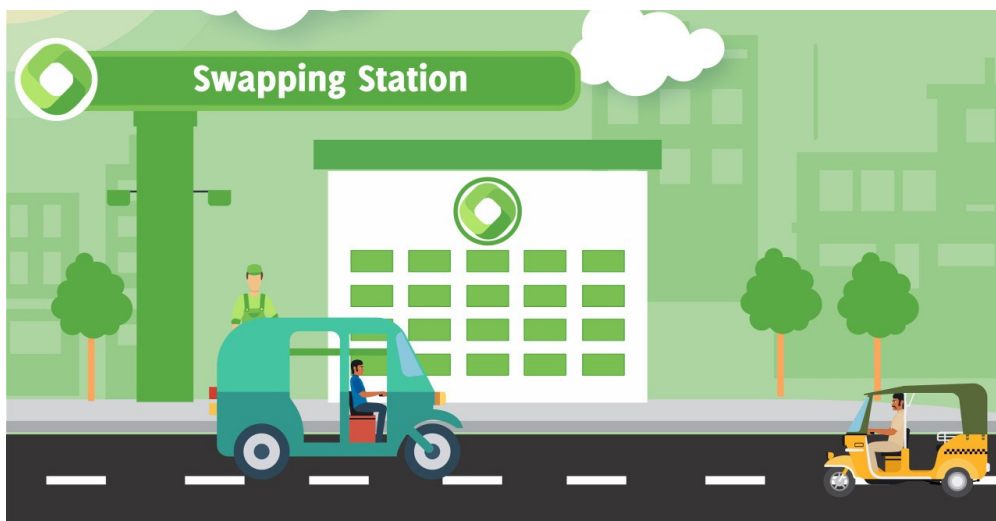
TYPES	INCENTIVES FOR PASSENGER CARS
CBUs	<ul style="list-style-type: none"> Import allowed at 25% Custom Duty (CD), 0% Additional Custom Duty (ACD), 0% Regulatory Duty (RD), 0% Value Added Tax (VAT) and 0% Federal Excise Duty (FED) Import of 100 CBUs per company @ 50% of the prevailing CD rate
CKDs	<ul style="list-style-type: none"> Import of EV specific parts including batteries, motors, motor control units and peripheral electronics allowed at 1% CD, 0% ACD, 0% RD, 0% VAT and 0% FED Import of CKD kits for small cars/SUVs with 50kWh battery or below and LCVs with 150kWh battery; <ul style="list-style-type: none"> Exemption on sales tax and VAT on import and 1% sales tax on sales 1% Withholding Tax (WTH) Exemption on GST and VAT at import stage
Manufacturing Plant and Machinery	Duty free import allowed at 0% CD, 0% ACD and 0% RD
EV Chargers	Import allowed at 1% CD, 0% ACD and 0% RD
Registration and Annual Renewal Fee	Reduced rate based on provincial policies
Financing	Financing allowed at 1+5% (State Bank of Pakistan)

- Duty- and tax-free import of plant and machinery to be allowed to both; existing and new entrants.
- Five-year income tax exemption for auto parts manufacturers who set up manufacturing facilities for EV related equipment in Pakistan.
- Raw materials used for EV-related manufacturing purposes to be exempted from duties and taxes for 5 years (applies

to in-house manufacturing by OEMs).

2.4 EV POLICIES AND REGULATIONS ACROSS REGIONAL COUNTRIES

To better analyze EV policies and regulations in Pakistan in the regional context, it is prudent to explore and compare policies and regulations dictating the development of EV



EV PENETRATION TARGETS



2025

100,000

2030

30% of new sales



2025

500,000

2030

50% of new sales



2025

1,000

2030

50% of new sales



2025

1,000

2030

30% of new sales

TABLE 2.2: APPROVED INCENTIVES FOR TWO AND THREE-WHEELERS AND HEAVY TRANSPORT VEHICLES (HTVS)

TYPES	INCENTIVES FOR TWO & THREE-WHEELERS	INCENTIVES FOR HTVS
CBU s	Import of 200 units allowed at a concessionary duty rate (50% of prevailing rate of CD) with the condition of establishing local manufacturing facilities.	Import allowed at 1% CD
CKDs / EV Specific Parts	EV specific parts import allowed at 1% CD for five years	CKD imports allowed at 1% CD for local assembling/manufacturing
Sales Tax	Waived at import stage	Waived at import stage.
Registration and Annual Renewal fee	<ul style="list-style-type: none"> Reduced registration rate based on provincial policies Toll tax reduced to 50% 	<ul style="list-style-type: none"> Reduced registration rate based on provincial policies Complete waiver for annual token tax and permits

value chain across regional countries.¹²

Unlike India and Pakistan, Bangladesh and Sri Lanka offer lesser incentives and regulatory roadmap for developing and promoting the EV value chain. India offers an elaborate set of policies, regulations, and fiscal and non-fiscal incentives to encourage EV adoption and the development of an EV value chain. However, unlike Pakistan, India has mainly adopted a decentralized approach. Despite demand and supply-side fiscal incentives offered by the Government of India through the National Electric Mobility Mission Plan (NEMMP) and subsequently Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME)-1 and FAME-2 programs,

most policies, incentives, and regulations are under the jurisdiction of state governments. Though certain states have developed and implemented such programs, many are still juggling to create them.

Therefore, a more appropriate approach is to provide uniform incentives and develop a consistent legal and regulatory framework across the entire country. In contrast, EV policies and regulations in Pakistan provide a standardized structure and facilitate the development of platforms for manufacturing EVs, EV components, setting up of charging infrastructure, and developing smart mobility solutions that are uniform across the country.



¹² Appendix 2.1, 2.2, and 2.3 present EV-related policies, regulations, and incentives offered in India, Bangladesh, and Sri Lanka respectively.

INTRODUCTION

The approval of the Electric Vehicle & New Technology Policy 2020-2025 provides a range of incentives for EV and parts manufacturers. As a result, over the last two years a large number of companies have started EV manufacturing. Most of these companies are startups that are looking to capture the future market for EVs. The current and future EV and battery markets are characterized by ambitious small and medium-sized enterprises (SMEs) with vast potential for investment and collaboration with other national and international players. This chapter explores key characteristics of Pakistan's current and future EV markets and potential investment and collaboration opportunities.

CHARACTERISTICS OF THE CURRENT AND FUTURE EV AND BATTERY MARKETS IN PAKISTAN



3.1 MARKET FOR ELECTRIC TWO-WHEELERS

CURRENT MARKET FOR ICE-BASED TWO-WHEELERS

To understand the development of the electric two-wheeler market, it is crucial to know specific characteristics of the current ICE-based two-wheeler market. There are almost 22 million two-wheelers in Pakistan, manufactured by over 100 mostly indigenous companies. Almost 99% of the two-wheeler market comprises the following three vehicle categories based upon engine capacity: 70cc, 100cc, and 125cc. Vehicles in these categories have a minimalistic design and offer only essential features to keep the purchase price low. A key trait of the two-wheeler market is that all vehicles belonging to a particular category have almost identical parts, components, chassis, and outlook. All parts and components are supplied locally through a uniform supply chain. This important trait of the two-wheelers provides many advantages. Most parts and components are readily available in the aftermarket and are interoperable among the same category of vehicles. Thus, repair centers can provide effective services for vehicles from all manufacturers. This creates a strong market for used vehicles, thereby improving the resale value. About 1% of the two-wheeler market comprises of vehicles having 200cc and above engine capacity and are mostly imported into the country.

CURRENT ELECTRIC TWO-WHEELER MARKET

A few new companies have started manufacturing electric two-wheelers based on the frame of ICE-based two-wheelers. Companies primarily use a

common frame to keep the prices low and use the existing parts and accessories value chain. Batteries, electric motors and motor control units are the components that distinguish electric two-wheelers from their ICE-based counterparts. A new parts and repair services ecosystem for these components is being established. The market for luxury electric two-wheelers is limited and only one local manufacturer is developing vehicles for this category.

All motors and motor control units used in the current market for electric two-wheelers are imported. Similarly, battery packs are also imported, but a few companies are assembling battery packs using imported lithium-ion cells. Due to the import of these components, the average price of current electric two-wheelers is almost double the average price of their ICE-based counterparts.

Presently, there are no commercial-scale charging facilities for the electric two-wheelers. Therefore, all manufacturers provide a slow home-based charger with the vehicles. These chargers can take up to 8 hours to completely charge the battery and provide a 65-120 km driving range. Electric two-wheelers provide up to 80% lower running cost. Presently, around 3,000 electric two-wheelers are on roads in Pakistan. Table 3.1 shows electric two-wheeler models that are available in the market along with their key characteristics.

FUTURE ELECTRIC TWO-WHEELER MARKET

Like the current electric two-wheeler market, the future market for electric two-wheelers will also be dominated by low-cost vehicles providing essential features only and utilizing parts (non-

TABLE 3.1: CURRENT ELECTRIC TWO-WHEELER MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS			PRODUCTION CAPACITY/MONTH
		PRICE (USD)	BATTERY (KWH)	RANGE (KM)	
JOLTA Electric	JE-50	433	1.8	50-60	3,000
	JE-70 D	526	2	60-80	
INER-Z	Alpha	<620	-	65	6,000
Mega Electric	JE-Sports (Luxury)	1,240	2.5	80	-
Teleport	T1	<1,240	1.75-2.6	100-120	15
Indus Motors	Retrofit Kits	<620	2.4	70	3,000
Elite Auto Industries	Swari Electric	930	1.5	75	-
Super Star Motorcycle	E-Bike	-	-	80	-
Sunra Pakistan	E-Bike	<1,240	1.5	75	100

EV specific) from the existing ICE-based two-wheeler segment. Additionally, almost all electric two-wheeler models in the future market will offer a similar average driving range, battery capacity and charger rating like the models in the current electric two-wheeler market. Similarly, like the current electric two-wheeler models, most future models of electric two-wheelers will utilize lithium-ion batteries. However, a large number of prospective entrants in the future market have shown interest in in-house development of motors, motor control units, battery packs and battery management systems (BMSs). Indigenous development of these modules is projected to further narrow the gap between the purchase price of electric two-wheelers and their ICE-based equivalents. As a result, the average price of the upcoming electric two-wheeler models is projected to be lower than the current electric two-wheeler models. Some automotive manufacturers are developing retro-fit kits to convert existing ICE-based two-wheelers to EVs by replacing the engine with battery, motor, and other associated hardware to offer low-cost electric mobility solutions. The projected cost of these retro-fit kits (excluding

batteries) for two-wheelers is about USD 200-250.¹³

3.2 MARKET FOR ELECTRIC THREE-WHEELERS

CURRENT MARKET FOR ICE-BASED THREE-WHEELERS

Like the two-wheeler segment, it is prudent to explore certain key traits of the current ICE-based three-wheeler market that dictate the development of their electric counterparts. The three-wheelers are a prevalent mode of transportation for commercial purposes. Presently, there are close to one million three-wheelers manufactured by over 45 automobile manufacturers. There are two types of three-wheelers: passenger transport vehicles and loaders (used for last mile freight delivery). The three-wheelers of each type share similar design, parts, components, and engine ratings. Almost all three-wheelers used for passenger transport have an engine capacity of 200-250cc, while the three-wheeler loaders typically have an engine

OPPORTUNITIES IN ELECTRIC TWO-WHEELER MARKET

The anticipated decline in the price of electric two-wheelers due to indigenous development of motors, motor control units, battery packs and BMSs is projected to spur widespread EV adoption among this popular vehicle segment due to projected price parity between electric and ICE-based two-wheelers and much lower running cost offered by the former. The market size of the current two-wheeler segment has witnessed an average annual growth of 8.3% from FY 2014-15 to 2018-19.¹⁴ The size of the two-wheeler segment is projected to grow at a similar rate in the foreseeable future. With only a few thousand electric two-wheelers presently in the transport sector, there is a vast untapped market for potential investors.

Almost all current and potential entrants in the electric two-wheeler category are newly established ventures with limited capital for increasing production capacities to meet projected demand and limited resources to conduct extensive research and development. These electric two-wheeler manufacturers can benefit from capital injection to accelerate production efforts and meet the projected demand. Therefore, most players in electric two-wheeler manufacturing are actively seeking partnerships through equity investment, joint ventures and other forms of collaboration.

¹³ Appendix 3.1 shows the characteristics of the future electric two-wheeler market in Pakistan.

¹⁴ Table 1.1 shows CAGR of indigenously developed vehicles from each segment.

OPPORTUNITIES IN ELECTRIC THREE-WHEELER MARKET

The current ICE-based three-wheeler segment has experienced a rapid average annual growth of about 22.5% from FY 2014-15 to 2018-19, creating a large, unexplored opportunity for prospective electric three-wheeler manufacturers. Most players in the current and future market for electric three-wheelers are young companies. These companies require financial support that national and international investors can pour in in the form of equity investment, venture capital funds or other modes of financial investment. Additionally, these newly established companies are actively seeking technical collaborations with national and international players for research and development, upgradation of manufacturing facilities and product designing.

TABLE 3.2: CURRENT ELECTRIC THREE-WHEELER MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS			PRODUCTION CAPACITY/MONTH
		PRICE (USD)	BATTERY (KWH)	RANGE (KM)	
Sazgar Engineering Works Ltd	Ecorik Ecorik+	3,000	6	125	2,000-4,000
		3,400	7.7	170	

capacity of 150-200cc. All three-wheelers carry a minimalistic design, offering essential features only. The local automotive parts industry for three-wheelers has achieved sufficient maturation. Almost all parts except the engine used in the three-wheelers are developed by indigenous Original Equipment Manufacturers (OEMs), resulting in lower upfront cost.

CURRENT ELECTRIC THREE-WHEELER MARKET

Like the current ICE-based three-wheeler market, the current market for electric three-wheelers offers minimalistic design and features of vehicles to keep the purchase price low. Other than the EV specific parts and modules (batteries, motors, motor control units, battery packs and BMS), most other parts utilized in the existing models of electric three-wheelers are interoperable with their ICE-based equivalents to keep the upfront purchase price of vehicles low and ensure availability of parts in the aftermarket.

All EV specific parts utilized in the current electric three-wheeler market are imported. All current electric three-wheeler models in the market utilize lithium-ion based batteries which are primarily imported. Since, the three-wheelers traverse much longer distances than private vehicles, all current electric three-wheeler models employ batteries with larger capacities. Due to import of EV specific parts and modules and employment of relatively larger battery capacities, the price of electric three-wheelers is on average twice their ICE-based equivalents. The price of ICE-based three-wheelers (loader and passenger vehicles) ranges between USD 1300-1700, whereas the price of electric three-wheeler models in the current market ranges between USD 2,200-3,400. Due to the lack of commercial-scale fast charging infrastructure for electric three-wheelers, all manufacturers offer slow home-based chargers. Typically, it

takes 8-10 hours to completely charge current models of electric three-wheelers using slow chargers. Presently, there is a negligible presence of electric three-wheelers in the transport sector and only one market player offers electric three-wheeler models. Table 3.2 shows electric three-wheeler models that are available in the market along with their key characteristics.

FUTURE ELECTRIC THREE-WHEELER MARKET

Like the current electric three-wheeler market, the future electric three-wheeler market will be characterized by low-cost vehicles with minimalistic design and essential features only. Most electric three-wheeler models of the future market will offer similar battery capacities and chemistries like the current market for electric three-wheelers as well as a similar driving range and charger ratings. Most automotive manufacturers in the future market for electric three-wheelers plan on in-house development of EV specific parts and tend to maximize utilization of parts (non-EV specific) from the existing indigenous supply-chain, which is projected to bring the upfront purchase price of the vehicles down.

Due to higher purchase price and longer charging time of the fixed battery-based electric three-wheelers, three automotive manufacturers (Sazgar Engineering Works, Viscelerate Mobility and Green Wheels) in the future market for electric three-wheelers are developing swappable battery-based vehicles. In the swappable battery regime, users will pay an upfront price of the vehicle (excluding batteries), while the batteries will be obtained through a network of battery swapping stations on a rental basis. Similarly, certain manufacturers are also developing retro-fit kits to convert existing ICE-based three-wheelers to EVs by replacing engines with batteries, motors and other associated hardware.¹⁵

¹⁵ Appendix 3.2 shows the characteristics of the future electric three-wheeler market in Pakistan.

TABLE 3.3: CURRENT ELECTRIC CAR MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS			IMPORTED/ INDIGENOUSLY DEVELOPED
		PRICE (USD)	BATTERY (KWH)	RANGE (KM)	
MG JW Automobile Pakistan	ZS EV	<43,400	44	300	Imported
Audi	E-Tron	<92,000	55	300	Imported
Zia Electromotive	M7	<12,400	10	200	Imported

3.3 MARKET FOR ELECTRIC CARS

CURRENT MARKET FOR ICE-BASED CARS

Most of the ICE-based car market in Pakistan is dominated by international companies having manufacturing facilities in Pakistan that are often established through partnerships with indigenous companies or business groups. Major international players in this market include Toyota, Suzuki, Kia, Hyundai, Honda, MG, Changan, BAIC, Proton, FAW, Prince, DFSK, United and others. Almost all luxury vehicles are imported into the country from companies such as BMW, Audi, Mercedes and Porsche among others. The vehicles' engine capacities in this segment typically range from 660cc – 3500cc. This ICE-based vehicular market has little or no commonality with electric counterparts as most companies are designing new vehicle models for their EV fleet.

CURRENT MARKET FOR ELECTRIC CARS

Unlike the current market for electric two and three-wheelers, the market for electric cars is diverse i.e., there are distinct models of vehicles from different manufacturers. Due to the need for higher degree of technological advancements for indigenous development, there are no local players in the current market for electric car manufacturing till now. There are almost 2,000 electric cars in Pakistan and all of them are imported. There are nearly a dozen fast charging stations dedicatedly developed to serve the existing fleet of electric cars. MG Motors is planning to start manufacturing its EVs by 2022. Zia Electromotive plans to bring its LSEV to the Pakistani market in 2021 with an intent to start indigenous manufacturing. Table 3.3 shows

current electric car retailers in Pakistan and the characteristics of the vehicles in the respective segment.

FUTURE MARKET FOR ELECTRIC CARS

Due to the size of the cars' segment (almost 4 million ICE-based units) and rapidly increasing gasoline prices, there is a high projected demand for low-cost electric cars. To this end, many newly established companies are planning to develop low-cost electric cars indigenously. Other than certain EV specific parts, most parts will be developed in-house by electric car manufacturers or will be developed by existing OEMs in Pakistan. In the short-term, the electric car industry will have to rely upon imported EV-specific components but local manufacturing may soon follow to reap the benefits of low duties and taxes on indigenous manufacturing. Most of the vehicles in this segment will offer limited driving range compared with imported vehicles in the current market for electric cars. Many commercial fast charging service providers have expressed interest in establishing fast charging infrastructure for electric cars (refer to section 4.5 for further details on the development of fast charging infrastructure). Certain automotive manufacturers in the respective segment are also developing retro-fit kits to offer low-cost electric mobility solutions.¹⁶

3.4 MARKET FOR LIGHT TRANSPORT VEHICLES (LTV) AND HEAVY TRANSPORT VEHICLES (HTV)

CURRENT MARKET FOR ICE-BASED LTV/HTV

A few companies have established local manufacturing of HTVs in Pakistan like Hino,

OPPORTUNITIES IN ELECTRIC CAR MARKET

The development of electric cars requires a higher degree of technological advancements than two and three-wheelers. Thus, all players in the electric car market require significant technical collaborations with established companies.

¹⁶Appendix 3.3 shows the characteristics of the future electric car market in Pakistan.

OPPORTUNITIES IN ELECTRIC LTV/HTV MARKET

Since electric HTVs demand high technological advancements, most players in this segment require technical collaborations with international players. The fiscal requirements for manufacturing in this segment are also relatively higher due to the need for development of elaborate facilities. For this purpose, many manufacturers in this segment are looking for various forms of investments to obtain requisite capital, and technological expertise.

The provincial governments are looking at plans to introduce electric buses in large cities. However, these opportunities may require end-to-end solution provisioning, including feasibility, route selection, appropriate vehicles, charging infrastructure, maintenance services, parts, and sometimes initial operations. Therefore, companies interested in exploring these opportunities will have to provide a range of services.

TABLE 3.4: CURRENT ELECTRIC HTV (BUSES/TRUCKS) MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS		IMPORTED/ INDIGENOUSLY DEVELOPED
		EXPECTED PRICE (USD)	RANGE (KM)	
VPL	Golden Dragon (PHEV)	-	-	Imported
Sapphire Group	BYD K9	324	250	Imported

Isuzu, Nissan, etc. Similarly, a few companies develop LTVs in Pakistan like Toyota, Hyundai, JW Foreland, Changan Master Motors, Al Haj FAW, etc. Despite the availability of local manufacturing facilities, most buses are imported into the country, while most medium-sized trucks are manufactured indigenously.

CURRENT MARKET FOR ELECTRIC LTV/HTV

There are almost 150 Golden Dragon PHEV buses in Pakistan that are in operation at Bus Rapid Transit (BRT) corridor in Peshawar. Sapphire Electric is collaborating with the Government of Sindh on introducing BYD electric buses in Karachi. For this purpose, a pilot project is underway to access the characteristics of buses in the local scenario. Presently, there is no manufacturing/assembly facility for electric buses. Therefore, all these buses will be imported. Table 3.4 shows the current electric HTV fleet in Pakistan along with its characteristics.

FUTURE MARKET FOR ELECTRIC LTVS/HTVS

Due to the need for a much higher degree of technological advancements to develop electric HTVs, there are no players in the market planning to build such vehicles indigenously. The future market for electric HTVs is projected to be dominated by imported vehicles.

There is little market for large domestic electric trucks in Pakistan due to these vehicles' very high upfront cost and the challenges associated with charging. However, there is a sizable market for small electric trucks with less than one-ton haulage capacity. Similarly, there is also a considerable market for electric LTVs.¹⁷

3.5 MARKET FOR BATTERIES

Pakistan has a large industrial base for lead-acid based battery manufacturing due to sizable demand. Presently, lithium-ion battery packs are mostly imported. However, due to the upcoming demand of lithium-ion batteries, many companies are interested in venturing into this segment. Battery cells will be imported in the next few years, but battery packs will likely be manufactured locally. Presently, only a handful of companies are manufacturing lithium-ion battery packs. The production capacities of these companies are also limited at the moment.

Many companies are interested in setting up technological collaborations and partnerships in new battery technologies. One of the challenges that companies face is in sourcing quality lithium-ion cells. The companies often have to rely on tier-2 cell manufacturers, compromising the quality and safety of battery packs. Table 3.5 shows current battery pack manufacturers in Pakistan developing their product line for potential use in EVs and their required investment and collaboration needs.¹⁸

3.6 MARKET FOR CHARGING SERVICE PROVIDERS AND CHARGING INFRASTRUCTURE DEVELOPMENT

The CAPEX and OPEX for developing fast charging stations is significant. The cost of each fast charger is typically more than USD 20,000. Due to the absence of EVs in the country, there are very few market players that are presently offering fast charging services. There are less than a dozen fast charging stations in the country at the moment. Indigenous development of fast chargers requires the latest technological

¹⁷Appendix 3.4 shows the characteristics of the future electric LTV/HTV market in Pakistan.

¹⁸Appendix 3.5 shows the characteristics of the future battery market in Pakistan.

TABLE 3.5: CURRENT BATTERY MARKET IN PAKISTAN

COMPANY	CHARACTERISTICS		PRODUCTION/ MONTH
	SEGMENTS	TECHNOLOGY	
Zoxcell	Two & three-wheeler	Li-ion & super capacitors	5 MWh
Adaptive Technologies	Storage	Li-ion	-
Barq Box	Batteries	Li-ion	1 MWh
Fuel Motion Inc.	Batteries/Storage	Li-ion	10 units

advancement and the development of partnerships. Table 3.6 shows market players that are presently offering fast charging services and infrastructure deployment.

Due to high CAPEX associated with fast chargers, many ventures are developing fast chargers indigenously. The development of fast chargers is a huge potential market in the next few years. The profit margin on the sale of indigenously developed fast chargers is also anticipated to be very high. Such high potential in the development of fast chargers has attracted many ventures.¹⁹

3.7 MARKET FOR AUTOMOTIVE PARTS AND COMPONENTS MANUFACTURING

Pakistan has a matured and well-established industrial base for automotive parts and components manufacturing with almost 250 manufacturers focusing on the ICE-based segment. With EVs gaining a stronger foothold in the transport sector in the next few years, a sizable market for EV related parts and

components will emerge. Presently, there are no Pakistan-based OEMs offering EV specific solutions.^{20,21}

The development of EV-specific parts requires a certain degree of technological advancements and the latest manufacturing techniques that are mostly unavailable in Pakistan. OEMs in this market are therefore actively seeking technical collaborations with market players that possess the requisite technical capacity. Some companies have expressed their desire to partner in mining rare earth minerals from Pakistan and are seeking collaborations.

Another available opportunity is software-based platforms to support EV adoption. This includes platforms that allow one to find and reserve fast chargers at charging stations, monitor battery life, provide a service to swap batteries at any location, lease batteries for certain vehicles and solve other significant challenges that come with EV adoption. The success factor of these platforms relies upon successfully solving local challenges while providing a valuable service.

TABLE 3.6: CURRENT CHARGING INFRASTRUCTURE MARKET IN PAKISTAN

COMPANY	TARGET MARKET	INDIGENOUS DEVELOPMENT/IMPORT
Tesla industries	Commercial	Indigenous development
MAQ international	Commercial	First import than indigenous development
Adaptive Technologies	Commercial and home-based	Indigenous development

OPPORTUNITIES IN BATTERY MARKET

The foremost requirement of technology partnership is the availability of reliable cell supply from tier-I manufacturers. Companies are also looking at collaborations to develop BMSs, thermal management systems, and safety mechanisms for battery packs.

OPPORTUNITIES IN CHARGING SERVICE AND INFRASTRUCTURE MARKET

Due to complexities in designing and manufacturing fast chargers, most emerging companies in the respective venture seek technical collaborations. This provides a valuable opportunity for international entities to collaborate with local players.

¹⁹ Appendix 3.6 shows the characteristics of the future charging infrastructure and services market in Pakistan.

²⁰ Appendix 3.7 shows the characteristics of the future EV related parts and motors market in Pakistan.

²¹ Appendix 3.8 shows the characteristics of the future electronics, mining and software market in Pakistan.

INTRODUCTION

The transportation sector in Pakistan requires market penetration and risk mitigation strategies to enhance the chances of success within the market. This section highlights important factors for each segment of the transport sector that can contribute towards successful ventures in the market for EVs in Pakistan.

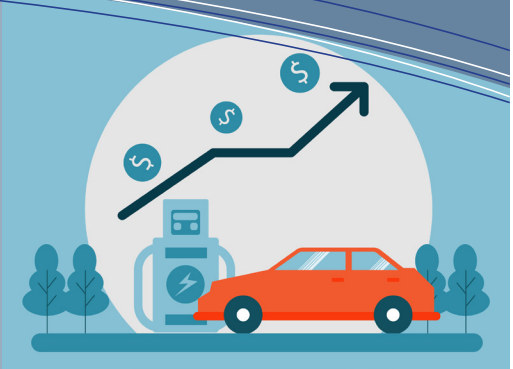
FACTORS FOR SUCCESS IN THE MARKET

4.1 DEVELOPMENT OF SIMPLE, LOW-COST VEHICLES USING INDIGENOUSLY MANUFACTURED PARTS

More than 95% of the current automobile market in Pakistan is highly price-sensitive, especially the two-wheeler and the three-wheeler segments that constitute almost 84% of the vehicular fleet. To this end, most indigenously developed vehicles have a minimalistic design and offer only essential features to have a low upfront purchase price. Therefore, existing and prospective automotive manufacturers must develop vehicles that carry a lower price tag by offering a minimalistic design and essential features only to gain a larger market share in EV sales.

The resale value of a vehicle is an important factor dictating the purchase decision. A key determinant of the resale value is the availability of parts in the aftermarket. Most vehicles in Pakistan remain in use for 2-3 decades and thus, require frequent repair and aftersale services before being retired and taken off the road. For the past two decades, the vehicles' design in the two-wheeler, three-wheeler and HTV segments has remained generally unaltered and is projected to remain the same in the short to medium-term time frame. As a result, Pakistan has a reliable and mature industry for automotive parts manufacturing, especially in the two and three-wheeler segments.

Furthermore, due to the comparable vehicles' design in the above mentioned vehicular segments, most parts are interoperable among vehicles belonging to the same category but developed by different automotive



manufacturers. Vehicles developed through the utilization of such parts enjoy a key advantage of reliable availability of parts in the aftermarket. In order to achieve wider market penetration, it is crucial that existing and prospective electric automobile manufacturers should employ the same strategy and ensure maximum utilization of indigenously developed parts to achieve a low-price tag and a high resale value.

4.2 OFFERING EV FINANCING SCHEMES

The ability of users to pay a higher upfront purchase price for EVs varies across different vehicle segments. It is therefore essential that different models for financing are designed to target different market segments. The two-wheelers, three-wheelers, LSEVs and LTVs are the most price sensitive segments. In these segment, automotive manufacturers, retailers and other financing institutions such as banks can propose a financing scheme with an upfront purchase price parity with the price of ICE-based equivalent vehicles. The remaining price differential can then be divided into equal periodic installments such that the cost of each installment is less than the savings obtained through lower driving cost of EVs. Such an approach can trigger widespread EV adoption through matched upfront cost and lower recurring cost compared with respective ICE-based vehicles.

4.3 SEGMENT-SPECIFIC DEVELOPMENT AND PLACEMENT OF CHARGING INFRASTRUCTURE

Even with fast-charging stations, it takes about 30-40 minutes to charge electric cars which

makes visits to charging stations inconvenient unless it is coupled with other activities such as work, shopping, food, amusement etc. Opportunistic charging thus seems a more convenient approach for commercial-scale vehicle charging. Users of each vehicle segment belong to different socio-economic brackets. The users of two-wheeler and three-wheeler segments typically belong to the low-middle income segment of the population, whereas the users of passenger cars usually belong to the high-income segment. Automobile users in each segment are attracted to different civic centers, based upon their socio-economic status. For instance, luxury shopping malls, fine dining restaurants, and clubs attract the high-income segment of the population, forming most of the passenger car customer base. Similarly, opportunistic charging for two-wheelers can best be setup at offices and commercial zones and designated stations for three-wheelers.

4.4 CONFIDENCE BUILDING MEASURES

Pakistan has a change-averse population at large, characterized by a relatively slow initial rate of technology adoption. However, once the technology barrier is crossed, the 'Jones effect' kicks in and buying decisions are influenced by peers. For EVs to gain a larger share in the transport sector, a range of confidence building measures will be required by OEMs, automobile manufacturers, retailers and charging service providers to cross this initial barrier. A key confidence building measure is development of a well-established and well spanned network of 3S services i.e., sales, spares, and services. A strong foundation of 3S services creates trust among users that the automotive company will remain an active market player in the long-run when frequent repair and aftersales services

are required. This also helps improve the resale value and provides greater confidence to first time buyers.

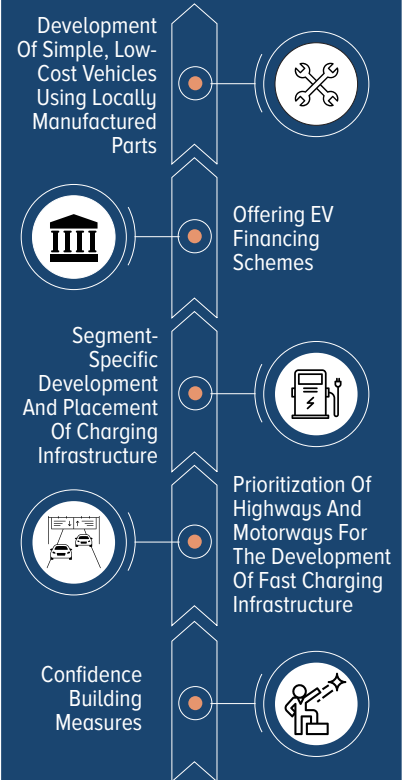
The other key confidence building measures can include the provision of mobile on-demand charging. For instance, truck-mounted fast chargers with batteries can be used to provide on-demand charging if the vehicle is stranded at a location where charging is not available nearby. Similarly, other such measures can include provisioning of battery leasing programs to reduce upfront purchase price of the vehicles and buy-back programs by retailers for newly sold vehicles.

4.5 PRIORITIZATION OF HIGHWAYS AND MOTORWAYS FOR THE DEVELOPMENT OF FAST CHARGING INFRASTRUCTURE

Slow home-based charging and opportunistic charging are often sufficient to cater most charging requirements for local travel and are the preferred means of charging due to convenience and low electricity prices. Therefore, fast-charging service providers need to concentrate development of charging infrastructure on motorways and highways.

Pakistan enjoys a key strategic advantage where all major cities are connected through a small set of highways and motorways. Strategic development of charging infrastructure along these highways and motorways can provide coverage to almost every urban center. Therefore, only a limited number of fast-charging stations need to be developed along key city-pair routes. This key trait of the road-network in the country provides a valuable opportunity for fast charging service providers, especially for early entrants in the respective venture.

FACTORS FOR SUCCESS



INTRODUCTION

The EV landscape is ripe in Pakistan for investment. The GoP is providing several incentives to encourage EV adoption. Thus, an upsurge of opportunities in the EV value chain is expected in the next few years. Similarly, many investment opportunities in the energy storage market are also expected. This section outlines the investment opportunities based on the short, medium, and long-term horizons.

INVESTMENT OPPORTUNITIES IN THE SHORT, MEDIUM AND LONG-TERM IN THE MARKET FOR EVS AND BATTERIES



5.1 SHORT TERM INVESTMENT OPPORTUNITIES

The short-term opportunities are open now and will continue to open up in the next three years. Therefore, the period of next three years provides a valuable opportunity to tap into the following EV segments.

Commercial Vehicles: Commercial passenger and freight carriers, including micro freight and last mile services, traverse a lot of miles. More mileage means better economic and financial value for their operators over a shorter period. Therefore, local passenger and freight carrying EVs may readily become the vehicles of choice for transition to EVs. Moreover, large companies have set goals to eliminate their carbon footprints. These companies may even be willing to pay a premium on the EV price to achieve their emission reduction goals.

Taxis and smart mobility services like Uber are also a natural fit for EVs to improve their unit economics. Likewise, bike-sharing services like Bykea and grocery and food delivery services like Cheetay, FoodPanda, GrocerApp, Airlift Grocer, and others can also use EVs for better economics. Equally, electric reefer trucks that deliver temperature-controlled produce such as frozen meat, seafood, and ice cream may also be a good candidate for local commercial operations. Given high summer temperatures in Pakistan, energy costs constitute a significant portion of cold chain transportation. Thus, electric standby reefer containers requiring Electric Transport Refrigeration Unit (eTRU) may attract many prospective buyers.

The charging infrastructure for all commercial vehicles may be a challenge, but most of these

vehicles do not operate 24/7 and have spare hours available during the night for charging. A slower charger may require six hours or so for charging; enough time to charge the battery completely. Therefore, charging will not be a hurdle in transition towards EV for commercial freight operations where the single fully charged battery is enough for the day-long operations. However, if charging is required during business hours, companies may need a different strategy.

Another open market is all types of government vehicles. Due to congestion, many cities use two and three-wheelers for first responders and ambulances. The government has plans to convert government vehicles to EVs to save on fuel costs and reduce emissions.

Public Transport: Local public transport in Pakistani cities is transforming. Since, traditional diesel-run buses constitute a significant source of environmental pollution, the government's priority is to bring cleaner options for public transport. The government would like to form a public-private partnership (PPP) to operate public transport. Thus, the private operator brings all the buses and the necessary infrastructure, and the government provides financial incentives so that the operator makes a profit from its investment while delivering efficient services to the public.

In cities like Karachi, Lahore, Islamabad, Peshawar, and Multan, the government has developed dedicated access routes for buses. Volume on these routes' ranges from 35,000 – 100,000 passengers daily. Presently, all bus operations on these routes use diesel or compressed natural gas-based (CNG) vehicles except Peshawar, where the city operates plug-in hybrid diesel

buses. These bus routes have large depots on one or both ends that can be converted to charging stations for battery electric buses. Interested investors may also propose converting these routes to electric trolley buses where buses can operate without a battery and use overhead electricity infrastructure for energy. Another possibility is to provide wireless charging technology where the vehicle charges through wireless infrastructure embedded in the road.

Another public transport segment ready for electric buses is intercity transport with 250 km or less distance, which does not require charging stations along the way. Many city pairs in Pakistan like Karachi-Hyderabad (151 km), Islamabad-Peshawar (184 km), Lahore-Faisalabad (184 km), and other high volume city pairs may be the best candidates for domestic electric transport. The population of all these cities is more than one million and is as large as 10 million or more for cities like Karachi and Lahore, producing a larger volume of traffic between these city pairs.

Finally, another opportunity is in school buses and B2B passenger movement. Many factories and businesses in Pakistan provide pick and drop services to their employees, especially females. These vehicles have smaller distance requirements and have good gap periods to charge fully. Owners of such conglomerates would like to transition to EVs to have a tight control over energy costs and also bear lower maintenance costs. Additionally, this will enable them to meet their carbon emission reduction targets for climate change.

Passenger Vehicles and Two-Wheelers: A lower disposable income and the higher cost of EVs hinder the ability of average Pakistanis to purchase low-end electric cars. There does exist, however, a market demand amongst upper-class Pakistanis for luxury class vehicles. The most sold EV in Pakistan is currently the Audi E-Tron. According to an estimate, almost 2000 Audi EVs have been purchased and are presently operating on roads in Pakistan. Other EV models like the MG ZS have also been launched in 2021 but have a relatively limited market share. The buyers of these luxury vehicles have significant disposable income and might use these vehicles for their local commute. Due to the non-availability of charging infrastructure on motorways and highways, owners only use these vehicles in cities. Therefore, if luxury segment vehicles from other brands are available with after-sales services and battery warranty, many individuals will buy

vehicles for their city commutes.

Pakistan has an extensive market for small cars. Almost half of the ICE-based passenger cars consist of low-cost cars having an engine capacity of 1000cc or less. For neighborhood commutes, Wuling Hongguang Mini EV manufactured by a JV of GM-SAIC-Wuling or similar spec vehicles, may succeed in Pakistan due to the lower capital cost. However, such vehicles may still be a local commute vehicle for most owners in the short term.

Beyond cars, around 20% (3.4 million) of the two-wheeler market consists of mid-to-high end vehicles. Among the two-wheelers, this segment is the first contender for potential shift to electric means of transportation. This segment is also popular in neighboring countries like Afghanistan, so possibilities exist for export.

Charging Infrastructure: Presently, the dearth of charging infrastructure in Pakistan is the biggest bottleneck in EV penetration. Therefore, investment in charging infrastructure is essential to eliminate range anxiety and provide domestic travel on EVs. Only a limited number of charging stations exist in the cities and along the lengths of motorways and highways.

Most of the population in urban areas of Pakistan live in one or two-story houses, although high-rise buildings are also getting common. As a rule of thumb, if a person can afford a 1300cc or higher ICE-based vehicle, the person has a private space to park. Thus, we see a large market for EV chargers for these private parking spaces. In the cities, car owners need fast chargers in malls, restaurants, shopping areas, hotels, office towers, and other places where people spend a long time. Mobility platforms like Uber and taxis require public fast charging at prominent locations in the cities. Therefore, such civic centers provide an opportunity for the development of charging infrastructure.

Due to the limited number of charging stations along the highways and motorways, a significant opportunity exists to establish charging stations. Most highways and motorways already have 'service areas' with many facilities, making them ideal locations for fast charging stations. Pakistan also has an extensive network of around 3000 CNG stations. Due to the low cost of CNG, Pakistan is amongst the top five countries with CNG-based vehicles. However, the natural gas supply in the country is dwindling, and CNG



SHORT TERM INVESTMENT



Commercial Vehicle



Public Transport



Passenger Vehicle & two-wheelers



Battery Packs



MEDIUM TERM INVESTMENT



Passenger Cars



Commercial Vehicle



Public Transport

stations are slowly closing down. They have ample space and infrastructure available to install charging stations. As CNG station owners are looking to utilize their space for other revenue generation avenues, there is an investment opportunity for charging stations coupled with other services.

The charging infrastructure needed for two and, three-wheelers, and LSEVs is very different from the other segments. For these segments, a swappable battery option can be a massive opportunity. The swappable battery option eliminates range anxiety and charging problems and allows exploration of new technologies and business models. One can even use existing fuel and CNG stations for the development of battery swapping stations or use parking spaces and other commercial areas for such purposes.

Battery Packs: Battery packs are the most critical component in EVs. In addition to EVs, UPSs, telecom towers, and hybrid and off-grid solar systems require battery storage. Many government-led initiatives like the solarization of public buildings also require storage solutions. Presently, these sectors use ill-fitted lead-acid batteries for storage. However, lithium-ion battery packs may quickly become the storage of choice because of falling prices and long battery life.

Therefore, battery pack manufacturing is a readily available investment opportunity to meet the needs of all sectors mentioned above. Currently, there is little or no competition in lithium-ion battery manufacturing in Pakistan. Pakistan has over hundred universities imparting engineering and technical education to produce qualified technical personnel required for high tech manufacturing. In addition to fulfilling local demands, these ready-made battery packs can be shipped to close geographic locations like Afghanistan, Gulf, Africa and countries in South Asia.

Opportunities in Ancillary Areas of EV: The segment for manufacturing of EV parts such as motors, motor control units, peripheral electronics, and software is readily available for investment. Unlike lithium-ion batteries, all of the items mentioned above are presently manufactured or developed in Pakistan.

Pakistan has a large motor industry that manufactures fans, water pumps, turbines. In 2020, the fan industry exported a million fans

to the countries in the region. EV motors are a natural progression for motor manufacturing companies.

For motor control units and peripheral electronics, Pakistan has companies that provide electronic manufacturing facilities for digital smart meters, mobile phones etc. Many of these companies have shown their interest in producing peripheral electronics and motor control units and are looking to find partners and/or investments.

Pakistan also has a substantial software industry that exported products and services in 2020 having an estimated worth of USD 2 billion. Presently, software companies work mainly on in-vehicle software like AUTOSAR and mobility platforms like ride-sharing and delivery services. However, given that the country has over 2000 software houses and is ranked 4th in freelancing services, one can find the talent to develop most EV-related software products and services.

5.2 MEDIUM TERM INVESTMENT OPPORTUNITIES

Medium term investment opportunities will open up in the next 3-6 years as EV technology becomes economical and the requisite infrastructure is readily available in the country.

Passenger Cars: The establishment of charging infrastructure along motorways and highways will allow people to buy EVs and use them for both local and domestic travel. In current market terms, these will be cars that will be equivalent to 1000-2000cc ICE-based vehicles. This segment typically has private parking facilities, and slow charging will not be a daily use problem. For long trips, one can charge using a charging network along highways and motorways. Another reason for this demand will be the projected parity of the price in this vehicle segment with ICE-based equivalents. By 2025-26 many analytical firms like Mckinsey, Bloomberg, and BNP Paribas predict that EV and ICE-based vehicle prices will be at par, removing the upfront cost barrier for people to buy EVs.

Public Transport and Commercial Vehicles: The public transport of city pairs between 250-450 km or 3-4 hours duration requires either a large battery or a recharging along the way. Typically, such bus routes of 3-4 hours in Pakistan have 20-30 minutes stop along the way. Therefore, such routes that

include Lahore-Islamabad (380 km), Lahore-Multan (346 km), Islamabad-Faisalabad (327 km) and other routes that have a high volume with more than a dozen departures every hour can make financial viability for the operators. Internationally, most bus operators develop their own charging infrastructure. However, one can look at investment models where multiple bus operators share their charging infrastructure or are privately owned.

The trucks for domestic freight services of less than 200 km may start becoming viable for commercial operations. These trucks may be able to carry between one to five tons of cargo. Again, charging infrastructure for trucks may be developed for nearby city pairs.

Another type of vehicle used in Pakistan is reefer trucks for farm to market and market to export delivery. Pakistan is an agricultural country with the fourth largest milk production. It ranks among the top ten producers of many fruits and vegetables and has significant meat and seafood production. However, almost 30% of farm produce in Pakistan is wasted by inefficient handling and transportation. Addressing these challenges requires reefer trucks capable of hauling produce from farm to markets and beyond. This opportunity opens up a huge market of temperature-controlled freight transport.

Similarly, agriculture machinery like tractors constitutes a significant share of diesel consumption in Pakistan. For agricultural locations with a grid infrastructure, battery-less tractors that operate with cable or tractors with small battery packs may reduce the cost of agricultural processes. Having an annual sale of a hundred thousand tractors opens up a large market of electric counterparts.

5.3 LONG TERM INVESTMENT OPPORTUNITIES

The long-term investment opportunities may open up in a five to six years' time frame.

Battery Cell Manufacturing: Given Pakistan's large energy storage market, we expect that battery demand will reach a point where cell manufacturing becomes viable. That will be the right time to start manufacturing battery cells in Pakistan to meet the local and export demands. The cell manufacturing capability will enhance battery pack manufacturing through reduced

time to market off-the-shelf battery packs and develop customized battery solutions for special purpose applications like forklifts and advanced agriculture machinery. Moreover, Pakistan has 184 million cell phone subscribers and is a significant market for these phones. Presently, cell phone manufacturers import batteries, but local cell manufacturing can enable battery pack development for cell phones.

Low Cost Two-Wheelers: Out of all vehicles, 84% of the market in Pakistan consists of two-wheelers. In the two-wheeler segment, almost 80% of the vehicles consist of low-cost two-wheelers priced at \$500 or less. Bringing equivalent EVs to this market requires a massive reduction in battery pack costs. However, even with lower battery pack costs, one may need new technological models such as swappable batteries or new low-cost fixed batteries. Additionally, a large export market exists for these vehicles in Asia and Africa with similar transportation demographics.

The segment for low-end cars with fixed batteries will also open up for investment in this timeframe. Since this segment is highly price-sensitive, local cell manufacturing and lower battery prices will provide competitive prices.

Long Distance Commercial and Public Transportation: The North-South interprovincial connectivity in Pakistan requires vehicles to travel a distance of over 1000 km. The ports of Karachi and Gwadar in Pakistan are towards the south. Most bulk freight hauling occurs between southern ports and populous areas in the mid to north of the country. Also, the China Pakistan Economic Corridor (CPEC), which connects western parts of China with Pakistani ports, will use this route as a primary transport artery. Covering this long distance may not be possible with current EV battery technology offering lower driving range. This segment may only start using EVs when charging time is reduced through swappable batteries or new battery technologies are evolved that offer higher driving range. Another opportunity is to use plug-in hybrid technology for long-distance traveling. Similar opportunities will open up for public transport over long distances as the challenges and solutions of commercial freight transport and public transport for long-distance travel are very similar.



LONG TERM INVESTMENT



Battery Cell Manufacturing



Low Cost Two-Wheelers:



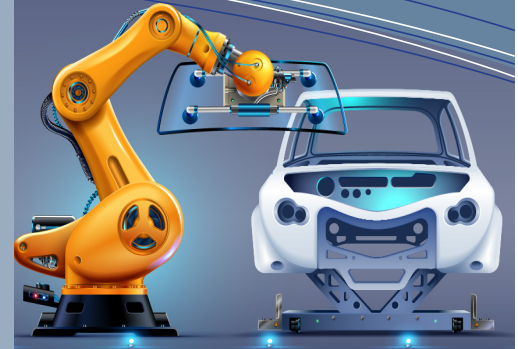
Long Distance Commercial and Public Transportation

INTRODUCTION

The introduction of policies, incentives and regulations by the GoP to govern and develop the EV value chain has created a conducive environment for indigenous manufacturing in various EV segments. Many companies in the EV market in Pakistan are keen on developing partnerships with international companies to mature their product line. Similarly, since most current and prospective market entrants are newly established companies and startups, many of them seek financial assistance from indigenous and international partners, creating opportunities for different modes of investment and partnerships.

Partnership models include foreign companies seeking local partners and local companies seeking international collaboration for technology and/or investment. In addition to vehicle manufacturing, there is also a significant interest in developing engagement models for EV design and EV specific parts manufacturing including batteries, motors, motor control units and composite materials. Following are some of the existing successful partnership models and examples that can serve as a reference for new entrants.

PARTNERSHIP MODELS



6.1 FOREIGN DIRECT INVESTMENT

Foreign direct investment (FDI) is an established model in Pakistan where international companies have established local manufacturing in Pakistan with major shareholding. This model allows a foreign firm or an individual to establish business operations or acquire assets in a Pakistani company. It generally entails technology and management interventions in addition to financial investment. Companies that would like to keep significant management and financial control prefer this engagement model. As per the rules of the GoP, foreign companies may repatriate a significant portion of their profits abroad.

Pak Suzuki Motors: Pak Suzuki Motors is a Japanese owned automobile manufacturer that manufactures cars and two-wheelers having an annual production of about 200,000 units combined. It was established as a JV between the GoP and Suzuki Motor Company, Japan, in 1983 but was acquired completely by the Japanese Management in 1992 which increased its equity from 25% to 73.09%. Pak Suzuki Motors has been a key player in establishing the indigenously vendor industry for automotive parts manufacturing. For example, Suzuki has a JV with Tecno Auto Glass (TAG) Ltd. to manufacture, develop, and design auto glass products for local and international markets.

Plum Qingqi Motors: The Chinese company Plum Qingqi Motors Ltd. was established as a manufacturer in the two and three-wheeler segment in 1994. It targeted the segment of low-cost commercial vehicles for passenger

and freight transport and has since established a presence in urban and rural settings for short-distance transport. The company has established supply and demand side networks which are now managed by separate entities. Since establishing operations, the company has been a key exporter to Bangladesh from Pakistan and has recently ventured into electric two-wheelers. They currently have a total annual production of 20,000 three-wheelers.

6.2 JOINT VENTURE WITH A LOCAL PARTNER

Joint venture is a model where investment is shared between the international manufacturer and the local partner with joint equity in the company.

The existing and prospective EV market players in Pakistan are open for JVs with international manufacturers based upon examples of existing JV models and are also keen in exploring the possibility of engagement in a new JV model, if required in the fast-evolving, technology-driven EV manufacturing segment. This section highlights certain key examples of already established partnerships using JV models. Several JV models are in operation in Pakistan. Following examples may serve as a template to evolve future JV models between interested local and foreign companies:

Indus Motor Company (IMC): Indus Motor Company, operating in Pakistan as Toyota Indus, is an example of JV in the automobile sector. IMC has 50 independent 3S (Sales, Service, and Spare parts) dealerships across the country. It has also played a key

role in the development of the value chain for automotive parts manufacturing through the transfer of technology to 52 vendors supplying parts for indigenous manufacturing. More than 80% shares of IMC are held by foreign investors/companies with 37.5% being held by Toyota Motor Corporation, Japan and Toyota Tsusho Corporation, Japan.

Honda Atlas Cars Pakistan (HACP): HACP was established as a joint venture between Atlas Group of Companies and Honda Motor Co. Ltd., Japan, in 1992 to manufacture Honda cars in Pakistan. Almost 16 companies are associated with HACP, offering services in the domain of parts manufacturing, battery assembling, insurance, asset management and other areas of operations. Over the time, HACP has developed a local supply chain by enabling local vendors to continuously develop automotive parts.

Atlas Honda Limited (AHL): AHL was incorporated as a JV in 1962 between Honda Motor Co. Ltd., and Atlas Group, with directors from both Pakistan and Japan serving on the board. The company manufactures two-wheelers and their parts with an annual production capacity of 1.35 million units. It has a market share of 50% - 60% of all two-wheelers sold in Pakistan. Over the years, it has established one of the largest 3S networks spanning across almost every major urban center. It currently exports two-wheelers to Bangladesh and Afghanistan.

Servis - Long March Tyres Pvt. Limited: Servis-Long March Tyres Pvt. Ltd., is a JV between Pakistan-based Service Industries Pvt. Ltd., and Chaoyang Long March Tire Company of China to manufacture radial tires for buses and trucks. This USD 250 million JV has 51% shareholding by Service Industries and 49% by Chaoyang Tyres. In this JV, the technology to manufacture tires is provided by Chaoyang Tyres.

Master Motors: Master Motors and Changan Automobile (Group) Co. Ltd., have signed an agreement for licensed manufacturing of Changan automobiles in Pakistan. As part of the agreement, right-hand-drive vehicles developed in Pakistan will also be exported to the international market.

6.3 TECHNOLOGY TRANSFER

The technology transfer model is another mode of engagement followed by some of the more recent partnerships established under ADP 2016-21.

The EV technology landscape is evolving at a fast pace. It is recommended that a technology transfer agreement should cover the innovations and developments in this area, to ensure a continued competitive advantage.

Yunus Brothers Group and KIA Motors created Lucky Motor Corporation Ltd., in Pakistan to bring a licensed manufacturing of a selected range of KIA automobiles in Pakistan with an investment of about USD 115 million.

Hyundai Nishat Motors is a similar partnership model established between Nishat Group and Hyundai Motor Company for manufacturing, marketing, and distribution of Hyundai's product line in Pakistan under the auspices of Hyundai Nishat Motor Pvt. Ltd. The license for manufacturing has been established through Sojitz Corporation, Japan.

Gandhara Nissan Ltd., was established in 1981 and is part of the Bibojee Group of Companies. The company manufactures trucks in partnership with JAC Motors and has partnerships with Nissan, Dongfeng, and Renault.

Al-Haj FAW Motors was established in 2006 as part of the Al-Haj group with production starting in 2012 with an initial investment of USD 6 million and a technology transfer agreement. The group also has companies in the transport and logistics, textile, tires, metal industry and real estate sectors.

Morris Garages (MG) Motors has quickly entered Pakistan as the first established EV brand to start manufacturing in Pakistan in partnership with JW Forland Pakistan and SAIC-MG group. The group established a JV between JW SEZ in Pakistan and Forland (Changsha Foton Motor Co. Ltd. China). Pakistani and Chinese members jointly hold key management positions in the company in Pakistan.

INTERNATIONAL AUTOMOBILE MANUFACTURERS IN PAKISTAN

TOYOTA

HONDA

SUZUKI

KIA

HYUNDAI

FAW

MORRIS GARAGES

FOTON

DAEWOO

HINO

ISUZU

JW FORLAND

NISSAN

NEW HOLLAND

MESSEY FERGUSON

BAIC

CHANGAN

PROTON

QINGQI

DFSK

YAMAHA

6.4 EQUITY FOR TECHNOLOGY

In a more recent engagement model, some partnerships have been established in the technology-oriented sectors to allow equity for technology swap. Local partners in Pakistan are willing to put up to 100% investment and still give equity share to the international partner organization in return for technology. There is no requirement or expectation of financial investment by the technology providing partner.

This engagement model allows the international technology-providing partner to come in with minimal financial risk and with a choice of the right partner; the operational risks can also be mitigated. International partners can evaluate the company's actual growth and may choose to invest financially for a larger stake in the company at a time of their choosing. For a country like Pakistan, the terms for this potential deeper engagement can be made part of the initial contract. Local partners are willing to make it more attractive for the international partners with locked-in terms at the onset.

The discussions held with local players in Pakistan for this study show a willingness of a majority of the players to engage in this model. This also includes companies interested in the manufacturing of components. It provides an opportunity for convenient entry for the international players by leveraging the strengths of the local partners in both the supply side and the demand side. The local partner will choose the technology to ascertain the viability of the business plan and arrange all the finances. International partners will gain an additional opportunity to understand functional and technical challenges and design the solutions best fit for requirements.

6.5 BRAND NAME LICENSING

Due to the perceived high quality of certain well-known and reputed brands, some local investors are willing to pay a royalty for the use of brand-name. This is a good opportunity, especially for companies looking to expand beyond their domestic markets.



INTRODUCTION

Development of the complete EV value chain demands a range of interventions and support from the government. Since the approval of the Electric Vehicle & New Technology Policy 2020-2025, several concerned government entities have been working on various aspects of the EV value chain in their respective domains. For instance, electricity distribution companies are planning to remove distribution constraints that may hamper uninterrupted supply of electricity to charging stations, National Electric Power Regulatory Authority (NEPRA) is developing a model for tariff rates for vehicular charging, and National Energy Efficiency and Conservation Authority (NEECA) is setting standards for EV chargers. In addition to the efforts by the GoP, developmental organizations such as USAID, World Bank, Asian Development Bank, and United Nations Development Programme (UNDP) are also providing valuable support in nurturing the EV ecosystem in Pakistan. In particular, industry-academia collaboration in Pakistan is also providing significant support for the development of the EV ecosystem by offering technical expertise to the local industry. This chapter outlines the progress made so far and planned interventions by various public and developmental organizations in supporting the EV ecosystem. These insights can serve as a valuable tool for aspiring national and international entrants in the EV business in Pakistan to gauge the country's readiness to support the EV ecosystem.

EFFORTS BY GOVERNMENT AND INTERNATIONAL DEVELOPMENT COOPERATION ON DEVELOPING EV ECOSYSTEM

7.1 EFFORTS BY GOVERNMENT ENTITIES IN DEVELOPING EV VALUE CHAIN

Ministry of Industries and Production:

The objective of the Ministry of Industries and Production (MoIP) is to achieve efficient, sustainable, and inclusive industrial development in Pakistan by acting as a facilitator in creating and enabling industrial growth. One of its fundamental roles is to develop policies and regulations that govern the development of local industry. Engineering Development Board (EDB), a constituent department of MoIP, regulates the development of the automobile sector. EDB is developing policies to support new entrants in the automobile sector. The Automotive Industry Development and Export Plan 2021-26 developed by EDB provides a framework for the automotive industry in Pakistan and provides incentives for export.

Ministry of Science and Technology:

The Ministry of Science and Technology (MoST) promotes and coordinates efforts to initiate and launch scientific and technological programs and projects as per national agenda and needs. The Board of Disruptive Technologies has been recently formed under the auspices of MoST to foster indigenous development of next-generation technologies, including EVs. The ministry has launched a program to kick-start new startups and tech-based ventures through a public-private partnership to develop and strengthen the respective industry. Pakistan Standards & Quality Control Authority (PSQCA), a constituent organization of MoST, has been directed to develop and ensure compliance to



internationally accepted standards, particularly in the EV domain, to tap into the international markets for exports. Additionally, the ministry has also approved the formation of National Centre for Electric Vehicles (NCEV) to serve as a center of excellence for providing support to the associated industry for rapid maturation and conducting research on next-generation technologies to enable their faster industrial adoption. There are four key focus areas of the NCEV: research and development on vehicle parts and components, HR training and development, smart charging infrastructure development, and allocation of funds for industry-academia collaboration and pilot projects. The MoST has approved the NCEV and is presently seeking approval from the Planning Commission of Pakistan.

Ministry of Climate Change: The Ministry of Climate Change (MoCC) promotes green and sustainable development in Pakistan and addresses challenges associated with climate change. The MoCC has played an integral part in developing the Electric Vehicle & New Technology Policy 2020-2025. The ministry acts as a liaison between different players in the EV value chain in Pakistan from the public and private sectors to coordinate joint efforts to develop the EV ecosystem. MoCC is also leading an inter-ministerial committee to implement EV policies and regulations across the country to fast-track policy implementation and ensure the realization of incentives. MoCC is also launching different pilot projects in some EV segments through the National Disaster Risk Management Fund (NDRMF).

National Electric Power Regulatory Authority:

The National Electric Power Regulatory Authority (NEPRA) regulates the power sector in Pakistan. A crucial role of NEPRA includes the development of tariff models and rates for residential and commercial sectors. NEPRA is developing different tariff regimes for residential and commercial-scale vehicular charging. For this purpose, a number of stakeholders from the public and private sector have been engaged. A comprehensive study by NEPRA evaluates various business models for EV charging to develop a tariff regime that incentivizes transition to electric means of transportation.

National Energy Efficiency and Conservation Authority:

The National Energy Efficiency and Conservation Authority (NEECA) serves as a federal focal agency mandated for initiating, catalyzing, and coordinating all energy conservation activities in different sectors of the economy. NEECA is devising a transport strategy that focuses on transport efficiency, particularly for EVs. For this purpose, a range of studies and meetings have been conducted to develop uniform standards for EV chargers to ensure compliance and uniformity. Different standards for EV chargers employed across the globe and international best practices in the local context are under investigation.

Electricity Distribution Companies (CASE STUDY: LESCO):

The Lahore Electric Supply Company (LESCO) is Pakistan's largest electricity distribution company. LESCO is developing a mechanism for providing expedited service to applicants for charging station connections. A plan is to appoint a focal person and create a unit to provide all required services under its jurisdiction to charging service providers. To ensure reliable supply, LESCO is working with NEPRA to provide connections from multiple feeders to charging stations to ensure uninterrupted supply of electricity. Moreover, LESCO plans to work with charging station companies to reduce chances of voltage dips and power quality variations. LESCO would also like to study the impact of charging stations on the

demand curve so that any major shift can be effectively handled.

Board of Investment:

The GoP has established the Board of Investment (BoI) to facilitate local and international investors. The BoI assists companies and investors who are investing or intend to invest in Pakistan and facilitate their projects' implementation and operation. BoI's wide range of services also includes providing information on the opportunities for investment and facilitating companies looking for joint ventures. It also acts as a focal point of contact for existing and prospective investors, both local and international, to provide all necessary information and assistance in coordination with other government departments/agencies at the federal and provincial levels. All four provinces of Pakistan also have their own boards for investment and trade that offer similar services to investors. All federal and provincial boards manage Special Economic Zones (SEZs). These SEZs offer a wide range of incentives and benefits for investment.^{22 23} In addition to SEZs, the GoP is also developing Special Technology Zones (STZs) to provide institutional and legislative support for the technology sector with internationally competitive and export-oriented structures and ecosystem, to attract foreign direct investment and develop a collaborative ecosystem.²⁴ The support and incentives offered by the STZs complement those provided by SEZs to further encourage investment and development of the technology-oriented industry.

7.2 EFFORTS BY INTERNATIONAL DEVELOPMENT COOPERATION IN DEVELOPING EV VALUE CHAIN IN PAKISTAN**United States Agency for International Development:**

The United States Agency for International Development (USAID) has been assisting public and private sectors in Pakistan on a diverse range of thematic areas, including entrepreneurship and economic growth. In the context of EVs, USAID is working with the government on facilitating EV penetration

INCENTIVES OF SPECIAL ECONOMIC ZONES

1. One-time exemption from custom duties and taxes for all capital goods imported into Pakistan.
2. Exemption from all taxes on income for a period of ten years.

INCENTIVES OF SPECIAL TECHNOLOGY ZONES

1. Exemption of Income Tax for Zone Enterprises.
2. Customs duties exemption on import of Capital goods for Zone Enterprises.
3. Sales Tax exemption on import of goods, plant & machinery, and equipment within zones.
4. Exemption from tax on Dividend income and Capital gains for venture funds investing in Special Technology Zones.
5. Property Tax exemption for Zone Enterprises.

²² For further information on SEZs, please visit: <https://invest.gov.pk/sez>

²³ For further information on incentives offered by SEZs, please visit: <https://invest.gov.pk/sites/default/files/inline-files/SEZ%20Incentive%20Package.pdf>

²⁴ For further information of STZs, please visit: <https://stza.gov.pk/>

Lahore University of Management Sciences (LUMS) is conducting multi-disciplinary research and development on various EV segments. A research group within LUMS is developing lithium-ion batteries for potential use in EVs. Similarly, another research group is developing software-based platforms for various purposes, such as managing charging at fast charging stations and other smart mobility applications, including BaaS. LUMS also has four spin-off companies (NeuBolt, NeuWat, Sol Drive and Burq Box) offering solutions in the EV domain ranging from development of battery packs to providing swappable battery-based charging services.

University of Engineering and Technology (UET)-Lahore is one of Pakistan's oldest and reputed engineering universities. Research and development on various types of motors and other associated hardware is being undertaken at UET-Lahore to assist the indigenous industry in uptake of next-generation technologies.

NED University of Engineering and Technology is offering degree programs in automotive engineering. In addition to imparting automotive knowledge, the university is offering technical support to OEMs and automotive companies in manufacturing and designing processes.

National College of Arts (NCA) is working on designing vehicles for various segments of the EV value chain. Recently, NCA has assisted a local electric car manufacturer in designing an indigenous vehicle.

in the country. Upon the instruction of the USAID, the Department of Energy's national laboratories such as the National Renewable Energy Laboratory (NREL) and Pacific Northwest National Laboratory (PNNL) have developed a Global Change Assessment Model (GCAM) for EV penetration projections in Pakistan. Additionally, USAID is helping entities within the government to develop EV regulations, design electricity tariffs for EV charging, and develop standards for EV components and charging equipment.

USAID is also helping the private sector in bringing climate-resilient technologies and solutions through local entrepreneurship. In association with the Private Finance Advisory Network (PFAN) and United Nations Industrial Development Organization (UNIDO), the USAID has started a program to coach budding entrepreneurs on securing international investments. This program will prepare the startups to develop bankable projects that are financially and economically viable.

World Bank: The World Bank collaborates with the public sector to introduce government-backed financing schemes for electric two-wheelers, three-wheelers and buses. For this purpose, a risk-sharing mechanism with local banks is under consideration to offer loans on convenient conditions to potential EV proprietors in the respective segments. Furthermore, the World Bank is devising a strategy to contribute USD 10 million as a subsidy to the Government of Punjab for the purchase of electric buses. In addition to financial assistance, the World Bank is offering technical expertise to the GoP on a range of issues related to the development of the EV value chain. For instance, the World Bank has assisted NTDC in forecasting load on the grid due to EVs under different penetration scenarios.

United Nations Development Programme: The United Nations Development Programme (UNDP) offers technical support on four key aspects to the GoP: GHG mitigation potential modeling, development of standards for vehicles and chargers, evaluation on-grid readiness to support load due to EVs, and tariff rate design

for vehicular charging. UNDP collaborates and provides technical assistance to the MoCC to model GHG emission mitigation potential under various EV adoption scenarios. UNDP is also providing technical assistance to PSQCA to develop various standards for EVs as well as chargers. All EVs and chargers must conform to uniform standards to ensure interoperability of chargers among different vehicle lines. Similarly, NEECA is also receiving technical support from UNDP to evaluate the electricity grid's readiness to support load due to EVs. In addition to offering technical support on a range of issues, UNDP is developing a framework for providing financial support to the GoP and private sector entities in the EV venture.

Asian Development Bank: The Asian Development Bank (ADB) is currently working on two projects related to EVs in Pakistan. The first project is the Bus Rapid Transit (BRT) corridor in Peshawar where ADB has introduced plug-in diesel hybrid buses. The objective of introducing diesel-based PHEV buses is to enable a smooth transition from ICE-based buses to electric buses through an intermediary technology. The second project is the introduction of electric three-wheelers for last-mile mobility. ADB would like to introduce about 250 electric three-wheelers in Karachi and Sialkot for local connectivity. ADB is looking for national and international companies to participate in this procurement through an open tender.

7.3 ROLE OF ACADEMIA IN DEVELOPING EV ECOSYSTEM IN PAKISTAN

More than 200 universities in Pakistan offer higher education in engineering, mathematics, computer science and other related fields. Presently, many universities are conducting a range of efforts on developing the indigenous EV value chain. These academic institutions include LUMS, UET-Lahore, NED University of Engineering & Technology, and NCA.

APPENDICES

APPENDIX 1 - INTRODUCTION TO THE VEHICLES AND BATTERIES MARKET IN PAKISTAN

Appendix 1.1 –Annual Vehicle Export Numbers (2015-16 to 2019-20)

TYPES	2015-16	2016-17	2017-18	2018-19	2019-20
Two-wheelers (motorcycle, mopeds, heavy bikes etc.)	10,653	6,250	7,752	10,039	5,980
Three-Wheelers (rickshaws, loaders etc.)	254	415	69	37	59
Cars(SUVs, mini-vans (<1 Ton), double cabin etc.)	65	29	19	36	6
Tractors (pedestrian, agriculture, road tractors SEMI etc.)	4,835	57	204	893	985
Total Vehicular Exports	15,807	6,751	8,044	11,007	7,030

Appendix 1.2 –Annual Vehicle Import Numbers (2015-16 to 2019-20)

TYPES	2015-16	2016-17	2017-18	2018-19	2019-20
Two-wheelers (motorcycle, mopeds, heavy bikes etc.)	1,396	2,029	4,460	5,861	849
Three-Wheelers (rickshaws, loaders etc.)	10,346	2,956	16,929	2,180	47
Cars (SUVs, mini-vans (<1 Ton), double cabin etc.)	48,516	39,154	26,607	10,812	3,596
Trucks (cargo, dumpers, firefighting, lorries, cranes, goods vehicles etc.)	11,680	72,506	11,995	5,325	1,497
Tractors (pedestrian, agriculture, road tractors SEMI etc.)	5,484	2,403	2,238	1,270	464
Total Vehicular Imports	77,422	119,048	62,229	25,448	6,453

Appendix 1.3 - Transmission Capacity Expansion Plan

Name of Project	Voltage Level (kV)	Line Length (km)			Completion Year
		500kV	220kV	HVDC	
Interconnection of HVC Converter Stations at Lahore and Matiari with HVAC system	660	60	-	-	2021-22
Faisalabad West with associated T/Line	500/220	2	125	-	2022-23
Lahore North with associated T/Line	500/220	150	44	-	2022-23
Islamabad West with associated T/Line	500/220	27	35	-	2023-24
CASA-1000 (HVDC)	500/220	17	2	110	2022-23
Guddu-Uch-Sibbi T/Line	220	-	360	-	2022-23
Gharo with associated T/Line	220	-	85	-	2022-23
Swabi sub-station with associated T/Line	220	-	55	-	2022-23

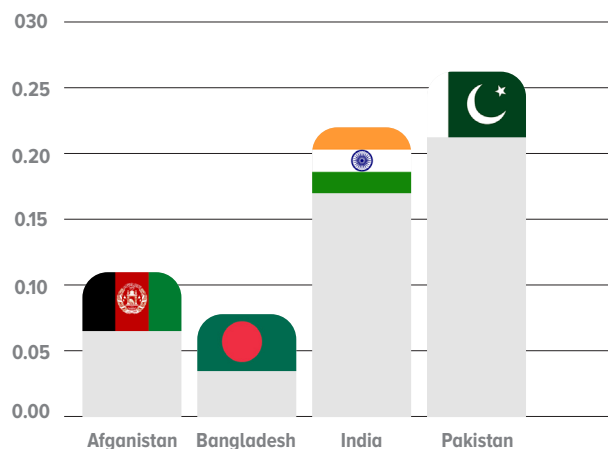
Appendix 1.4 – Emission Profile of Euro 1-6 Complaint Gasoline (Petrol) and Diesel

FUEL TYPE	GASOLINE (PETROL)		DIESEL	
	CO	NOx	CO	NOx
Euro-1	2.72	-	2.72	-
Euro-2	2.2	-	1.0	-
Euro-3	2.3	0.15	0.64	0.50
Euro-4	1.0	0.08	0.50	0.25
Euro-5	1.0	0.06	0.5	0.18
Euro-6	1.0	0.06	0.5	0.08

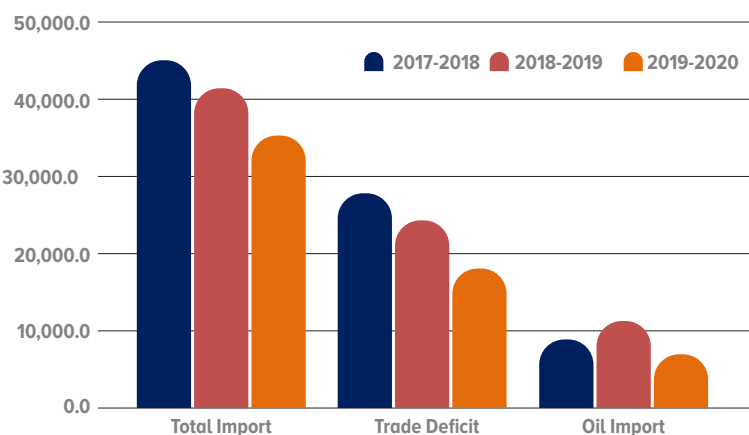
Appendix 1.5 – Mean Emission by Different Vehicles Categories in Pakistan

VEHICLE TYPE	FULE TYPE	CO (%)	SO ₂ (PPM)	SMOKE OPACITY (%)	HC (PPM)
Two-wheelers (motorcycle, mopeds, heavy bikes etc.)	2-stroke gasoline	4.7	45	21	6,200
	2-stroke gasoline	4.7	45	21	6,200
Three-wheelers (rickshaws, loaders etc.)	2-stroke LPG	3.5	55	47	13,000
	4-stroke CNG	2.5	25	10	700
	4-stroke gasoline	2.6	30	16	3,100

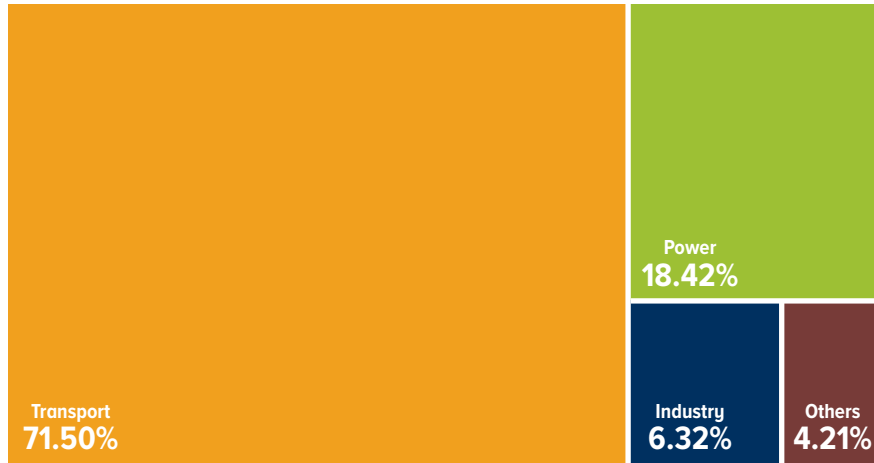
Appendix 1.6 – Transport Emissions per Capita (in tons)



Appendix 1.7 – Total Import, Import of Petroleum and Trade Deficit in FY 2017-18, 2018-19 and 2019-20 (in million USD)



Appendix 1.8 – Percentage Share of Different Sectors in Consumption of Petroleum in Pakistan



APPENDIX 2 – EV POLICY AND REGULATION

Appendix 2.1 – India

The Government of India announced the National Electric Mobility Mission Plan (NEMMP) in 2013 to provide reliable and affordable electric mobility solutions (all-electric and hybrids) to the Indian population through incentivizing local production by fostering Government-industry-academia collaboration [22]. The NEMMP aimed at achieving sale of 6-7 million units of EVs by 2020. For this purpose, Government of India committed EUR 2.1 billion in the form of subsidies, tax breaks and other funds. The breakdown of total investments (public and private) per category committed in the NEMMP is as follows in the Table A2.1:

TABLE A2.1: COMMITTED INVESTMENT CATEGORIES IN NEMMP [21]

INVESTMENT CATEGORY	COMMITTED INVESTMENT
Demand-side incentives	EUR 1.9 billion
Development of Infrastructure	EUR 806 million
Research and Development	EUR 241 million

Similarly, the total investment committed according to vehicular categories under the NEMMP is highlighted in the Table A2.2.

In order to fulfill the committed EV sale targets set in the NEMMP, Faster Adoption and Manufacturing of Electric (including hybrids) Vehicles (FAME-I) program was introduced in 2015 for a period of two years to focus on requisite technology development, demand creation, pilot projects and development of charging

TABLE A2.2: COMMITTED INVESTMENT ACCORDING TO VEHICULAR CATEGORIES IN NEMMP [21]

VEHICULAR CATEGORY	COMMITTED INVESTMENT
Two-wheelers	EUR 1.5 billion
Three-wheelers	EUR 102 million
Cars	EUR 1.2 billion
Buses	EUR 175 million
Light Commercial Vehicles	EUR 233 million

infrastructure [23]. Table A2.3 shows the year-wise break-up of funds allocated for the FAME-I.

TABLE A2.3: FUNDS ALLOCATED FOR FAME-1 SCHEME

INVESTMENT CATEGORY	2015-16	2016-17
Technology development (including testing)	INR 700 million	INR 1,200 million
Demand incentives	INR 1550 million	INR 3400 million
Charging Infrastructure	INR 100 million	INR 200 million
Pilot project	INR 200 million	INR 500 million
IEC/operations	INR 50 million	INR 50 million

The crux of the FAME-I scheme revolved around indigenous development of emerging technologies in the EV value chain and reducing the upfront purchase price of the vehicles through offering incentives for the end-users as well as the manufacturers. FAME-I scheme was extended from time to time until March 2019 and the funds allocated were increased to INR 8950 million.

Based upon the review of the FAME-I, Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, adopted FAME-2 scheme with a much wider scope and far-reaching impact compared with FAME-I [22]. In addition to offering demand incentives, FAME-2 focused on catalyzing the market for faster EV adoption, enabling development of supportive ecosystem for EVs and crossing the threshold of economic viability in order to encourage widespread EV adoption. Table A2.4 shows the breakup of funds allocated for the FAME-2.

TABLE A2.4: FUNDS ALLOCATED FOR FAME-2 SCHEME

INVESTMENT CATEGORY	2020-21	2021-22
Demand incentives	INR 45,870 million	INR 31,870 million
Charging infrastructure	INR 4,000 million	INR 3,000 million
Administrative expenses	INR 130 million	INR 130 million
Total	INR 50,000 million	INR 35,000 million

The demand incentives are available to the consumers as well as the OEMs. The incentives for the consumers will be offered in the form of reduced up-front purchase price of the vehicles. The reduced prices offered to the consumers will be reimbursed to the OEMs by the Government of India. The incentives offered are based upon the capacity of the battery utilized in the vehicles. Demand incentive of INR 10,000/ KWh of battery capacity is proposed for all vehicles (excluding buses). For buses the respective incentive is INR 20,000/ KWh. The range of incentives are also extended to promote development of charging infrastructure. The flexibility of funding for the development of commercial-scale charging infrastructure is extended to 100% of the cost of the project including the civil works.

India's approach to EV penetration depends on decentralized policy initiatives. In addition to incentives offered by the NEMMP and subsequently FAME-1 and FAME-2, EV penetration in India is largely contingent upon fiscal and non-fiscal benefits offered by individual states. Of the 28 states within India, 14 have already announced a range of fiscal and non-fiscal policy incentives to spur EV adoption within the respective state. To give an overview of important policy incentives, we have highlighted policy measures adopted by three of these states: Delhi, Tamil Nadu and Kerala. Table A2.5 highlights these policy incentives.

TABLE A2.5: POLICY INCENTIVES IN DIFFERENT STATES OF INDIA

STATE	POLICY INCENTIVES
Delhi (Delhi Electric Policy 2020 ^[25])	<ul style="list-style-type: none"> • Waiver on road tax and registration fee for all EVs • Purchase incentive on two-wheelers of INR 5,000/ KWh of battery capacity in the vehicle up to INR 30,000/ vehicle • Scrapping incentive of INR 5,000 per vehicle for ICE-based two-wheeler owners who purchase electric two-wheelers. • Purchase incentive of INR 30,000 on each electric three-wheeler. • Interest subvention of 5% on loans/other purchase schemes for electric three-wheelers. • Purchase incentive of INR 10,000/ KWh of battery capacity with a maximum incentive of INR 150,000 per vehicle (cars). • Exemption on parking fee for all-electric goods carriers • Grant of up to INR 6,000 on purchase of private charger for first 30,000 chargers • Development of at least one fast charging station in 3 sq km area within cities. • Concession on lease rentals for energy operators who provide fast charging solutions. • Concessionary tariff rate for private and commercial EV charging.
Tamil Nadu (Tamil Nadu Electric Vehicle Policy, 2019 ^[26])	<ul style="list-style-type: none"> • Waiver on road tax and registration fee for two-wheelers, light goods carriers and commercial cars • Waiver on registration fee and exemption on road tax (50%-100%) for private cars. • At least one fast charging station to be developed in 3 sq km in major cities and across 25 km on highways. • Complete exemption on electricity tax for commercial-scale fast charging. • Private EV charging will incur the same tariff rate as domestic consumption. • Tariff for public charging will not exceed above 15% of the average cost of supply of electricity. • Preference will be given to the fast-charging station on supply from renewable sources. • 100% reimbursement of the state GST. • Capital subsidy of 15% will be offered to the investors incase state GST cannot be waived. • 15-50% subsidy on the cost of land for EV and charging infrastructure manufacturing industry.
Kerala (Policy on Electric Vehicles for the State of Kerala ^[27])	<ul style="list-style-type: none"> • At least one fast charging station to developed in 3 sq km in major cities and across 25 km on highways. • Capital Subsidy of 15% on the value of the charging station (equipment and machinery only). • Capital subsidy of 25% of the fixed capital investment (of eligible assets). • Establishment of fund for acquisition of technology for manufacturers of EVs and charging hardware. • Priority to be given to manufacturers for allocation of land. • Setting-up of specialized EV manufacturing zones. • Kerala State Electricity Board Ltd., to ensure firm and reliable supply of electricity for EV charging and provide attractive tariff rate.

Appendix 2.2 – Bangladesh

Provisions have been made for EVs in the Automobile Industry Development Policy of 2020, which calls for at least 15% of the registered vehicles to be powered by “environment-friendly electricity” by 2030. The government has also declared attractive tax exemptions for investments related to energy-efficient vehicles (EEVs) and import duty reductions for materials that promote local EEV assembly. Various tax incentives have also been put in place recently for hybrid vehicles and electric two and three wheelers. Similarly, tax rebate have been announced for assembling, component production, R&D activities, and new technology acquisition for EEVs. New tariff categories have been introduced for charging stations by the Bangladesh Energy Regulatory Commission (BERC). With regards to the import of EVs, the government of Bangladesh is increasingly concerned about environmental protection and has allowed EV import on the condition that recycling and disposal of lithium-ion batteries occurs in a sustainable manner. Arrangements have been made about re-exporting lithium-ion batteries for recycling purposes to other regions, for which the importer is required to enter into an agreement with the government. Until a few years ago, battery-run three-wheelers were not being registered, depriving the government of registration and licensing fees. However, now the Bangladesh Road Transport Authority (BRTA) has issued guidelines regarding the registration of EVs. The Government of Bangladesh has taken several steps in the right direction to fast-track electrification of the transport system of the country. Tax incentives have been announced for the import of EVs, and at various steps of the manufacturing and assembling supply chain. Incentives have also been declared for the installation of charging infrastructure, therefore, making it a suitable ground for EV investors.

Appendix 2.3 – Sri Lanka

The Government of Sri Lanka has announced certain incentives in the budget for FY 2018 and 2019 to promote the use of electric and hybrid vehicles ^{[18],[19]}. Sri Lanka plans to complete shift to non-fossil fuel-based vehicles by 2040 and by 2025 the entire state-owned vehicular fleet will be shifted to either electric or hybrid vehicles. The import tax on electric cars has been reduced by LKR 100,000. Similarly, the luxury tax-free threshold for electric cars has been increased to LKR 6 million and revision on excise duty on hybrid and electric vehicles has been proposed to reflect energy efficiency benefits. In order to encourage EV penetration in the three-wheeler segment, proposal has been put forward to revise loan-to-value ratio to 90:10. A concessionary loan scheme has been proposed for three-wheelers where government will bear 75% of the interest rate. Introduction of 50 electric-buses has been proposed in the vehicular fleet of Sri Lanka Transport Board. Proposal to incentivize off-grid solar PV for vehicular charging has also been put forward to curb dependence on fossil fuels.

Another key vertical of Sri Lanka’s approach on transition towards electric mobility is through increase in exiting taxes and duties on ICE-based vehicles. The import tax on ‘high-end’ ICE-based vehicles has been increased by LKR 2.5 million and an additional special tax on luxury vehicles, having an engine capacity of more than 2500 cc, has been imposed. A proposal has been put forward to increase carbon tax on all ICE-based vehicles. Similarly, import tax on diesel-run three-wheelers has been increased by LKR 50,000.

APPENDIX 3 – CHARACTERISTICS OF THE CURRENT AND FUTURE EV AND BATTERY MARKETS IN PAKISTAN

APPENDIX 3.1: FUTURE ELECTRIC TWO-WHEELERS MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS		POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
		EXPECTED PRICE (USD)	RANGE (KM)	
Electrum Motors	E-bike	500	80	Joint venture
Plum Qingqi	E-bike	930	80	-
IRTIKAZ Solutions	E-bike	-	60	Potential partnership
Viscelerate Mobility	E-bike	775	-	Module and charger designing/ 3-5 million
SoluNox	E-bike	-	-	Partnership with EV giants as solution provider
Cyber Drive	E-bike	-	-	Open for venture capital fund
Ravi Automobile	E-bike	-	-	Technical support for two-wheeler/ equity investment
Treet Group	E-bike	-	-	Technology transfer or partner JV

APPENDIX 3.2: FUTURE ELECTRIC THREE-WHEELERS MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS		POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
		EXPECTED PRICE (USD)	RANGE (KM)	
Electrum Motors	E- 3W	1,700	120	Joint Venture
Plum Qingqi	E- 3W	-	-	-
Mega Electric	E- 3W	-	-	Technology transfer/seeking capital investment
Viscelerate Mobility	E- 3W	3,100	-	Module and charger designing/ 3-5 million
SoluNox	E- 3W	-	-	Partnership with EV giants as solution provider
Cyber Drive	E- 3W	-	-	Venture capital fund
Green Wheels	E- 3W	2,500	120	Equity investment
JOLTA Electric	E- 3W	-	-	In-house designing, R&D in batteries & motors/10-million as VC funds
Indus Electric	R-kits	2200	100	Potential partnership

APPENDIX 3.3: FUTURE ELECTRIC CARS MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS		POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
		EXPECTED PRICE (USD)	RANGE (KM)	
KAN Energy	E-car	<19,000	300	Technology partnership and possible joint venture
AEI	LSEV	-	-	Seeking partnership in batteries, control units and in electronics
Designit	R-kits	6,200	-	Conversion kits, staff training, manufacturing support/0.1-0.5 million
MAQ International	E-car	-	-	Joint venture and partnership in equipment and charging infrastructure.
OptoElectronics	E-car	-	-	Open to discuss the potential collaborations
INER-Z	E-car	-	-	Partnership in batteries and charging/ 6-7 million
SoluNox	E-car	-	-	Partnership with EV giants as solution provider
Mega Electric	E-car	-	-	Technology Transfer/seeking capital investment
Sapphire Group	E-car	-	-	-
JOLTA Electric	R-kits	-	-	In-house designing, retrofitting of cars
Green Wheels	LSV	-	-	JV and ToT/ 3 million for cars

APPENDIX 3.4: FUTURE ELECTRIC LTV/HTV MARKET IN PAKISTAN

COMPANY	PRODUCT	CHARACTERISTICS		POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
		Capacity	RANGE (KM)	
AUTOCOM	E-Truck	<1 ton	-	Transfer of technology along with investment
Zia Electromotive	E-LTV/HTV	1-5 ton	-	Joint venture
Tesla Industries	E-Truck	1 ton	-	Seeking Investment in product designing and manufacturing

APPENDIX 3.5: FUTURE BATTERY MARKET IN PAKISTAN

COMPANY	SEGMENTS	TECHNOLOGY	POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
FFC	All	Li-ion	Seeking potential partners in development and manufacturing/ open for JV and technology partnership
Treet Group	All	Li-ion	Seeking technology partnerships/JV
SB-entrack	Two & three-wheelers	Li-ion	Company might invest 1-2 million in the first phase-JV is preferred/interested in ToT
Ather Tech.	All	Li-ion	Seeking potential partnerships
Orient Energy	All	Li-ion	After market research, will be seeking potential partnerships
Lotia Engineering	All	Li-ion	Interested in investing 0.2-0.4 million for ToT and JV
SabzTek	Lithium-ion cells	Li-ion	Technology partnership/seeking investment of 300 million
ZUES Energy	All	Li-ion	Transfer of technology and equity share
NeuWat	All	Li-ion	Technology transfer and potential partnership
Inventus Power	All	Li-ion	Seeking potential JV with pakistan companies

APPENDIX 3.6: FUTURE CHARGING INFRASTRUCTURE AND CHARGING SERVICES MARKET IN PAKISTAN

COMPANY	SEGMENTS	POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
Hadron solar	Charging/battery swapping stations	Open to discussion and venture capital fund
Orient Energy	Commercial charging stations	After market research, will be seeking potential partnerships
Euro Oil	Commercial charging stations	Seeking partnership in development & deployment of charging stations and swapping stations/ open for JV and ToT
NeuBolt	Swappable stations/ BAAS	Seeking partner to venture in swappable battery model/ invest in swap stations
Hill Enterprise	Commercial & home-based chargers	Equity investment
Fuel Motion Inc.	Commercial charging stations	Seeking potential partnership
Solis Energy	Chargers/ charging stations	Transfer of technology and seeking support for local production
Energi by Matra	Commercial charging stations	Transfer of technology in chargers and technical staff support
FFC	Charging stations	Seeking potential partners in development and manufacturing/ open for JV and technology partnership
Woot Tech	Charging stations	Technology partnership in setting up charging stations for three-wheelers and partnership in R&D.
ZUES Energy	Charging infrastructure	Transfer of technology and equity share
KAN Energy	Charging stations	Technology partnership with US and international companies

APPENDIX 3.7: FUTURE EV RELATED PARTS AND MOTORS MARKET IN PAKISTAN

COMPANY	SEGMENTS	POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
AMZ international	Parts manufacturing	Seeking potential partnership in electronics, controlling software and BMS
Ravi Automobile	Casting & forging/ EV related parts	Technical support in EV parts/interested in equity investment
Lotia Engineering	EV parts for motors, chargers etc.	Interested in investing 0.2-0.4 million for ToT and JV
SBEEC	Motor drive & controllers	Company might invest 1-2 million in the first phase-JV is preferred/ interested in ToT as well
Fuel Motion Inc.	Drivetrain and BMS of batteries	Seeking potential partnership
FFC	High efficiency motors and control units	Seeking potential partners in development and manufacturing/ open for JV and technology partnership
G.F.C	Motors	Open to joint venture and technology partnership model
KAN Energy	Motors, BMS and EV parts for cars	Technology partnership and possible joint venture

APPENDIX 3.8: FUTURE ELECTRONICS, MINING AND SOFTWARE MARKET IN PAKISTAN

COMPANY	SEGMENTS	POTENTIAL COLLABORATION/ INVESTMENT NEEDS (USD)
Microtech	EV related electronics	Partnership in technology development to allow quick entry in local market/ open for JV and technology partnership
Woot Tech	BMS, automation and electronics	Potential partnership in R&D
Telsec	Sensors, controllers & electronics	Interested in potential partnerships, already collaborated with companies in UAE and EU
Piranha	Mining of lithium, nickel and manganese	Technology partnership/ investment of 30 million for small scale extracting of composites
Sabztek	Mining of rare earth elements	Technology partnership/ investment of 300 million

APPENDIX 4 – LIST OF INTERACTIONS DURING THE STUDY

Sr. No	NAME	COMPANY	WEBSITE
1	Shaaf A. Mehboob	Adaptive Technologies	https://adaptive-tec.com/about/
2	Shahab Raza Raja	AEI-Tek	http://www.aei-co.com/
3	Tauqir Lodhi	AGL Supply Chain (Pvt) Ltd	www.agl-sc.com
4	Ashar Afzal	Ahmed Fine Weaving	http://www.ahmedfine.com/mv.html
5	Abdul Manan	AMZ Internationals	https://amzinternational.com/
6	Ali Ahmad Minhas	Army Welfare Trust	https://www.awt.com.pk
7	Mian Shaukat Shafi	Asian Development Bank	https://www.adb.org/
8	Rizwan Majeed	Ather Technology	http://www.athertechnologies.com/
9	Mansoor Jamil	Atlas Battery Ltd.	http://www.atlasbattery.com.pk/
10	Sadullah Ejaz	Atlas Honda Limited	https://www.atlashonda.com.pk/
11	M. Faisal ur Rehman	AUTOCOM	https://autocom.com.pk/
12	Mansoor Lashari	Barq Box	https://barqbox.com/
13	Ahmad Khan	Cheetay	https://cheetay.pk
14	Dr. Aazir Khan	Cyber Drive/IECE	https://uol.edu.pk/iece/
15	Benjamin Brink	DEG	https://www.deginvest.de/International-financing/DEG/
16	Awais Jalai	Designit	http://designit.com.pk/
17	Almas Haider	EDB	http://engineeringpakistan.com/
18	Muffi Ghadiali	Electriphi	https://www.electriphi.ai/
19	Rana Tauseef Iqbal	Electrum Motors	
20	Omer Mukhtar	Energi by Matra	https://www.energi.com.pk/
21	Adnan Nasir	Euro Oil Limited	https://www.euro.com.pk/
22	Tauqeer Hassan Khan	FFC	https://www.ffc.com.pk/
23	Bakhtiar Agha	Fuel Motion Inc.	http://fuelmotioninc.com/
24	Nabeel Ilyas	GFC Fans	https://www.gfcfans.com/
25	Muhammad Ayaz	Green Wheels Pvt. Ltd	
26	Waqas Moosa	Hadron Solar (Pvt) Ltd.	https://www.hadronsolar.pk/
27	Feroz Arshad	Hills Enterprise	
28	Jahanzaib Burana	Hoopoe	https://myhoopoe.com/
29	Tanzeel ur Rehman	Indus Electric	https://induselectric.com.pk/
30	Murtaza Zaidi	INER-Z	https://iner-z.com/
31	Michael Grundke	Inventus Power	https://inventuspower.com/
32	Munir Raza Waris	IRTIKAZ Solutions	http://irtikaz.com/
33	Omer Ayub Izhar	Izhar Group	https://izhar.com/
34	Shiomi Masahiro	JICA	https://www.jica.go.jp/pakistan/english/index.html
35	Omer Khokar	JOLTA Electric	https://www.joltaelectric.com/
36	M. Khalid Mushtaq	KAN Energy	https://kanenergy.com/
37	Majir Munir	Karakorum Capital Partners	
38	Hassan Daud Butt	KP-BoIT	http://kpboit.kp.gov.pk/#sthash.phUR6fvF.dpuf
39	Pervaiz Iqbal	LESCO	http://www.lesco.gov.pk/
40	M. Ali Lotia	Lotia Engineering	https://lotiaeng.com/
41	Atiq Qasim	MAQ International	https://www.maqint.com/
42	Shakeel Ahmed Meer	Mega Electric	https://megabikes.pk/step-1-mega-bikes
43	Ahmad Majeed Khan	Mentor Graphis Pakistan	https://www.mentor.com/company/
44	Ammar Khalid	MG Motors	https://mgmotors.com.pk/
45	Malik Amin Aslam	MoCC	http://mocc.gov.pk/
46	Shibli Faraz	MoST	https://most.gov.pk/
47	Nauman Saeed	MTI	http://www.mtilimited.com/
48	Saad Bin Hammad	n4business	https://n4business.com/index.html

Sr. No	NAME	COMPANY	WEBSITE
49	Sardar Mohazzam	NEECA	https://neeca.gov.pk/index
50	Tauseef Farooqi	NEPRA	https://www.nepa.org.pk/
51	Muhammad Salman	NeuBolt	http://neubolt.com
52	Khurram Ali Ilyas	NeuWat	http://neuwat.com
53	Khawaja Haris Nadeem	OptoElec	
54	Sajjad Nasim	Orient Energy System	https://www.orient-power.com/
55	Suneel Surfarz Manj	Pakwheels	https://www.pakwheels.com/
56	Mashood Khan	PAPAAM	https://www.paapam.com/
57	Sohail Qadri	PBIT	http://www.pbit.gop.pk/
58	Syed Kazmi	PEPSICO	https://www.pepsico.com/
59	Tariq Khan	Piranha Company	http://www.piranhacompany.com/
60	Shah Alam	PLUM Qingqi Motors	http://qingqi.com.pk/
61	Talha Gorski	QUALCOMM	https://www.qualcomm.com/
62	Fahad Iqbal	Ravi Motors	http://www.raviautomobile.com/
63	Naveed Nazir	SabzTek	http://sabztek.com/
64	Bilal Juadet Ahmed	Sapphire-BYD	https://www.sapphire mills.com/sapphire-group
65	Zubair Aamir	Sazgar Engineering Works	http://www.sazgarautos.com/
66	Moiz A. Khan	SB- Entrack/SyedBhais	http://enttrack-sb.com/
67	Farman Lodhi	Solis Energy Solution	https://solis-energy.com/
68	Sajid Ali K. Tareen	SoluNox	https://solunox.com.pk/
69	Adeel Gohar	Sunra EV	http://sunraev.pk/
70	Shaukat Qureshi	SZS's EV Auto Division	https://www.zias.com.pk/
71	Mohyuddin Khan	Teleport	https://teleport.com.pk/
72	Dr. Afnan Ullah Khan	TELSEC CORP	http://www.telseccorp.com/
73	Aamir Hussain	Tesla Industries (pvt) Ltd.	http://tesla-pv.com/
74	Mehmet CelePoglu	Total Parc Pakistan	http://www.totalparco.com.pk/
75	Syed Shahryar Ali	Treet Group	https://treetgroup.com/
76	Usman Manzoor	UNDP	https://www.undp.org/
77	Bilal Hussain	VISCELERATE Mobility	
78	Badar ur Rehman	Volvo Pakistan	http://vpl.com.pk/
79	Dr. Bilal Siddique	Woot Tech	https://woot-tech.com/
80	Said Dahdah	World Bank	https://www.worldbank.org
81	Rehan Aslam	ZOX Cell	https://www.zoxcell.com/
82	M. Faheem Ashraf	ZUES Energy	https://www.zeus.com.pk/

APPENDIX 5- PARTNERSHIP MODELS

Government's Commitment

SEZs, STZs and Export Processing Zones serve as key Government entities in developing and diversifying economy of Pakistan through the creation of specialized industrial zones at strategic locations ideally suited for logistics and transportation of goods. Developed land with ready access to utilities is provided with 100% ownership rights with easy installments and provides ready access to existing skilled labor or harnessing available HR potential to train people with specific skills. To incentivize production, there is a 10-year tax holiday on corporate income tax and custom duty exemption on capital goods for setup of the industry. All the services are provided through a one-window operation with on-site Environmental Impact Assessment (EIA) approvals.

In the most recent budget of 2021, an additional Special Technology Zones Authority (STZA) has been created for promotion of technology related industry. Pakistan offers a potentially huge HR resource with 40,000 IT graduates entering the workforce every year. The aim of STZA is to facilitate collaboration between industry, academia, and the government for a tech-driven Pakistan. The Special Technology Zones are slated to be setup in Islamabad Capital Territory and each of the provincial capitals of Karachi, Lahore, Quetta and Peshawar. In addition to the incentives provided to SEZs, STZs provide exemption from property tax and exemption of GST on goods and services for import of plant, machinery, equipment and raw materials for consumption of these items within zones by the STZA. To facilitate a culture of entrepreneurship, STZs offer tax exemption on dividend income and long-term capital gains from investments for a period of ten years. STZs are generally suitable for the EV value chain to help with design and development of engineering products in batteries, motors, drive-train, peripheral electronics and value added services in smart mobility with new paradigms such as Mobility as a Service (MaaS) and Energy as a Service (EaaS).

The incentives of National EV Policy are geared towards a gradual establishment of the local value chain with 2 years of SKD units import in vehicles and components moving to CKD units and then localization of manufacturing. The custom duties and GST have been reduced to a minimum and waiver of registration fee is recommended in the policy. Setting up of an inter-ministerial committee for resolution of EV policy issues shows a continued commitment of the government to increase the facilities extended to this sector and address the newly identified challenges in this fast-evolving area of technology driven manufacturing.

REFERENCES

- [1] Worldometers.info. 2021. *Pakistan Population (2021) - Worldometer*. [online] Available at: <<https://www.worldometers.info/world-population/pakistan-population/>> [Accessed 15 July 2021].
- [2] NHA. n.d. *National Highway Authority*. [online] Available at: <<https://nha.gov.pk/sitepages/topic/13>> [Accessed 19 July 2021].
- [3] *State of Industry Report 2020*. [ebook] NEPRA. Available at: <<https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202020.pdf>> [Accessed 15 July 2021].
- [4] Finance.gov.pk. 2020. *Trade and Payments*. [online] Available at: <https://www.finance.gov.pk/survey/chapter_20/08_Trade_and_Payments.pdf> [Accessed 24 June 2021].
- [5] Ahmad, A., Saqib, M., Rahman Kashif, S., Javed, M., Hameed, A. and Khan, M., 2016. Impact of wide-spread use of uninterrupted power supplies on Pakistan's power system. *Energy Policy*, 98, pp.629-636.
- [6] *Pakistan Statistical Yearbook 2019*. [ebook] Pakistan Bureau of Statistics, p.458. Available at: <https://www.pbs.gov.pk/sites/default/files/other/Pakistan_Statistical_yearbook_2019.pdf> [Accessed 18 July 2021].
- [7] *National Broadband Policy-2021*. [ebook] p.19. Available at: <[https://moitt.gov.pk/SiteImage/Misc/files/National%20Broadband%20Policy%202021%20Consultation%20Draft\(1\).pdf](https://moitt.gov.pk/SiteImage/Misc/files/National%20Broadband%20Policy%202021%20Consultation%20Draft(1).pdf)> [Accessed 4 July 2021].
- [8] Senate.gov.pk. 2020. [online] Available at: http://senate.gov.pk/uploads/documents/questions/1591786040_459.pdf
- [9] Pakistan Engineering Development. n.d. *Electric Vehicle Policy*. [online] Available at: <<http://engineeringpakistan.com/wp-content/uploads/2020/08/EV-New-Tech-Policy-060420.pdf>> [Accessed 28 June 2021].
- [10] *ALTERNATIVE AND RENEWABLE ENERGY POLICY 2019*. [ebook] Government of Pakistan. Available at: <https://www.aedb.org/images/Draft_ARE_Policy_2019_-_Version_2_July_21_2019.pdf> [Accessed 27 July 2021].
- [11] Eckstein, D., 2019. *GLOBAL CLIMATE RISK INDEX 2020*. [online] Berlin: Germanwatch, p.9. Available at: <https://germanwatch.org/sites/germanwatch.org/files/20-2-01e%20Global%20Climate%20Risk%20Index%202020_10.pdf> [Accessed 10 November 2020].
- [12] Pakistan Today, 2020. Gujranwala, Faisalabad among five most polluted cities in world. [online] Available at: <<https://www.pakistantoday.com.pk/2020/02/25/airborne-pollutants-pakistan-ranked-2nd-globally/>> [Accessed 10 November 2020].
- [13] *Pakistan 7Th Most Vulnerable Country To Climate Change*. [online] United Nations Development Programme. Available at: <<https://www.adaptation-undp.org/pakistan-7th-most-vulnerable-country-climate-change>> [Accessed 10 November 2020].
- [14] Kiani, K., 2021. Govt orders all petrol, diesel imports be Euro-V compliant as oil companies protest move. *DAWN*, [online] Available at: <<https://www.dawn.com/news/1567870>> [Accessed 17 July 2021].
- [15] Cia.gov. n.d. *Country Comparison*. [online] Available at: <<https://www.cia.gov/the-world-factbook/field/roadways/>>

country-comparison> [Accessed 2 July 2021].

[16] Yasar, A., Haider, R., Tabinda, A.B., Kausar, F. and Khan, M., 2013. A comparison of engine emissions from heavy, medium, and light vehicles for CNG, diesel, and gasoline fuels. *Pol. J. Environ. Stud*, 22(4), pp. 1277-1281.

[17] Pbs.gov.pk. 2021. *External Trade Statistical Data at 8-Digit Level Year 1990-1991 to 2019-2020* | Pakistan Bureau of Statistics. [online] Available at: <<https://www.pbs.gov.pk/node/1358>> [Accessed 24 June 2021].

[18] Parliament.lk. 2018. *Budget 2019*. [online] Available at: <<https://www.parliament.lk/files/pdf/budget/2019/budget-speech-2019.pdf#page=161>> [Accessed 2 July 2021].

[19] Parliament.lk. 2018. *Budget Speech 2018*. [online] Available at: <<https://www.parliament.lk/files/pdf/budget/2018/budget-speech-2018.pdf>> [Accessed 2 July 2021].

[20] Development Plan for Pakistan- Oil and Gas Industry 2020. [ebook] Available at: <[http://www.mprn.gov.pk/SiteImage/Downloads/1389\(20\)Development%20Plan%20New%20Mail%20on%2011-11-2020%20\(2nd%20Draft\).pdf](http://www.mprn.gov.pk/SiteImage/Downloads/1389(20)Development%20Plan%20New%20Mail%20on%2011-11-2020%20(2nd%20Draft).pdf)> [Accessed 11 July 2021].

[21] Jiip.eu. 2021. *National Electric Mobility Mission Plan*. [online] Available at: <<https://jiip.eu/mop/wp/wp-content/uploads/2021/01/National-Electric-Mobility-Mission-Plan-2020-India.pdf>> [Accessed 27 July 2021].

[22] Ministry of Heavy Industry. 2020. *National Electric Mobility Plan*. [online] Available at: <<https://dhi.nic.in/writereaddata/Content/NEMMP2020.pdf>> [Accessed 8 July 2021].

[23] Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India. [ebook] Available at: <https://smartnet.niua.org/sites/default/files/resources/Fame_India_Revised_270415.pdf> [Accessed 8 July 2021].

[24] Different Between Euro 5 and Euro 6 Gasoline & Diesel Standards. [ebook] p.03. Available at: <<https://engage.aiche.org/HigherLogic/System/DownloadDocumentFile.ashx?DocumentFileKey=d4fae029-91c5-4189-ac75-d8d404d81f41&ssopc=1>> [Accessed 17 July 2021].

[25] Ministry of heavy Industry. 2021. [online] Available at: <https://transport.delhi.gov.in/sites/default/files/All-PDF/Delhi_Electric_Vehicles_Policy_2020.pdf> [Accessed 30 July 2021].

[26] Tamil Nadu Electric Vehicle Policy 2019. [ebook] Government of Tamil Nadu. Available at: <<https://powermin.gov.in/sites/default/files/uploads/EV/Tamilnadu.pdf>> [Accessed 21 July 2021].

[27] Mvd.kerala.gov.in. 2019. *Policy on Electric Vehicle for Kerala State*. [online] Available at: <https://mvd.kerala.gov.in/sites/default/files/Downloads/e_vehicle_policy_go_no24_19.pdf> [Accessed 6 July 2021].

[28] Finance.gov.pk. 2021. *Trade and Payments*. [online] Available at: <https://www.finance.gov.pk/survey/chapters_21/08-Trade%20and%20payments.pdf> [Accessed 25 June 2021].

[29] Finance.gov.pk. n.d. *Trade and Payments*. [online] Available at: <https://www.finance.gov.pk/survey/chapters_19/8-Trade%20and%20payments.pdf> [Accessed 25 June 2021].



USAID
FROM THE AMERICAN PEOPLE