SAARC Energy Centre, Islamabad
Pakistan

THE REPORT

Webinar to Disseminate the Study on
“Infrastructure & Enabling Environment for Road Electric
Transport in SAARC Member States”

Tuesday, May 5, 2020, Islamabad
Organised by
SAARC Energy Centre, Islamabad

5th May 2020

SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF),
Islamabad, Pakistan
www.saarcenergy.org
Introduction

SAARC Energy Centre Islamabad, under its approved Program Activities for the year 2020, successfully conducted a Webinar to Disseminate the Study on “Infrastructure and Enabling Environment for Road Electric Transport in the SAARC Member States” on Tuesday, 5th May 2020. The agenda of the webinar is available at Annexure-I.

1. The main focus of the webinar was towards dissemination of the findings and recommendations of the study to the delegates from the SAARC Member States to get their feedback and comments for value addition and further improvement of the study report. Areas discussed were: Study Approach and Methodology, Global EV Scenario and Future Growth, EV Types and Battery Technologies, EV Business Models, Key Drivers for EV Adoption in SAARC, and Country-wise Recommendations. Furthermore, China’s rapid journey towards EV and Pakistan’s current EV landscape were also discussed.

Participation

2. The webinar was attended by a total of 116 professionals representing public sector organizations, academia, private sector, and other stakeholders from within and outside the SAARC region. The Study Authors from India Smart Grid Forum and Resource Persons from China and Pakistan shared their knowledge of technologies, government policies, existing practices, and international experience in the field of Electric Vehicles. The participant’s list is available at Annexure-II.
Description
3. The webinar started with welcome remarks by Program Coordinator, Mr. Muhammad Umar Mukhtar, from SAARC Energy Centre. The technical session comprised of presentations by the Resource Persons. Each presentation was followed by a brief Q&A session. The program coordinator read-out conclusions, which were gathered during the webinar. Before closing the webinar, the Program Coordinator from SAARC Energy Centre offered remarks of appreciation to all the participants and Resource Persons.

Technical Proceedings
4. All the presentations delivered during the webinar are available at SEC’s website www.saarcenergy.org. The list of Resource Persons / Experts is available at Annexure-III and presentations made by them at Annexure-IV. Brief information about each delivered presentation is as follows:

Presentation 1 – Introduction to the Study and ISGF
Mr. Reji Kumar Pillai, President India Smart Grid Forum & Ms. Reena Suri, Executive Director ISGF

5. Mr. Pillai is a well-known name in India with regards to smart grids and electric vehicles and advises the Government of India on EV policies. Being the Team Lead of the study author team, he started the technical proceedings by providing a brief introduction to the study, including its aims, objectives, and key areas of focus. He, along with fellow colleague Ms. Reena Suri also introduced the credentials of India Smart Grid Forum (ISGF) to the participants, especially their past work on electric vehicles.

Presentation 2 – Study Approach, Methodology, Outcomes, & Findings
Mr. Suddhasatta Kundu, Technical Manager, India Smart Grid Forum

6. Mr. Suddhasatta Kundu has vast experience in planning and developing EV projects and studies in India, and was a key part of the study team. He apprised the participants on the approach and methodology taken for the study report. Furthermore, Mr. Kundu explained the Global EV Scenario and gave a detailed technical overview of the types of EVs and the battery technologies covered in the study report. He comprehensively covered the study outcomes and presented a thorough roadmap for each SAARC Member State for adopting EVs. Finally, he concluded his presentation by explaining the Electric Vehicle Maturity Model to the participants, based on which the country-wise roadmaps and recommendations were developed.

Presentation 3 – Manufacturing of BEV: Discussion on Global Trends and Pakistan
Dr. Shakeel Sadiq Jajja, Assistant Professor, Lahore University of Management Sciences

7. Dr. Shakeel discussed the technical aspects of Electric Vehicles in detail and informed the participants of the perspectives and issues related to the manufacturing of
EVs. He presented the key components of EVs with regards to local manufacturing and comprehensively described the EV manufacturing value chain in Pakistan.

8. According to Dr. Shakeel, Pakistan’s industry with regards to battery manufacturing mainly focuses on lead-acid batteries, and there is not enough focus on lithium-ion batteries. Furthermore, he informed the participants that various motor manufacturers exist in Pakistan, but they lack in motor quality and sophistication because mostly recycled and scrapped material is used for motor manufacturing. He further informed that controller manufacturing is non-existent in Pakistan, and stressed the need for universities and R&D institutes to shift their focus towards EV research.

**Presentation 4 – The Road to Electrification in China**

*Mr. Alan Liu, CEO, GH Energy, China*

9. Mr. Liu presented a comprehensive overview of China’s EV revolution and informed the participants how China rapidly became a world leader in EV manufacturing and adoption. He started his presentation by describing the current situation of EVs in China and apprised the participants that around 1.2 million EVs were sold in China in 2019 alone. Mr. Liu stated that since 2014, over 200 startups in China have been developing and manufacturing EVs, and the focus is now on integrating artificial intelligence and 5G technology to develop intelligent EVs. He also described that due to China’s dependence on imported oil, the government has prioritized the electrification of the transport sector through EVs.

**Feedback Session and Conclusion**

*Mr. Muhammad Umar Mukhtar, Research Fellow (Energy, Transport & Environment), SAARC Energy Centre*

10. Mr. Mukhtar moderated a feedback session for getting insights and comments from the participants with regards to the study report. The participants did not have any specific comments regarding the study; however, they were keen to ask more questions from the study authors regarding general EV topics and trending EV technologies. The participants were given the chance to openly interact with the Resource Persons and ask questions on wide-ranging topics such as charging standards, EV life cycle impact, technology localization, Pakistan EV policy, EV maturity model, and the longest distance covered by EVs in India. At the end of the session, Mr. Mukhtar thanked everyone for their active participation in the session. He informed the participants that the draft study report has been uploaded on the SEC website, and requested them to go through the study report to share study-related feedback and comments in the email.
Closing of Webinar

Mr. Muhammad Umar Mukhtar, Research Fellow (Energy, Transport & Environment), SAARC Energy Centre

11. Mr. Muhammad Umar Mukhtar informed all the participants that the presentations will be available on SAARC Energy Centre’s website (www.saarcenergy.org). He requested the participants to submit suggestions and comments to the SEC for any further improvement to the study report. He informed the participants that they may also suggest and submit any topics of their interest to the SEC for arranging future webinars. He closed the webinar with a thank you note to everyone attending the Webinar.

12. All the presentations delivered during the webinar are available at SEC’s website www.saarcenergy.org.
Annexures
Webinar Agenda

**Webinar to Disseminate the Study on “Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States”**

*Tuesday, 5th February 2020*

<table>
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<tr>
<th>Time</th>
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<td>1100 – 1105</td>
<td><strong>Introduction</strong></td>
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| 1105 – 1125 | **Introduction to the Study and ISGF**  
*Presenter: Mr. Reji Kumar Pillai (President – India Smart Grid Forum)* |
| 1125 – 1145 | **Approach and Methodology of the Study**  
*Presenter: Mr. Suddhasatta Kundu (Technical Manager – ISGF)* |
| 1145 – 1150 | Q & A session                                                            |
| 1150 – 1225 | **Study Outcomes, Findings, and Recommendations**  
*Presenter: Mr. Suddhasatta Kundu (Technical Manager – ISGF)* |
| 1225 – 1230 | Q & A session                                                            |
| 1230 – 1245 | **Study Report Feedback Session**  
*Moderator: Mr. Muhammad Umar Mukhtar – RF(ETE) SAARC Energy Center* |
| 1245 – 1305 | **Manufacturing of BEVs: Discussion on Global Trends and Pakistan**  
*Presenter: Dr. Shakeel Sadiq Jajja (Assistant Professor – LUMS)* |
| 1305 – 1310 | Q & A session                                                            |
| 1310 – 1330 | **The Road to Electrification in China**  
*Presenter: Mr. Alan Liu (CEO – GH Energy)* |
| 1330 – 1335 | Q & A session                                                            |
| 1335 – 1345 | **Summarizing Conclusions and Recommendations of Webinar**              |
| 1345      | Closing of Webinar                                                       |

**Information for the participants:**

1. All times mentioned in the agenda are according to Pakistan Standard Time (PKT). The participants from the other Member States may attend Webinar by following their own national time. The time conversion for all Member States is given below for reference:

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2. The participants can ask questions to presenters by typing questions or clicking to the raised hand option into the Attendees pane of the main window of GotoWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation.

3. All participants can also submit comments/views and/or observations on a webinar to SAARC Energy Centre through email to Mr. Muhammad Umar Mukhtar, Research Fellow (ETE) (rfete@saarcenergy.org) by 12th May 2020.
List of Participants

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<td>73</td>
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<td>Husnain</td>
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<td>Sohail</td>
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<td><a href="mailto:plet@saarcenergy.org">plet@saarcenergy.org</a></td>
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<td>Narangoda</td>
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<td>P</td>
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<td>Wahab</td>
<td><a href="mailto:wahab.saarc@gmail.com">wahab.saarc@gmail.com</a></td>
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<td>Shuvam</td>
<td>Sarkar Roy</td>
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<td>zain ul abedin</td>
<td>khewa</td>
<td><a href="mailto:engineerzain17@gmail.com">engineerzain17@gmail.com</a></td>
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<td>Mahmood</td>
<td><a href="mailto:asadm_46@yahoo.com">asadm_46@yahoo.com</a></td>
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<td>100</td>
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<td><a href="mailto:s.kundu@indiasmartgrid.org">s.kundu@indiasmartgrid.org</a></td>
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<td>kumar</td>
<td><a href="mailto:ravichandran.pradeep.kumar@pwc.com">ravichandran.pradeep.kumar@pwc.com</a></td>
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<td>Mirza Itaf</td>
<td>Hussain</td>
<td><a href="mailto:altafmirza878@gmail.com">altafmirza878@gmail.com</a></td>
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List of Presenters/Resource Persons

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<th>S. No.</th>
<th>Name</th>
<th>Designation</th>
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<td>5.</td>
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<td>CEO</td>
<td>GH Energy</td>
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Presentations Delivered During the Webinar

1. “Study on Infrastructure and Enabling Environment for Road Electric Transport in the SAARC Member States” by Mr. Reji Kumar Pillai, Ms. Reena Suri and Mr. Suddhasatta Kundu (ISGF)
ISGF Credentials on E-Mobility

- Development of implementation roadmap for electrification of public transportation in Kolkata
- Establishment of charging stations for deployment of 80 electric buses (FAME-I) in Kolkata
- Advisory Services on scaling up of electric mobility deployment for the Transport Department of West Bengal, India
- Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States
- Feasibility study on introduction of electric vehicles in the Sundarbans mangroves with special focus on the forest fringe parts of Indian Sundarbans
- Detailed Planning Studies for installation of Electric Vehicle Charging Stations and network upgradation in Bangalore City (on-going)
- Preparation of proposal for Alfantar Energy Pvt. Ltd., Saudi Arabia for allotment of Charging Stations under Fame II Scheme in Cities
- Active participation and contribution in BIS ETD-51 Committee for preparation of Indian standards for EV Charging Infrastructure (IS:17017 series)
- Advised/ Advising several states on formulation of EV Policies (Karnataka, Kerala and West Bengal)

ISGF Credentials on E-Mobility

- Worked with Forum of Regulators (FOR) and several State Electricity Regulatory Commissions for creation of separate electricity tariff slab for EV charging – presently 16 states have special EV tariff
- Conducted a series of brainstorming sessions with different stakeholders and submitted the recommendations to Ministry of Power (MoP), based on which MoP issued order clarifying that EV Charging Business does not require separate license
- Published following White Papers:
  - Electric Vehicle Policies and Electricity Tariff for EV charging in India (2019)
  - Electric Vehicles: A Sustainable Solution for Air Pollution in Delhi (2016)
  - Policy Framework for Electric Rickshaws in Delhi (2014)
Annexure-IV

ISGF Credentials on Smart Grids, RE etc

- Smart Grid Vision and Roadmap for India (2013)
- Smart Grid Roadmap for Perusahaan Listrik Negara (PLN), Indonesia (2019)
- Smart Grid Roadmap for Bangalore Electricity Supply Company (2017-18)
- Energy Storage System Roadmap for India (2019)
- Peer to Peer (P2P) Trading Platform on Blockchain Technology for Trading of Solar Power at Customer Premises in Uttar Pradesh, India (on going)
- Designing of Time of Use Electricity Tariff in the State of Gujarat (on going)
- AMI Rollout Strategy and Cost Benefit Analysis in India (2016)
- Next Generation Smart Metering – IP Metering (2016)

Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States
Annexure-IV

Project Brief and Objectives

- SAARC Energy Centre has been awarded the project “Study on Infrastructure and Enabling Environment for Road Electric Transport in SAARC Member States” to India Smart Grid Forum on 1st June 2018.

**Project Purpose**
- Readiness assessment for transition to electric mobility and subsequent formulation of EV implementation plan for the SAARC member nations

**Key Focus Areas**
- Global EV Scenario
- Global best practices for EV adoption
- Readiness assessment for SAARC countries

**Key Interventions**
- Policy & regulatory
- Business model & tariff design
- Electric grid upgradation
- Institutional development

**Outcome**
- Creation of enabling environment for EV adoption in each SAARC member nation.

Approach and Methodology

- Review of global EV deployment in terms of technology trends, market evolution, vehicle stock etc.
- Assessment of EV infrastructure requirement in terms of charging technology, standards, communication protocol etc.
- Review of best practices adopted by top three global leaders in EV deployment
- Assess readiness of SAARC countries in terms of policy, regulations, institutional capacity and technology deployment for EV
- Recommendation for SAARC countries with respect to policy support, institutional development, incentive mechanism etc.

Electric Vehicle Maturity Model (EVMM) framework has been used for preparing the Electric Vehicle roadmap for the SAARC countries. Details about EVMM process is explained in slides #40-#41
Global Electric Vehicle Scenario

Annual Electric Car sales registered a milestone of 5.1 million + in 2018.

Global Electric Car Stock stands at over 5 million in December 2018.

Largest Stock is in China - 57% of global total.

Global E-2W Sales were 300 million for 2018.

Global E-2W Stock stands at 800 million.

China has the highest share - over 99%.

Almost 4.66 million private chargers at residence & workplace, globally.

Public Slow Charger Outlets: 0.4 million.

Public Fast Charger Outlets: 0.14 million.

China has almost 1 million outside chargers for buses.

Global EV Stock and Future Growth

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<th>Vehicle Type</th>
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<th>2030</th>
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<td>Two Wheelers</td>
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<td>Three Wheelers</td>
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<td>Light Duty Vehicles</td>
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<td>Total</td>
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Types of EV

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<th>HEV</th>
<th>PHEV</th>
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<td>Regenerative Braking</td>
<td>Plug-in</td>
<td>Fuel Cell Energy</td>
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<td>Electricity</td>
<td>Petrol/Diesel</td>
<td>Petrol/Diesel/Electricity</td>
<td>Hydrogen</td>
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<td>Infrastructure</td>
<td>Electric Charging Facilities</td>
<td>Refueling Stations</td>
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<td>Hydrogen Production and Transportation facilities</td>
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<td>Low</td>
<td>Low</td>
<td>No</td>
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<td><strong>Features</strong></td>
<td>High efficiency</td>
<td>Low emission</td>
<td>Low emission</td>
<td>High energy efficiency</td>
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<tr>
<td></td>
<td>• Oil independent</td>
<td>• Better fuel economy compared to ICE vehicles</td>
<td>• Better fuel economy compared to ICE vehicles</td>
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<td></td>
<td>• Commercially available</td>
<td>• Commercially available</td>
<td>• Commercially available</td>
<td>• Under Development</td>
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**Challenges**
- High cost compared to ICE vehicles
- Lack of charging infrastructure
- Relatively short range
- Battery and battery maintenance
- High cost compared to ICE vehicles
- Battery sizing and management
- Longer Range
- High cost compared to ICE vehicles
- Battery sizing and management
- Lack of charging infrastructure
- Longer range compared to conventional hybrids
- Fuel Cell cost, reliability, safety
- Hydrogen infrastructure

Existing Battery Technologies

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<th>Battery Chemistry</th>
<th>Maximum C Rate</th>
<th>Max Temperature (Degree Celsius)</th>
<th>Life (Maximum Cycles)</th>
<th>Power Density (Wh/kg for cell)</th>
<th>Average Module Price (US$/kWh in 2018)</th>
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<td>Lithium Ion Iron-Phosphatate (LFP)</td>
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<td>40</td>
<td>1500-3000</td>
<td>100-130 Wh/kg</td>
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<td>1000-2000</td>
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<td>1000-1500</td>
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<td>60</td>
<td>7500-10000</td>
<td>50-80 Wh/kg</td>
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EV Business Models

I. AGGREGATOR MODEL
- Coordinator between system operator, EV owner and distribution utility
- Collates EVs and create a potential source of energy that can be used by the utilities and system operator during the periods of high demand-supply gap.

II. DISCOMS
- DISCOMs shall be the owners and operator of charging facilities under a separate deregulated model

III. BULK DEPOTS
- STUs themselves shall be the owners and operators of charging facilities for their own buses as well as their franchisee private bus operators

IV. BATTERY SWAPPING
- The battery charging could be at public facilities or at their own captive industrial establishments from where charged batteries can be delivered at strategic locations within the city

V. FRANCHISEES AT PARKING LOTS AND MUNICIPAL FACILITIES
- Franchisees of DISCOMs will own and operate charging facilities at premises allotted by City Governments/Municipalities or leased from the landlords.

Electric Vehicle Key Drivers in SAARC Countries

- Limited Availability and Depleting Fuel
- GHG Emissions from the Transport Sector
- Deteriorating Air Quality
- Volatility in Oil Prices
- INDC Commitments
### SAARC Countries: Existing Scenario

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<th>Country</th>
<th>Installed Power Generation Capacity (MW)</th>
<th>Crude Oil Imports (USD Million)</th>
<th>Petrol Imports (USD Million)</th>
<th>Diesel Imports (USD Million)</th>
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<tr>
<td>Afghanistan</td>
<td>16%</td>
<td>127.32</td>
<td>16.50</td>
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<td>Electricity imports of 5763 GWh from neighboring nations</td>
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<td>37.4</td>
<td>234</td>
<td></td>
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<tr>
<td>Nepal</td>
<td>1,670</td>
<td>-</td>
<td>1,087,656</td>
<td>-</td>
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<tr>
<td>Pakistan</td>
<td>26,186</td>
<td>1,840,742</td>
<td>4,066</td>
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<td>Srilanka</td>
<td>4,043</td>
<td>587,656</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Total</td>
<td>4,01,424</td>
<td>-</td>
<td>-</td>
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### SAARC Countries: Transport Sector Scenario

- **GDP**
  - The transport sector for each SAARC country has a contribution of at least 7% in the respective GDP.

- **Registered Motor Vehicles**
  - SAARC region has over 250 million registered motor vehicles.
  - Heavy increase in motor vehicles forecasted in the near future.

- **Primary Energy Consumption**
  - By the year 2015, the share of transport sector in primary energy consumption stood at 7%.

- **GHG Emissions**
  - The transport sector contributes 8% to 27% of total GHG emissions for different SAARC countries.

Source: [SAARC](https://www.saarc.org), [TERI](https://www.teri.in), [GIZ](https://www.giz.de)

**Share of transport sector in consumption of oil and petroleum products**

- **Share of transport sector in GHG emission**
  - Pakistan: 11%
  - Bangladesh: 6%
  - Srilanka: 16%

Source: [UAEAD](https://www.uaead.com)
Key Recommendations of the Study

Afghanistan: EV Roadmap 2018-20

Visions, Policy & Regulatory, Institutional Capacity (VPIC)
- Establishment of an EV Apex Body for Transport Planning and Policy Development

Roadmap for Incentives (RI)
- Subsidize import, duty on LiBs and registration on e-2W and e-3W
- Provide property tax for charging station installation

Automotive Sector (AS)
- E-3W to be imported from India, China and Japan
- Battery and charging equipment to be imported from India and China for pilot projects

Electrical Infrastructure (EI)
- Utilization of 300MW RE potential and power capacity augmentation by DABs for EV charging

EV Technology (EVT)
- Due to import of e-buses and e-3W from China and India, DABs, CCHGR, or CCEP should be adopted

Value Chain Integration (VIC)
- Big business houses to use e-2W and e-4W for own use and to set up ESS in their areas
- Hotels, hospitals and companies to use their CSR funds for financing of electric buses, four wheelers and charging stations on pilot basis

Customer (CU)
- Create awareness regarding EV pilot programs and encourage this population to use e-Buses and e-3W

Social & Environmental
- Organizing EV awareness programs and conduct workshops and seminars.
Afghanistan: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- National EV Policy
- Pilot project on e-Bus and e-3W in major cities by central and local governments and development banks
- Roadmap for Incentives (RI)
  - Govt support for e-3W, e-Bus and taxi pilot projects
  - Line-up to focus on e-2W and e-4W
- Govt support for 3rd party charging station installation

Automotive Sector (AS)
- F-Bus and e-3W for pilots to be imported from India, China and Japan. Services to be provided by OEMs for initial years.

Electrical Infrastructure (EI)
- Upgradation of electrical infrastructure in bus depots and terminus, three wheeler parking spaces, etc in major cities by DABS for installation of charging stations.

EV Technology (EVT)
- Retrofitting of existing three wheelers which are operating for a long time into e-3W
- Value Chain Integration (VCI)
  - Battery swapping model for e-3W with the help of a Battery Leasing Agency (BLA)
  - DABS and Ministry of Transport to set up charging stations for e-buses in bus depots

Customer (CUST)
- Govt vision on EVs communicated to customers
- Incentives and benefits for adopting an EV to be communicated properly to customers

Social & Environmental
- E-buses and commercial taxi fleets can also provide opportunity to the existing workforce by providing them adequate training or OEM skills

Afghanistan: EV Roadmap 2025-30

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Mandated EV zones in certain city centres, government offices, embassies, major market areas
- EV adoption city targets focused on public transportation by 2035

Roadmap for Incentives (RI)
- Subsidized registration charges for one year for passenger cars as well as subsidies on CABEX
- Duty free import of plant and machinery for setting up of assembly unit on one time basis

Automotive Sector (AS)
- Setting up small assembling units for e-2W and e-3W with foreign companies
- Servicing facility for charging stations can be provided by OEMs and local capacity development

Electrical Infrastructure (EI)
- Improvement in power quality through deployment of technologies like harmonic filters, static compensators
Annexure-IV

Bangladesh: EV Roadmap 2018-20

- Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
  - Launch nation-wide EV mission along with a set of policies and guidelines for e-JW
  - Model agency to oversee the implementation

- Roadmap for Incentive (RI)
  - Subsidize import duty on EVs and registration on e-JW for 3 years
  - Reduce property tax for e-JW manufactures and assemblers
  - Free parking and reduced tolls for electric vehicles

- Automotive Sector (AS)
  - Electric two-wheelers and 3-wheelers to be locally produced or assembled from parts imported from India, China and Japan. PPP or JV route can be used for this purpose

- Technical Infrastructure (TI)
  - Power Quality, Peak Demand and DT assessment by DISCOMs in urban areas for EV charging

 EV Technology (EVT)
- Batteries used in e-JW to be upgraded to lithium ion batteries
- E-JW technology to be upgraded in terms of design, battery capacity etc.
- Value Chain Integration (VCI)
  - Government building and offices to install charging stations in their premises for E usage
  - Major utilities like BPSA, REB etc. to invest in public charging and EV fleet infrastructure

 Customer (CUST)
- Incentives and benefits of EVs passed on to customers
- R&D on the vehicle usage pattern to figure out the load curve for a particular day by EV cell

 Social & Environmental
- Organizing EV awareness programs, conducing workshops and seminars

Bangladesh: EV Roadmap 2020-25

- Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
  - RIIA and RIJa to define guidelines for licensing, driving norms, operation routes to streamline the EV adoption process
  - Public bus, taxi fleet, 3 wheelers fleet electrification and charging station targets in Dhaka and Chittagong

- Roadmap for Incentive (MI)
  - Tax free/reduced tax for profit repatriation to foreign companies
  - Reduced tariff for passenger using electric water transport

- Automotive Sector (AS)
  - Servicing for electric ferries and charging stations to be provided by OEMs for initial years
  - Local manufacturing through foreign collaborations or IMEX FDIs and EV parts

- Technical Infrastructure (TI)
  - Technical infrastructure upgradation and power quality improvement in bus depots and terminals, 3 wheeler parking spaces, etc. in cities by discoms for charging station installation

 EV Technology (EVT)
- EV standards of India and Japan adopted for interoperability

 Value Chain Integration (VCI)
- PPP model with private parking owners or service providers or OEMs and discoms to distribute risk
- Bundle EV/SE as mandatory in new buildings through Building Codes

 Customer (CUST)
- TOU pricing for EV to be communicated to customers
- Subsidized 3WVs and 2 wheelers for first few 1000 customers

 Social & Environmental
- E-bus and Commercial Taxi fleets to provide opportunity to existing workforce
**Annexure-IV**

**Bhutan: EV Roadmap 2020-25**

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Subsidies on CAPEX for e-2W and e-4W
- Separate EV tariff to be considered as also TOU tariff

**Roadmap for Incentive (RI)**
- Reduced electricity tariff for charging
- Reduced road tax for electric four-wheeler commercial
- Reduced property tax for residential charging infrastructure

**Automotive Sector (AS)**
- Servicing facilities for EVs and charging stations to be provided by OEMs
- Electrical Infrastructure (EI)
- Electrical infrastructure upgrade and power quality improvement in cities by BPC for charging station installation
- Grid asset modernization for V2G integration

**Value Chain Integration (VCI)**
- Major cities and tourist places to prioritize the installation of charging stations in parking lots, urban centers, markets, tourist spots etc.
- Mandatory for the JV/ Hydropower projects companies to develop public charging stations

**Customer (CUST)**
- TOU pricing for EV to be communicated to customers
- Incentives and benefits passed onto EV users

**Social & Environmental**
- EV deployment mainly buses and commercial taxi fleets can also provide opportunity to its existing workforce by providing them adequate training on O&M skills

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**Bhutan: EV Roadmap 2025-30**

**Vision, Policy & Regulatory, Institutional Capacity (VPRIC)**
- Guidelines for 3rd party charging stations and providing charging as a service without any kind of licensing at least for one year
- Grid Code and Distribution Code guidelines must be updated for Vehicle to Grid (V2G) integration

**Roadmap for Incentive (RI)**
- Attractive FDI policy with single window clearance, registration, tax breaks, reactivation facility etc.
- Bulk insurance at concessional rate for commercial fleets

**Automotive Sector (AS)**
- Testing and certifying facility to be established in conjunction as assembly units for EVs
- Promote local manufacturing of e-2W through PP or with foreign companies
- Electrical Infrastructure (EI)
  - Upgradation of electrical infrastructure
  - Grid asset modernization for implementing V2G solution

**Value Chain Integration (VCI)**
- R&D on EV design to be initiated in collaboration with technology institutes, research labs, industries etc.

**Customer (CUST)**
- Customers are engaged in consumer programs through V2G integration on pilot basis
- Advanced services for customers like door step service for car charging

**Social & Environmental**
- 3rd party service providing of charging station will lead to job creation and people
India: EV Roadmap 2018-20

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Public transport electrification - Smart City Mission
- Grid Code and Distribution Code guidelines to add VDC
- Building code revision: Charging infra mandated

Roadmap for Incentive (R1)
- Reduced tax on profit repatriation
- Subsidized registration charges for 1-2 years for 3 wheelers. Road and toll tax exemption for electric buses. Subsidized parking charges for electric cars.

Automotive Sector (AS)
- Servicing facilities of electric vehicles and charging stations to be provided by OEMs

Electric Infrastructure (EI)
- Upgradation expense shared by OEMs or 3rd party service providers of charging stations
- Implementation of charging stations by supermarkets, big retailers with electrical network upgradation at own cost.

India: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- EV Technology (EVT)
  - Enhancement of the charging standards and communication protocols being used
  - State Transport Authorities to install charging stations on ferryghats for boats
  - PPP model with private parking owners: service providers or OEMs and depending on distribution risk
  - Pilot projects for water transport fle electrification

Value Chain Integration (VCI)
- Advance booking of parking slots through booking based on time and number of slots required by the individual
- Incentives and benefits of EVs passed on to customers

Social & Environmental
- E-2W and E-3W manufacturing an assembling plants will help in job creation
India: EV Roadmap 2025-30

- Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Government to make mandatory full electrification of public & private buses in cities and towns
- R&D on battery and battery recycling
- Value Chain Integration (VCI)
  - Bundle EVSEs as mandatory in new buildings
  - Customer (CUST)
    - Customers are engaged in consumer programs
- Social & Environmental
  - Usage of electric boats and launches will negate the chances of oil spills from boats.

Maldives: EV Roadmap 2018-20

- Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- MTE, MND, and MTA to launch nation-wide EV mission with a set of policies
- Technology (EV)
  - Technology for E-290s to be upgraded in terms of design, battery capacity, etc.
  - Maldives can adopt CCHS and CHADEMO and India charging standards
- Value Chain Integration (VCI)
  - Government building offices to elect"
Annexure-IV
Nepal: EV Roadmap 2018-20

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Govt to launch nation-wide EV mission with a set of policies and coverage all 7 provinces
- MPT to identify and eradicate EV adoption targets across cities with respect to public transportation, including buses and three wheelers

Roadmap for incentives (RI)
- Exempt import and customs duty on EVs and EV components
- Reduced electricity tariff for charging

Automotive Sector (AS)
- E-3Ws to be assembled with imported parts from India or China
- Promote local manufacturing through PPP or with joint ventures with foreign companies like in India, Japan etc.

Electrical Infrastructure (EI)
- Ensure the availability of power and space capacity in BRT, in areas having potential for charging station implementation

Nepal: EV Roadmap 2020-25

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
- Separate EV tariff or TOU pricing for EVs
- Building codes to mandate charging facility in dedicated spaces in urban areas

Roadmap for Incentives (RI)
- Reduced road tax for EVs commercial fleet
- Reduced property tax for residential complexes, resorts and hotels for installing charging stations

Automotive Sector (AS)
- Servicing facility for charging stations to be provided by OESAs. 100% local manufacturing units to be promoted for e-3W and e-3W
- Feasibility study for metro in the capital

Electrical Infrastructure (EI)
- Uplifting of electrical infrastructure in bus depots and terminals, parking lots, malls etc. by NEA for installation of charging stations

EV Technology (ETV)
- Batteries used in E-3Ws to be upgraded lithium ion batteries
- Indian charging standards (IS:17017) may be adopted

Value Chain Integration (VCI)
- Government buildings and offices to electrify vehicles and install charging stations
- NEA along with DoT to invest in charging stations for electric buses in bus depots and terminals

Customer (CUST)
- Government vision and target for EVs communicated to customers. All incentives and benefits for adopting or using an EV to be communicated properly to customers
- Tourism will flourish by promoting areas as carbon neutral with EVs

Social & Environmental
- EV deployment will provide opportunities to the existing workforce by providing adequate training on O&F skills
Nepal: EV Roadmap 2025-30

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
Mandate private electric fleet electrification
Grid Code and Distribution Code guidelines to add VEC

Roadmap for Incentive (RI)
Promote battery recycling industry through tax free income in initial years or reduced interest on loans for RIAs with minimum 25% stake of local companies

Automotive Sector (AS)
Local capacity development on R&D of charging stations through training and skill development
Charger manufacturing units to be set up with 100% FDI or through JVs with local companies

Electrical Infrastructure (EI)
Grid asset modernization for facilitating two way communication for implementing vehicle to grid solution
Electrical infrastructure upgradation for monorail implementation in Kathmandu

Value Chain Integration (VCI)
Transaction of private cars into electric fleets will provide opportunity for the retailer or third party service providers to provide door to door servicing on charging of EVs in Kathmandu

Customer (CUST)
Customers are engaged in consumer program through V2G integration on pilot basis
Advanced services for customers like door to door service for car charging in Kathmandu

Pakistan: EV Roadmap 2018-20

Vision, Policy & Regulatory, Institutional Capacity (VPRIC)
MoC, SAP to launch nation-wide EV mission with a set of policies
Pilot e-bus fleet project in Karachi, Lahore, Islamabad etc.
EV cell creation within concerned ministries

Roadmap for Incentive (RI)
Exempt import and custom duty on EVs and EV components
Subsidized registration charges for one year for electric 2 and 3 wheelers
Reduced tariff for passengers using electric buses

Automotive Sector (AS)
Automotive Testing and Training Center to approve the 2 wheelers and 3 wheelers being manufactured and assembled
Battery and charging stations to be imported from countries like China for the pilot projects

Technical Infrastructure (TI)
Discoms to assess the spare capacity in DTL, power availability and peak demand in both summer and winter season to figure out the EV demand the load network

Value Chain Integration (VCI)
Current status of charging stations which follows IEC standards and as most of the vehicles are Japanese or Chinese, Pakistan can use O & M company and GB charging standards

Customer (CUST)
Government vision and target for electric vehicle is communicated to customers
Incentives and benefits to be passed onto the customers

Social & Environmental
Organizing EV awareness programs, condu workshops and seminars to make people aware of the benefits of EV adoption
Sri Lanka: EV Roadmap 2018-20

ROADMAP FOR INCENTIVE (RI)
- Exempt import and custom duty on EVs and EV components
- Subsidized parking charges for EVs
- Reduced property tax for EV manufacturers, EV assembly companies and hotels and resorts using EVs and charging equipment

AUTOMOTIVE SECTOR (AS)
- E-PMVs to be assembled with parts being imported from India or China
- Promote local manufacturing of electric 2 and 3 wheelers through PPPs or M&As with foreign companies

ELECTRICAL INFRASTRUCTURE (EI)
- Disclose the supply and availability of spare capacity in sub-stations and power supply from NEC

Sri Lanka: EV Roadmap 2020-25

ROADMAP FOR INCENTIVE (RI)
- Reduced road tax for E-2W and commercial EVs
- Tax free or reduced tax for profit reparation for foreign companies

AUTOMOTIVE SECTOR (AS)
- Servicing facility for charging stations to be provided by O&Ms and local capacity development on O&M through T&L
- 100% local manufacturing units to be set up for e-2W and e-3W service centres

ELECTRICAL INFRASTRUCTURE (EI)
- Upgradation and improvement in power quality of electrical infrastructure by CEB and LECO for charging infrastructure installation

EV Technology (EVT)
- Technology for e-2W to be upgraded in terms of design, battery capacity etc.
- As Sri Lanka is currently using ChAdeMO & CHAdeMO, it may use Indian standard

Value Chain Integration (VCI)
- CEB with STBM to invest in charging infrastructure for e-buses in bus depots and terminals
- Private parking owners, service providers, CE and LEED, mall owners or hospitals can install public charging stations

CUSTOMER (CUST)
- Government vision, target, incentives and benefits for EVs must be communicated to customers
- TOU pricing and benefits must be communicated to customers

Sustainable Environmental
- Organizing EV awareness programs, condu-workshops and seminars
Sri Lanka: EV Roadmap 2025-30

Roadmap for incentive (RI)
- Reduced property tax for EV and battery manufacturers and promote battery recycling industry through tax free income

Automotive Sector (AS)
- Charger manufacturing units to be set up with EVs with foreign companies
- Battery recycling industry to be developed with foreign collaborations

Technical Infrastructure (TI)
- Grid asset modernization for facilitating two way communication for implementing vehicle to grid solution

EV Technology (EV)
- R&D on EV design & battery recycling

Value Chain Integration (VCI)
- Bundle EVSE with highway development cost and install charging stations in the highways
- Dedicated fleet operators like for e-busers and e-Ask can invest by themselves or bring third party

Customer (CUST)
- Customers are engaged in prosumer program through V2G integration on pilot basis
- Advanced services for customers like door to door service for car charging

Social & Environmental
- Provide electricity to remote areas
- Usage of electric boats for inland transport and fishing thereby reducing water pollution

Electric Vehicle Maturity Model (EVMM)

India Smart Grid forum has developed an Electric Vehicle Maturity Model (EVMM) to assess the readiness of a Country/City for EV adoption of EVs in terms of policy, infrastructure, technology, institutional structure, market dimensions, customer acceptance etc. which will help all stakeholders including concerned Government, Public Transport Utilities, Taxi/Fleet Operators, Electric Utilities, EV and Battery Manufacturers, EVSE Service Providers etc. to identify and implement the required steps that need to be taken in a phased manner to ensure sustainable EV adoption across the country/city.

The EVMM is structured across eight domains and 6 Levels of maturity to assess the preparedness/readiness for EV rollouts and measure the progress made in each domain by the country/city.
Overview of the Model

Eight Domains

- Vision, Policy, Regulatory & Institutional Capacity
  - Govt. Plans & Programs
  - Policy & Regulations
  - Org. Structure
  - Capacity Building

- EV Technology
  - EV, EVSE & Battery Technology
  - Power Electronics
  - R&D

- Roadmap for Incentives
  - Tax Breaks, Subsidy
  - Profit Regeneration
  - EMI
  - Loan Benefits
  - Concessional Imports

- Automotive Sector
  - Local Manufacturing
  - Auto Financing
  - Impact of Auto Components

- Electrical Infrastructure
  - EVSE Network
  - Electric Network Capacity
  - EV Tariff Structure
  - VGI

- Six Levels
  - "5" Pioneering
  - "4" Optimising
  - "3" Integrating
  - "2" Enabling
  - "1" Initiating
  - "0" Default

Value Chain Integration
- Business Model for EVSE
- Incentives for V2G

Customer
- Consumer Interest
- Capacity to Pay
- Advanced Services

Societal & Environmental
- Emission Reduction
- Shared Public Transportation
- New Job Creation

Thank You

India Smart Grid Forum
CISP Building, Mullick Marg,
Chandrakurti
Delhi-110022
Website: www.indiasmartgrid.org
2. “Manufacturing of BEVs: Discussion on Global Trends and Pakistan” by Dr. Shakeel Sadiq Jajja, Assistant Professor – LUMS
**Electric Vehicle Types**

1. Battery Electric Vehicles (BEVs) or All-Electric Vehicles
2. Plug-in Hybrid Electric Vehicles (PHEVs)
3. Hybrid Electric Vehicles (HEVs)

**Why is it important to differentiate?**

1. Consumer standpoint
2. Infrastructure standpoint
3. Distribution and after-sale service standpoint
4. Manufacturing standpoint
5. Technological transition standpoint
6. Regulatory standpoint

---

**Key Components of BEVs**

- Battery
  - Lithium-Ion
  - Lead Acid
- Battery management system
- Motor
  - DC Series Motor
  - Brushless DC Motor
  - Permanent Magnet Synchronous Motor (PMSM)
  - Three Phase AC Induction Motors
  - Switched Reluctance Motors (SRM)
- Controller
- Cables
- Body

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Dr. Shakeel Sadiq Jajja, LUMS
Global Trends

- Electric mobility is expanding at a rapid pace globally.
- In 2018, the global electric car fleet exceeded 5.1 million, up 2 million from the previous year and almost doubling the number of new electric car sales.
- Battery electric vehicles (BEVs) account for 64% of the world’s electric car fleet.
- The People’s Republic of China remains the world’s largest electric car market, followed by Europe and the United States.
- Norway is the global leader in terms of electric car market share.
- Vision 30 @ 30 – Aims to reach 30% EV market share by 2030. Signatories: China, Japan, Finland, France, Netherlands and Sweden.

Dr. Shakeel Sadiq Jajja, LUMS

Regional Share in Global Stock of Electric Cars - 2018

Dr. Shakeel Sadiq Jajja, LUMS
Global electric car sales and market share, 2013-18

Drivers of BEV Mass Adoption

- Energy efficiency: EVs are three-to-five times more energy efficient than conventional internal combustion engine (ICE) vehicles.
- Energy security: BEVs reduce reliance on oil-based fuels and can reduce dependence on oil imports for many countries.
- Air pollution: BEVs have zero tailpipe emissions and can address pollution issues, especially in urban areas and along road networks.
- Green House Gas emissions: BEVs can deliver significant reductions in GHG emissions especially from road transport relative to ICE vehicles.
- Noise reduction: EVs are quieter than ICE vehicles and hence contribute to less noise pollution, especially in the two/three-wheeler category.
Falling Battery Prices

- Battery price $1000/kWh in 2010
- By 2025 batteries will increasingly use cathode chemistries that are less dependent on cobalt, such as NMC 811 (80% nickel, 10% manganese, and 10% cobalt) or advanced NCA batteries
- Graphene Technology
- Supercapacitor (SC)

Dr. Shakeel Sadiq Jajja, LUMS

Global Battery Market

- Lead acid batteries have a higher market share but LiBs have a higher growth rate
- Automotive applications accounted for over 70% of total lithium-ion battery shipments in 2018, compared to just 43% in 2015 and 6% in 2010

Dr. Shakeel Sadiq Jajja, LUMS
Government Policies

- Critical policy measures used by leading countries:
  - Fuel economy standards (e.g. Corporate Average Fuel Economy, ZEV mandate etc.): used in U.S.A, China, Japan, Canada and EU
  - Fiscal Incentives for zero- and low-emissions vehicles (e.g. tax credits, subsidies to manufacturers and consumers)
  - Economic Instruments - To boost the value proposition of EVs and help bridge the total cost of ownership gap between electric and conventional vehicles (e.g. free registration or license plates, lower toll or parking fees, access to bus lanes etc.)
  - Globally policy support is being used to address the strategic importance of the battery technology value chain.

Dr. Shakeel Sadiq Jajja, LUMS

Government Policies

- Procurement Programs – To stimulate demand for electric vehicles and to enable an initial roll-out of publicly accessible charging infrastructure.
  - In the city of Shenzhen, government mandated operators to go electric, 16 000 electric buses operate, the largest-scale electric bus transition observed in a city.
  - Largest electric bus fleet procurement in Europe: 100 electric buses on routes in the Schiphol Airport area in the Netherlands

- Infrastructure Support Policies: Minimum requirements to ensure EV readiness in new or refurbished buildings and parking lots, and the roll-out of publicly accessible chargers in cities and on highway networks.

- Adoption of standards to facilitate inter-operability of various types of charging infrastructure.

Dr. Shakeel Sadiq Jajja, LUMS
CHINA — Adoption Trends

- Target of 5 million EVs by 2020 including 4.6 million passenger light-duty vehicles (PLDVs).
- New electric vehicle (NEV) mandate: 12% NEV credit sales in passenger cars. NEVs get between two and six credits depending upon their range. OEMs must earn enough credit to match 12% of their output.
- Roadmap for NEV sales share: 7-10% by 2020, 15-20% by 2025 and 40-50% by 2030.
- Proposal for tightened fuel economy standard for cars (4 L/100 km by 2025).
- Current fuel economy standard to be used till 2020

Dr. Shakeel Sadiq Jajja, LUMS

CHINA — Adoption Trends

- China is both the biggest manufacturer and the biggest market for cars globally.
- Buys more than half of the world’s new electric cars.
- China’s electric car market is 3 times larger than the US electric car market. In 2018, China had 1.26 million electric cars to 361,000 electric cars in the US.
- China has the largest volume of EV in absolute terms. But relatively, EVs still account only for a small fraction of the market.

Dr. Shakeel Sadiq Jajja, LUMS
CHINA – Manufacturing Trends

- Uses the term New Energy Vehicles which includes BEVs, hybrids and plug-in hybrids.
- Built a complete value chain with a high percentage of locally produced components being incorporated into foreign cars produced in China.
- Foreign automotive vehicle & components manufacturers must form joint ventures with local firms to enter the Chinese market.
- China leads the electric two-wheeler market: produced 26 million units and had an estimated stock of 250 million units (1/4th of the global stock) in 2018.
- Domestic OEMs have a 94% market sales share of the Chinese EV market.
- Incentives being phased out in recent years as industry matures and cost of production falls.
- China remains the global leader in the production of both mined rare earth products and refined rare earth compounds, with Chinese production accounting for 86% of global refined production in 2017. Rare earths are a key raw material in permanent magnets which are used in electric motor for EVs.
- Research focus on Graphene Technology - China International Graphene Industry Union (CIGIU) for industrial development of Graphene.

Dr. Shakeel Sadiq Jajja, LUMS

BEVs Value Chain in Pakistan

Dr. Shakeel Sadiq Jajja, LUMS
Entrepreneurial ventures
• Power Electronics Pakistan (PEP), Lahore
• Jolta, Lahore
• S. Zia ul Haq & Sons (SZS), Karachi
• InerZ, Islamabad

Existing automobile manufacturers (Perspectives)
• Nishat Hyundai
• Atlas Group
• Sazgar Engineering
• Omega Industries (Road Prince)

Dr. Shafeeq Sadiq Jajja, LUMS

Component manufacturers (Current Situation)

• Battery
  • Treet Daewoo (Lead acid: deep cycle and maintenance free batteries)
  • Atlas (Lead Acid)
  • Pakistan’s battery industry seems to be lead acid based manufacturing
  • Some effort towards importing and assembling Li ion cells is happening
  • LUMS School of Science and Engineering (Assembly of Li ion using imported cells)
  • Challenge is optimization of energy density, charging time, price, temperature, efficiency (temperature sensitive), weight, life cycle...
  • Graphene based technology and ultra capacitors: globally battery constraints seem coming down sharply

• Motor manufacturing
  • Gujranwala (Golden pumps, Diamond Motors, Aiklbs Motors...)
    • Various types of motors though mostly AC motors
    • Sophistication and export orientation is lacking
    • Mostly from recycled material (electric sheets, majority recovered from international scrap, copper wire: original requires scale so second hand used, bearing: several levels of quality ABCD...)
    • Key facilities for research and development such as for testing for international standards lacking
    • Efficiency and temperature relationship
    • Can possibly reverse engineer over time (5-7 years) and designing might take longer
  • Possible role of fan manufacturing industry

Dr. Shafeeq Sadiq Jajja, LUMS
Component manufacturers (Current situation)

- Cables
  - Fast Cables
  - Two items: conductor (almost constant) and insulator (varies)
  - Current automobile market size is too small for large companies
  - BEVs can bring opportunities in 4 wheelers
  - In BEVs, unlike ICE based vehicles, temperatures not very high
  - Though lab equipment is missing it can quickly catch up
- Controller
  - Could not find a specific company
  - Companies like Jolta and InerZ are working to develop their own

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Universities and R&D Institutions

- LUMS School of Science and Engineering
  - Student projects on electric vehicles and international competitions
- NED Karachi
  - Student projects
  - Working with Mehran fans to develop motors
- UET Lahore
  - Test beds of electric motors
- UET Peshawar
- LUMS Energy Institute
  - Working with federal government to provide intellectual support in the development of BEVs encouraging policies

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International players

- Interested in:
  - Pakistan's market
  - Manufacturing for global markets
- Integrated electric kits providing combination of:
  - Battery packs
  - Battery management system
  - Motor
  - Controller
  - Battery swapping system

Economic sense of BEVs

- Upfront cost
  - Battery is the major cost in BEVs (approximately 30-50% in Li ion based BEVs)
  - Cost goes very high with Li ion battery
  - Affordable price with lead acid but issues of lead acid
  - Li ion is the way to go – for now
- Companies in Pakistan are targeting some design innovations to bring the upfront cost down e.g., SZS (4 wheeler) and InerZ (2 wheeler)
- Operating cost attractive
Regulatory framework

- Current Auto Development Policy 2016-21 does not have needed focus on BEVs
- Recently government has announced an electric vehicles policy
- Policy making in conflicting objectives: new players, existing players, climate change, localization
- Pakistan hoping to become a signatory of International Energy Agency’s 30%@2030 initiative
- Green banking regulations of State Bank of Pakistan (mainly focus on solar energy)
- Energy supply in Pakistan is surplus in next ten years (LUMS Energy Institute)
- Energy infrastructure and business models

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Future Outlook - Pakistan

- Key components
  - EV kits: Seem a transition for aspirant 2/3 wheelers
  - Battery (Li-ion and or lead acid) – Reducing cost: step wise localization beginning from assembly of cells
  - Battery management system: critical for Pakistani environment
  - Motor: leverage the existing knowledge to localize in 5-7 years
  - Controller: some companies are working on it
  - Body: requires innovation to bring the cost down
  - Cables: seem quite ready
- Financing (high upfront cost)
  - Loans for BEVs
  - Battery leasing models: Cars and batteries
- Starting target markets: Two/three wheelers, commercial vehicles, institutional customers
- Policy (Enhancing demand versus enhancing demand as well as localization)

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3. “The Road to Electrification in China” by Mr. Alan Liu – CEO GH Energy
Annexure-IV

In 2014, Elon Musk brought the first Tesla to China to complete the delivery. China kicks off a wave of car electricization.

Since 2014, more than 200 start-ups in China have been developing and manufacturing intelligent electric vehicles.

We’re going through a history similar to the mobile Internet.
Annexure-IV

Why Electric Vehicles Become China's National Policy

China's dependence on foreign oil in 2019 has exceeded 72%, making oil the country's biggest security risk.

Foreign exchange reserves, the country's core wealth, are handed over to oil companies in the form of crude oil or diesel vehicles, making it difficult to develop China's electrical vehicles and electric vehicles. This is also a concern to the Chinese government.

Promote the development of electric vehicles for the Ministry of Industry and Information Technology of the National Development and Reform Commission by 2016.

26-28 as Premier Li Keqiang of the State Council promotes industry development.

13 General Secretary Xi Jinping "Traffic Plan" rises as national strategy, with electrification in the first place.

After 6 years of accumulation, electric vehicles have become quite competitive with fuel vehicles.

Mainstream brands will launch mainstream all-electric vehicle suing in 2019.

China has become the world's largest electric vehicle market in 2018, accounting for more than 50% of the global market.
Tesla China plant to release maximum capacity

China’s major auto companies have also unveiled ambitious plans for electric vehicles

China’s government’s “new infrastructure construction” plan also includes electric vehicle charging infrastructure in key areas

China’s electric vehicle market will lead the global electric vehicle market for a long time

Thank you!