Industry Readiness for Manufacturing of Battery Electric Vehicles in Pakistan

Dr. Syed Zahoor Hassan (Lahore University of Management Sciences)
Dr. Shakeel Sadiq Jajja (Lahore University of Management Sciences)*
Dr. Haritha Saranga (Indian Institute of Management Bangalore)

This research was mainly funded and supported by SAARC Energy Center Islamabad.
Research Objectives

• **Collect the auto industry insights** for potential transition towards BEV manufacturing through field survey/interviews.

• Analyze the field findings and develop a baseline information for the Member State about:
  • where they stand **right now**
  • **elements having potential** to become strength in BEV value chain.

• **Recommend improvements** to strengthen the competitiveness of local auto industry in respect to manufacturing of BEVs
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 (2018) and Germany (2019) - the global leader in terms of electric car market share in sales

• Vision 30 @ 30 – Aims to reach 30% EV market share by 2030. Signatories: China, Japan, Finland, France, Netherlands, Sweden, India...
Global Trends – Sales and Market Share, 2013-19
Global Trends – Key Benefits

• Energy efficiency: Three-to-five times

• Oil bill: Reduce economic reliance on oil-based fuels

• Air pollution: BEVs have zero tailpipe emissions and can address pollution issues, especially in urban areas and along road networks

• Green House Gas emissions: Significant reductions especially from road transport relative to ICE vehicles

• Noise reduction: Quieter than ICE vehicles, especially in the two/three-wheeler category
Global Trends – Regulatory Drivers of Diffusion

• Policy measures used by leading countries:
  • **Fuel economy standards** e.g., Corporate Average Fuel Economy and ZEV mandate in U.S.A
  • **Fiscal Incentives** e.g. tax credits and subsidies to manufacturers and consumers for zero- and low-emissions vehicles
  • **Economic Instruments** e.g., free registration or license plates, lower toll or parking fees, and access to bus lanes to boost the value proposition of EVs

• Globally policy support is being used to address the strategic importance of the **battery technology value chain**.
Global Trends – Regulatory Drivers of Diffusion

- **Procurement Programs**: To stimulate demand and to introduce publicly accessible charging infrastructure
  - Shenzhen government mandated operators to go electric, **16000 electric buses** operate, the largest-scale electric bus transition observed in a city.
  - Europe: **100 electric buses** on routes in the Schiphol Airport area in the Netherlands

- **Infrastructure Support Policies**: Buildings, parking lots, publicly accessible places, and highway

- **Adoption of standards** to facilitate inter-operability of various types of charging infrastructure.
Global Trends – Battery’s Declining Prices

- Improvements in battery productions and chemistry
- Increased scale of production in manufacturing plants
- Redesign of vehicle manufacturing platforms using simpler and innovative design architecture
- Digital technologies adapting battery capacity size to user needs
- Improvements in Lead-Acid batteries
- Graphene Technology
- Supercapacitor (SC)
Global Trends – Battery Market Share

Lithium Ion Battery Market Share

- Coslight: 24%
- Maxell: 9%
- BAK: 9%
- Samsung SDI: 7%
- Sanyo: 8%
- Sony: 5%
- Lishen: 9%
- LG Chem: 19%
- Others: 3%

Graph showing the growth in MWh from 2005 to 2025:
- 2005: 210 GWh
- 2010: 325 GWh
- 2015: 432 GWh
- 2020: 628 GWh
- 2025: 847 GWh
Global Trends – China

• The biggest manufacturer of EVs
• The biggest market for EVs (approx. 3 x US)
• Buys more than half of the world's new electric cars
• Target of 5 million EVs by 2020
• New Energy Vehicles (NEV) mandate: 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 (100km/4L by 2025)
Global Trends – China’s EVs/Battery Manufacturing

Facts

• Leads two-wheeler EVs market: produced 26 million units and an estimated stock of 250 million units (1/4th of the global stock) in 2018
• Domestic OEMs have 94% market
• Incentives being phased out in recent years as industry matures and cost of production falls.
• Investment in battery manufacturing is most notable in China
• 80% share in global Lithium supply in 2020 up from 25% in 2016
• Least cell manufacturing cost in the world at $217/kWh.
• 90% of the EVs produced by Chinese manufacturers use locally made lithium-ion cells
• Foreign OEMs and vendors must form JVs with local firms to enter the Chinese market
Global Trends – China’s EVs OEMs (BYD) – Others

• Shenzhen-based manufacturer BYD - world’s largest electric vehicle manufacturer for the past three years running, in both consumer and industrial EVs.
• Revenue : 130.05 Bn Yuan and 20% market share in 2018
• BYD – vertical integration strategy- has the world’s biggest battery plant in China
• BYD main supplier of electric buses in North America, Europe, Latin America
• Announced production of 0.6 million electric car sales in 2020.
Entrepreneurial ventures

• Power Electronics Pakistan (PEP), Lahore
  • Three wheeler (E-Rickshaw)
  • Converted normal open rickshaw into electric
  • Controller and wiring by PEP
  • Closed premises usage

• Jolta, Lahore
  • Two wheeler (70, 100, 125) and closed three wheeler
  • Controller and battery management system developed locally
  • EV Kit (battery, battery management system, DC motor, and controller)
  • Technology partner
  • Testing on logistics fleet
  • Working on Graphene based technology
Entrepreneurial ventures

• S. Zia ul Haq & Sons (SZS), Karachi
  • Importing and making of four (cars, vans, pickups) and two (scooters) wheelers
  • Targeting same prices as ICE based vehicles
  • Seeks to localize battery and chargers manufacturing
  • Complete built unity => Semi knock down => Complete knock down
  • Working on motors in Gujrat/Gujranwala

• InerZ, Islamabad
  • Research, design, and engineering company
  • Efficient battery pack (space, cost and energy)
  • Targeting 70cc bike and price
  • Prototyping and test stage
  • Large scale commercial vehicles fleet e.g., TCS
Existing Automobile Manufacturers (Perspectives)

- Sazgar Engineering
  - Current focus on ICE and BEVs (three and four wheelers)
  - Developed a prototype of electric three wheeler (lightened body)
  - Price is highly dependent on battery

- Omega Industries (Road Prince)
  - Current focus on ICE based vehicles
  - Developed hybrid two wheeler about four years ago
  - Focus on demand – allow import – ensure buyers (remove license, registration free, school/college/university students)
  - Development will naturally begin: Import => reverse engineering => design
  - Begin from: 3 wheeler, commercial, and possibly lead acid to reduce cost
Existing Automobile Manufacturers (Perspectives)

• Nishat Hyundai
  • Current focus on internal combustion engine (ICE) based vehicles
  • Putting plant together before June 2021 to benefit from Auto Development Policy 2016-21
  • Initial demand points: commercial three and four wheelers

• Atlas Group
  • Continuing focus on ICE based vehicles
  • Principal led
  • Battery business is OEM driven: Lead acid => Maintenance free => Li ion
  • Pathway: CBU => SKD => CKD => Assembly => Parts
  • Initial demand point: four wheeler cars (trend setters)
Component manufacturers (Current Situation)

• Battery
  • Treet Daewoo (Lead acid: deep cycle and maintenance free batteries)
  • Atlas (Lead acid)
  • Some effort towards importing and assembling Li ion cells is happening
  • 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, Akhlas 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
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
  • Companies like Jolta and InerZ are working to develop their own
Universities and R&D Institutions

- LUMS Business School
  - Faculty
  - Graduate Students

- LUMS Energy Institute

- NED Karachi
  - Student projects
  - Working with Mehran fans to develop motors

- UET Lahore
  - Test beds of electric motors

- UET Peshawar
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)
Regulatory framework

• In past few SROs to encourage import of BEVs and related parts by reducing duties

• Auto Development Policy 2016-21 is based on ICE based vehicles

• EVs Policy for two and three wheelers 2020

• Policy making in conflicting objectives: new players, existing players, climate change, localization

• Pakistan hoping to become 17th signatory of International Energy Agency’s 30%@2030 initiative

• Green banking regulations of State Bank of Pakistan (mainly focus on solar energy)

• Energy infrastructure
Key Points

- 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)

- Learnings from past developments in auto industry
  - Tractors industry
Thank you!
Questions.