

# Industry Readiness for Manufacturing of Battery Electric Vehicles in Pakistan

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



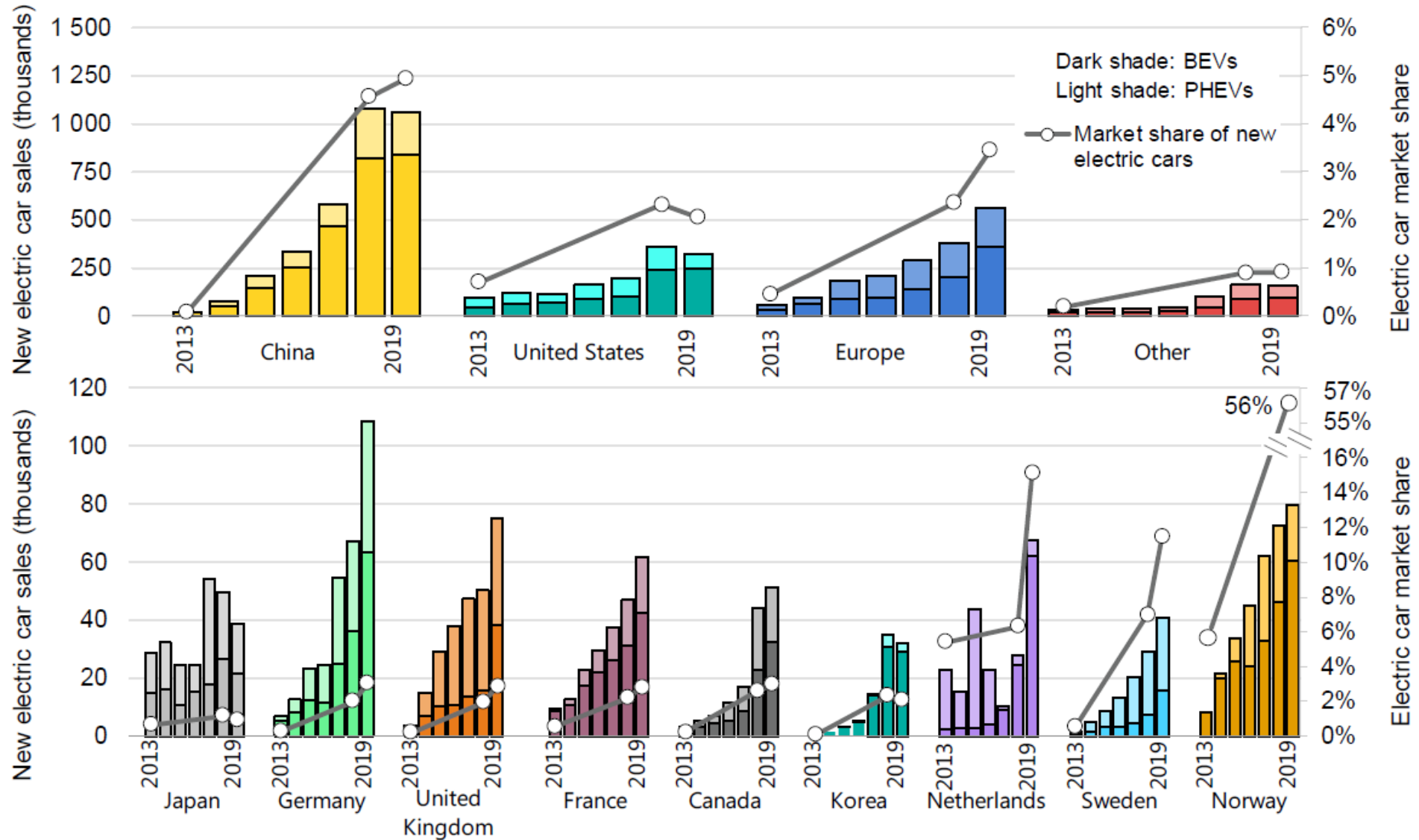
# Research Objectives

- 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

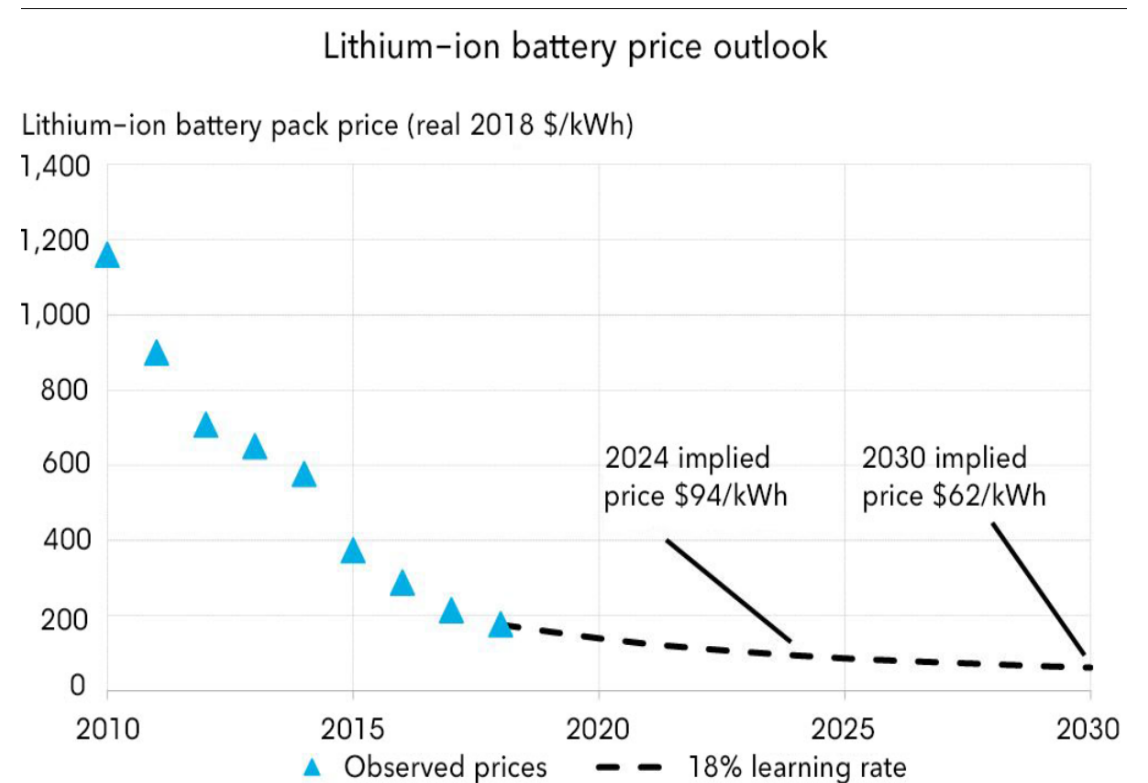
- Policy measures used by leading countries:
  - **Fuel economy standards** e.g., Corporate Average Fuel Economy and ZEV mandate in U.S.A
  - **Fiscal Incentives** e.g. tax credits and subsidies to manufacturers and consumers for zero- and low-emissions vehicles
  - **Economic Instruments** e.g., free 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

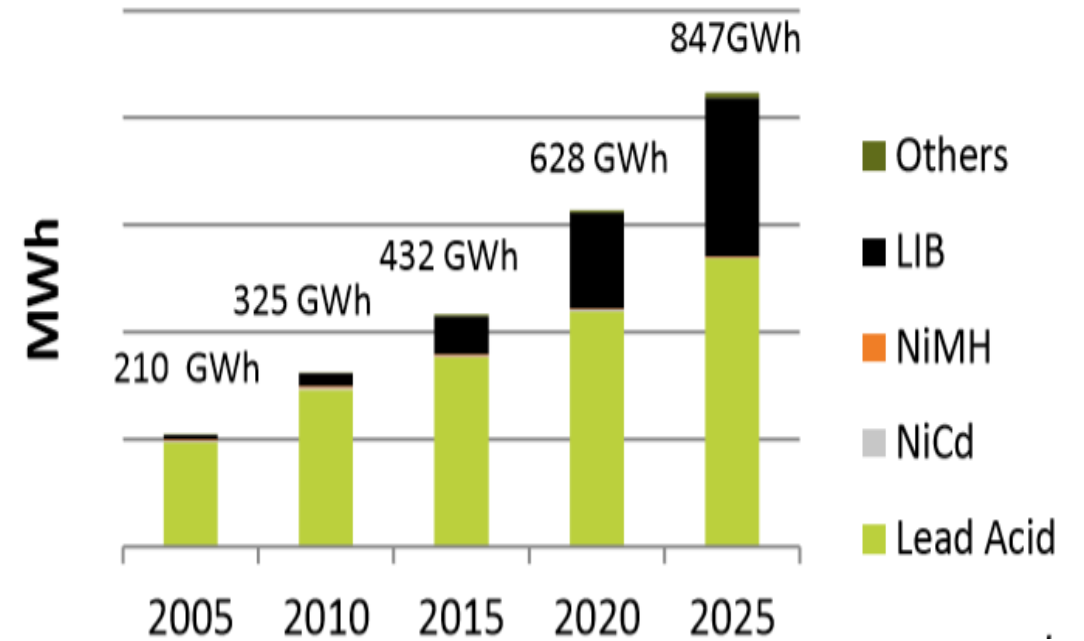
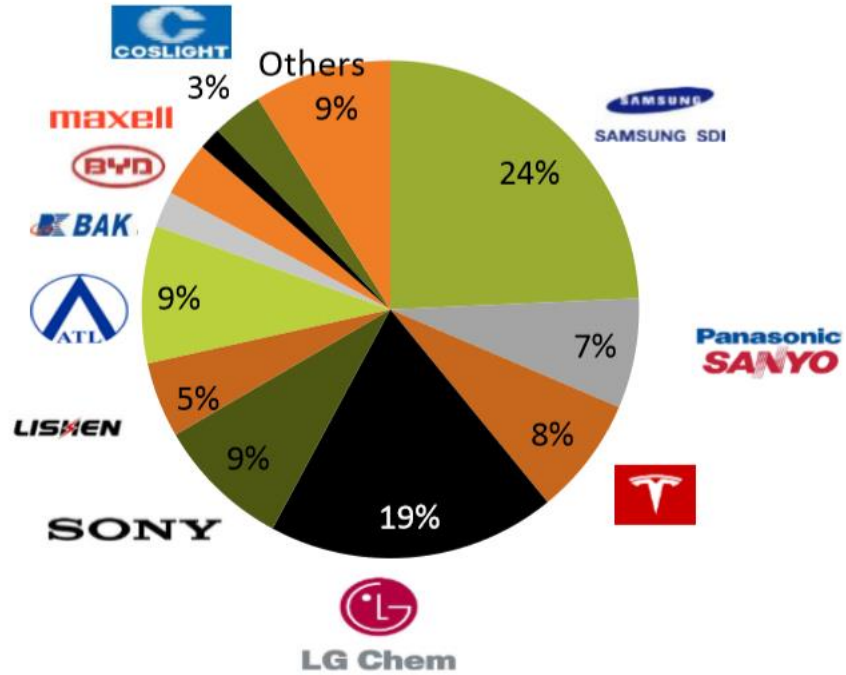
- Improvements in battery productions and chemistry
- Increased scale of production in manufacturing plants
- Redesign of vehicle manufacturing platforms using simpler and innovative design architecture
- Digital technologies adapting battery capacity size to user needs
- Improvements in Lead-Acid batteries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



Source: BloombergNEF



# Global Trends – Battery Market Share



Lithium Ion Battery Market Share

# 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 (1/4<sup>th</sup> 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 17<sup>th</sup> 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.

