



## Battery Electric Vehicles in India

**For Prelims:** Battery Electric Vehicles, [Ethanol](#), [Flex Fuel](#), [FAME-II](#), [NEMMP](#)

**For Mains:** [Electric Vehicles Manufacturing and Adoption - challenges and opportunities](#), EVs and Global Goals of Net Zero Emission.

**Source:** [IE](#)

### Why in News?

As India strives to achieve its [net-zero emissions target](#), **battery electric vehicles (BEVs)** have emerged as a centerpiece of the **government's push for sustainable mobility**.

- However, while countries like Norway and China have seen success with BEVs, India faces unique challenges due to its specific conditions.

### What are Battery Electric Vehicles?

- **About:**
  - Battery Electric Vehicles (BEVs) are a type of electric vehicle that runs solely on **electric power stored in high-capacity batteries**.
  - They do not have an [internal combustion engine \(ICE\)](#) and **produce zero tailpipe emissions**.
  - BEVs use electric motors to drive the wheels, providing **instant torque** and smooth acceleration.
- **Battery Technology:**
  - BEVs rely on advanced battery technology, **primarily [Lithium-ion \(Li-ion\) batteries](#)**.
  - Li-ion batteries offer **high energy density, longer range**, and improved performance.
- **Charging Infrastructure:**
  - BEVs require a **network of charging stations** for recharging their batteries. Charging infrastructure includes various types of chargers:
    - **Level 1 (household outlets)**
    - **Level 2 (dedicated charging stations)**
    - **Level 3 (DC fast chargers).**
  - Public charging stations, workplaces, and residential buildings play a crucial role in expanding the charging infrastructure.

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## FOUR TYPES OF EVs

**HEVs:** Conventional hybrid electric vehicles (such as variants of the Toyota Hyryder Hybrid or Honda City e:HEV in India) combine a conventional ICE system with an electric propulsion system, resulting in a hybrid drivetrain that substantially lowers fuel usage. The onboard battery in a conventional hybrid is charged when the IC engine is powering the drivetrain.



**PHEVs:** Plug-in hybrid vehicles (such as the Chevrolet Volt) also have a hybrid drivetrain that uses both an ICE and electric power for motive power, backed by rechargeable batteries that can be, in this case, plugged into a power source.

**BEVs:** Vehicles like the Tata Nexon in India, or the Nissan Leaf and Tesla Model S, have no ICE or fuel tank, and run on a fully electric drivetrain powered by rechargeable batteries.

**FCVs:** Fuel cell vehicles (such as Toyota's Mirai and Honda's Clarity) use hydrogen to power an onboard electric motor. FCVs combine hydrogen and oxygen to produce electricity, which runs the motor, and the only residue of the chemical process is water. Since they're powered entirely by electricity, FCVs are considered EVs – but unlike BEVs, their range and refuelling processes are comparable to conventional cars and trucks.

### What are the Problems with Battery Electric Vehicles?

- **Charging Network:**
  - Currently, **India has a limited number of public charging stations**, requiring a tailored strategy that accommodates the dominant presence of two- and three-wheelers.
    - Only about 2,000 public charging stations are currently operational across the country.
  - There exists a lack of **standardization and interoperability among chargers and vehicles.**
- **Electricity Source:**
  - The majority of **India's electricity is still generated from coal-fired thermal plants**, impacting the environmental benefits of EVs.
  - Unless the power generation mix changes significantly, India would be using fossil fuel generation to power EVs.
- **Value Chain Dependency:**
  - The demand for Li-ion batteries from India is projected to grow at a **CAGR of ~30% by volume up to 2030**; more than **50,000 tonnes of lithium requirement for the country** to manufacture EV batteries alone.
    - However, more than **90% of the global Li production is concentrated in Chile, Argentina, and Bolivia (and Australia and China)** and other key inputs such as **cobalt and nickel are mined in the Congo and Indonesia**. As a result, **India would be almost entirely dependent on imports from a small pool of countries** to cater to its demand.
- **High Initial Cost of Owning an Electric Vehicle:**
  - EVs remain **expensive compared to Internal Combustion Engine (ICE) vehicles**. Costly batteries contribute to the overall high price.
  - Limited **availability and affordability of EV** models in the **mass market segment** makes the transition to EVs even more difficult.
- **Lack of Awareness and Consumer Preference:**
  - **Consumer preference for ICE vehicles** based on brand loyalty, resale value, and comfort and **limited knowledge of potential buyers** regarding EV benefits and features further adds to the problem.

- Cultural factors also influence **social acceptance and perception of EVs.**
- **Other Challenges:**
  - **Shortage of skilled workers and technicians for EV servicing** and repair.
  - Increasing **electricity demand and grid stability concerns.**
  - Surge in 2 and 3-wheeler EVs but same can't be said for 4-wheeler EVs.

## What are the Possible Alternative Technologies to BEVs?

- **Hybrid Vehicles:**
  - Hybrids offer improved **fuel efficiency** without requiring extensive charging infrastructure.
  - They can serve as an **intermediate step towards 'all-electric' vehicles and help establish the battery ecosystem.**
- **Ethanol & Flex Fuel:**
  - **Flex fuel vehicles** can run on various fuel types, including [ethanol](#), **reducing reliance on fossil fuels.**
- **Fuel Cell Electric Vehicles (FCEVs) & Hydrogen ICE:**
  - FCEVs run on hydrogen fuel cells, which **produce electricity and water as the only by-products** offering a **clean and efficient alternative to BEVs.**
  - **Hydrogen ICE vehicles** use **hydrogen as a fuel in ICEs** offering a simpler and **cheaper alternative to BEVs.**
    - However, both FCEVs and Hydrogen ICEs have their own shortcomings in terms of infrastructure and zero-emissions.
- **Synthetic Fuels:**
  - Porsche is developing **synthetic fuels that make ICEs CO<sub>2</sub>-neutral**, potentially extending the life of ICE vehicles.
  - These fuels, produced from carbon dioxide and hydrogen using renewable energy, could have broader applications.

## What are Some Government Initiatives to Promote EV adoption?

- [Faster Adoption and Manufacturing of Electric Vehicles \(FAME\) scheme II](#)
- [National Electric Mobility Mission Plan \(NEMMP\)](#)
- [National Mission on Transformative Mobility and Battery Storage](#)
- [Go Electric campaign](#)
- [Production Linked Incentive \(PLI\) scheme:](#)
  - Incentives for the manufacturing of EVs and components
- **Ministry of Power's Revised Guidelines on Charging Infrastructure:**
  - At least one charging station to be present in a grid of 3 km and at every 25 kms on both sides of the highways.
- **Amendment to [Model Building Bye-laws, 2016 \(MBBL\):](#)**
  - Mandatory to set aside 20% of the parking space for EV charging facilities in residential and commercial buildings.
- India's support to the global [EV30@30 campaign](#)

## Way Forward

- Collaborate with **public and private stakeholders** to rapidly **expand the charging network**, ensuring adequate coverage across urban, semi-urban, and rural areas.
- Prioritize the **establishment of standardized and interoperable charging infrastructure** to enhance convenience and **address range anxiety.**
- Launch **comprehensive awareness campaigns to educate consumers** about the benefits of BEVs, including **lower operating costs, reduced environmental impact**, and governmental incentives.
- Encourage R&D efforts to **diversify the dependency on Li-ion batteries** by exploring alternative battery chemistries, while investing in domestic battery manufacturing capabilities.

## UPSC Civil Services Examination Previous Year Question (PYQ)

### **Mains**

**Q.** How is efficient and affordable urban mass transport key to the rapid economic development in India? (2019)

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