



## Hybrid Vehicles as Alternative to EVs

**For Prelims:** Hybrid Vehicles as alternative to Electric Vehicles, [Battery Electric Vehicles \(BEVs\)](#), [Hybrid Vehicles](#).

**For Mains:** Hybrid Vehicles as alternative to Electric Vehicles, Electric Vehicles Manufacturing and Adoption - challenges and opportunities, EVs and Global Goals of Net Zero Emission.

[Source: IE](#)

### Why in News?

Recently, HSBC Global Research has released a note, suggesting that, in the next 5-10 years, India should prioritize adopting [Hybrid Vehicles](#) as a **Sustainable Mobility Solution** before transitioning to full [Battery Electric Vehicles \(BEVs\)](#).

- Hybrid vehicles integrate a conventional Internal Combustion Engine with an Electric Propulsion system.

### How is India Faring in Adopting Electric Vehicles (EVs)?

- India is actively pursuing electrification in its automotive sector, with significant investments and focus on EVs. While many automobile industries in the country are heavily investing in EVs, some are prioritising hybrid vehicles.
- The government is providing clear tax incentives **primarily for a specific category of cars**. Other technological platforms in the automotive industry are grouped together in the upper end of the tax bracket, suggesting a tax structure that **may not be equally favourable for all types of vehicular technologies**.
- India's electric mobility plan is **prominently focused on the widespread adoption of BEVs** to replace traditional **internal combustion engine (ICE) vehicles**.
- In this context **lithium-ion (Li-ion) batteries are currently considered the most viable option**. This indicates a strategic **emphasis on BEVs and a preference** for specific battery technologies to drive the electric mobility transition in the country.

### What are Battery Electric Vehicles (BEVs)?

- **About:**
  - 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.

## 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 ICE 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 Challenges in Adoption of Battery Electric Vehicles?

- **Upfront Cost:**
  - The experience in markets from **Norway to the US and China** shows that the **electric push works only if it is backed by state subsidies.**
    - Norway's EV policy has fostered the world's most advanced EV market. So, the government waives the **high taxes on EVs, which** it imposes on sales of non-electrics; it lets electric cars run in bus lanes; toll roads are free for electric vehicles; and parking lots offer a free charge.
  - However, in India, subsidies, particularly in the form of tax breaks, often benefit the **middle or upper middle classes**, who are the primary purchasers of electric four-wheelers.
    - This distribution pattern **poses a hurdle in ensuring** that subsidies effectively **reach a broader demographic.**
- **Charging Infrastructure:**
  - Countries like **Norway and China, leaders in EV adoption**, attribute their success to sustained efforts in **expanding public charging infrastructure.**
    - China, particularly dominant in charger numbers, boasts **85% of global fast chargers and 55% of slow chargers.**
    - **Norway has 99% hydroelectric power. In India**, the grid is still fed largely by **coal-fired thermal plants.**
  - However, **India** faces a unique challenge with **only about 2,000 operational charging stations** for its growing EV market. This challenge is intensified by the dominance of **two- and three-wheelers**, each with distinct charging requirements.
    - An analysis by the **World Bank (WB)** has found that **investing in charging**

**infrastructure is between four and seven times more effective in ensuring EV adoption** compared with providing upfront purchase subsidies.

▪ **Supply Chain Issues:**

- The global supply chain for key **components like lithium-ion batteries is concentrated in a few countries**, leading to concerns about supply chain stability and dependence on specific nations for crucial materials.
  - More than **90% of the global Li production is concentrated in Chile, Argentina, and Bolivia**, alongside Australia and China, and other key inputs such as **cobalt and nickel are mined in the Congo and Indonesia**.
- India would, therefore, be **almost entirely dependent on imports from a small pool of countries** to cater to its demand.
  - The **demand for Li-ion batteries from India is projected to grow at a CAGR of more than 30%** by volume up to 2030, which translates to **more than 50,000 tonnes of lithium requirement** for the country to manufacture EV batteries alone.

▪ **Consumer Awareness and Education:**

- Many consumers may still lack awareness of the benefits of BEVs, and **misconceptions about their capabilities**, charging infrastructure, and overall cost-effectiveness can impede adoption.
- 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.

## What are Hybrid Vehicles?

▪ **About:**

- Hybrid vehicles combine a **traditional [Internal Combustion Engine \(ICE\)](#) with an Electric Propulsion system**, allowing the vehicle to operate using either or both power sources.
- There are different types of hybrid systems, but the most common ones include **parallel hybrids** (both the engine and electric motor can power the vehicle independently) and series hybrids (only the electric motor drives the wheels, while the engine generates electricity).

▪ **Significance:**

- **Practicality in the Medium Term (5-10 years):**
  - Hybrids are seen as a **practical and viable option** for the medium term as India gradually **moves towards full electrification** of its vehicle fleet. This transition is **expected to take 5-10 years**.
- **Cost of Ownership Perspective:**
  - Hybrids are considered **cost-effective**, making them an **attractive option for consumers**.
  - Hybrid cars **use both fuel and electric power** to run, resulting in **better fuel economy** compared to conventional fuel cars. This translates to cost savings for drivers over time.
- **Critical for Decarbonization Drive:**
  - Hybrid vehicles play a role in **India's [Decarbonization](#) efforts**. Hybrid vehicles have **lower total (well-to-wheel, or WTW) carbon emissions than both electric and traditional ICE** vehicles for similarly sized vehicles.
    - **Hybrids emit 133 grams per kilometre (g/km) of CO<sub>2</sub>, while EVs emit 158 g/km**. This translates to hybrids **being 16% less polluting than the corresponding EV**.
    - **Total (well-to-wheel, or WTW) carbon emissions** does not focus only on tailpipe emissions, but **includes vehicle emissions** (tank-to-wheel, or TTW) and **emissions from crude mining, refining, and power generation as well**.
  - Hybrids are also critical for India's decarbonization drive. The **cheaper upfront cost of hybrids will encourage many more people to adopt** low-emission vehicles.

## What are the Other Possible Alternative Technologies to BEVs?

- **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 km 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

- Prioritize substantial investment in building a robust and widespread charging infrastructure network. **Increasing the number of charging stations**, especially in urban areas and along highways, is crucial for easing range anxiety and encouraging EV adoption.
- Implement consistent and supportive government policies and incentives to make EVs more affordable. This may include tax breaks, subsidies, and other financial incentives to both manufacturers and consumers.
- Conduct public awareness campaigns to educate consumers about the benefits of EVs, dispel myths, and promote their environmental advantages. Enhancing public knowledge can positively influence consumer attitudes and choices.

## UPSC Civil Services Examination, Previous Year Questions (PYQs)

### Prelims

**Q. In the cities of our country, which among the following atmospheric gases are normally considered in calculating the value of Air Quality Index? (2016)**

1. Carbon dioxide
2. Carbon monoxide
3. Nitrogen dioxide
4. Sulfur dioxide
5. Methane

**Select the correct answer using the code given below:**

- (a) 1, 2 and 3 only
- (b) 2, 3 and 4 only
- (c) 1, 4 and 5 only
- (d) 1, 2, 3, 4 and 5

**Ans: (b)**

**Exp:**

- National Air Quality Index (AQI) is a tool for effective communication of air quality status to people in terms which are easy to understand. It transforms complex air quality data of various pollutants into a single number (index value), nomenclature and colour.
- There are six AQI categories, namely Good, Satisfactory, Moderately Polluted, Poor, Very Poor, and Severe.
- It considers eight pollutants namely:
  - Carbon Monoxide (CO), hence, 2 is correct.
  - Nitrogen Dioxide (NO<sub>2</sub>), hence, 3 is correct.
  - Sulphur Dioxide (SO<sub>2</sub>), hence, 4 is correct.
  - Ozone (O<sub>3</sub>),
  - PM 2.5,
  - PM 10,
  - Ammonia (NH<sub>3</sub>),
  - Lead (Pb).
- Therefore, option b is the correct answer.

**Q. With reference to the Agreement at the UNFCCC Meeting in Paris in 2015, which of the following statements is/are correct? (2016)**

1. The Agreement was signed by all the member countries of the UN and it will go into effect in 2017.
2. The Agreement aims to limit the greenhouse gas emissions so that the rise in average global temperature by the end of this century does not exceed 2°C or even 1.5°C above pre-industrial levels.
3. Developed countries acknowledged their historical responsibility in global warming and committed to donate \$ 1000 billion a year from 2020 to help developing countries to cope with climate change.

**Select the correct answer using the code given below:**

- (a) 1 and 3 only
- (b) 2 only
- (c) 2 and 3 only
- (d) 1, 2 and 3

**Ans: (b)**

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### **Mains**

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

