

## A STUDY ON THE IMPACT OF ELECTRIC VEHICLE USAGE IN REDUCING CARBON DIOXIDE EMISSIONS IN INDIA

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### ABSTRACT

*Electric vehicles (EVs) have emerged as a transformative solution to reduce greenhouse gas emissions, notably carbon dioxide (CO<sub>2</sub>), in India. The transportation sector is a major contributor to India's CO<sub>2</sub> emissions, primarily due to the high reliance on fossil fuels. The transition to EVs, powered by renewable energy sources, offers a promising route to mitigate environmental impacts. This paper explores the potential impact of EV adoption on CO<sub>2</sub> emissions reduction in India by examining current emission levels, policies, and the anticipated effects of large-scale EV integration. India's government has introduced various initiatives, such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme, to accelerate EV deployment. Through policy incentives, tax benefits, and charging infrastructure development, India aims to achieve a substantial reduction in transportation-related emissions by 2030. This paper assesses both the direct and indirect impact of EVs on emission reductions in India, comparing them with traditional internal combustion engine (ICE) vehicles. The findings underscore the significance of aligning EV growth with clean energy expansion.*

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**Keywords:** *Electric Vehicles, Carbon Dioxide emission, Internal Combustion Engine, Transportation.*

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### Introduction

The transportation sector is one of the largest contributors to global carbon dioxide (CO<sub>2</sub>) emissions, responsible for nearly a quarter of all energy-related emissions worldwide. As climate change intensifies and its consequences become increasingly evident, reducing emissions from transportation has become a global priority. The rise of electric vehicles (EVs) represents a transformative shift in this sector, holding the promise of significantly reducing carbon emissions and lessening dependence on fossil fuels. Electric vehicles are often touted as a cleaner alternative to conventional internal combustion engine (ICE) vehicles because they rely on electricity rather than gasoline or diesel. This distinction is critical, as the combustion of fossil fuels in traditional vehicles releases substantial amounts of CO<sub>2</sub>, contributing heavily to air pollution and global warming. EVs, in contrast, produce no direct tailpipe emissions, offering a pathway to potentially lower emissions depending on the energy sources used for electricity generation.

### Global Scenario of Electric Vehicles

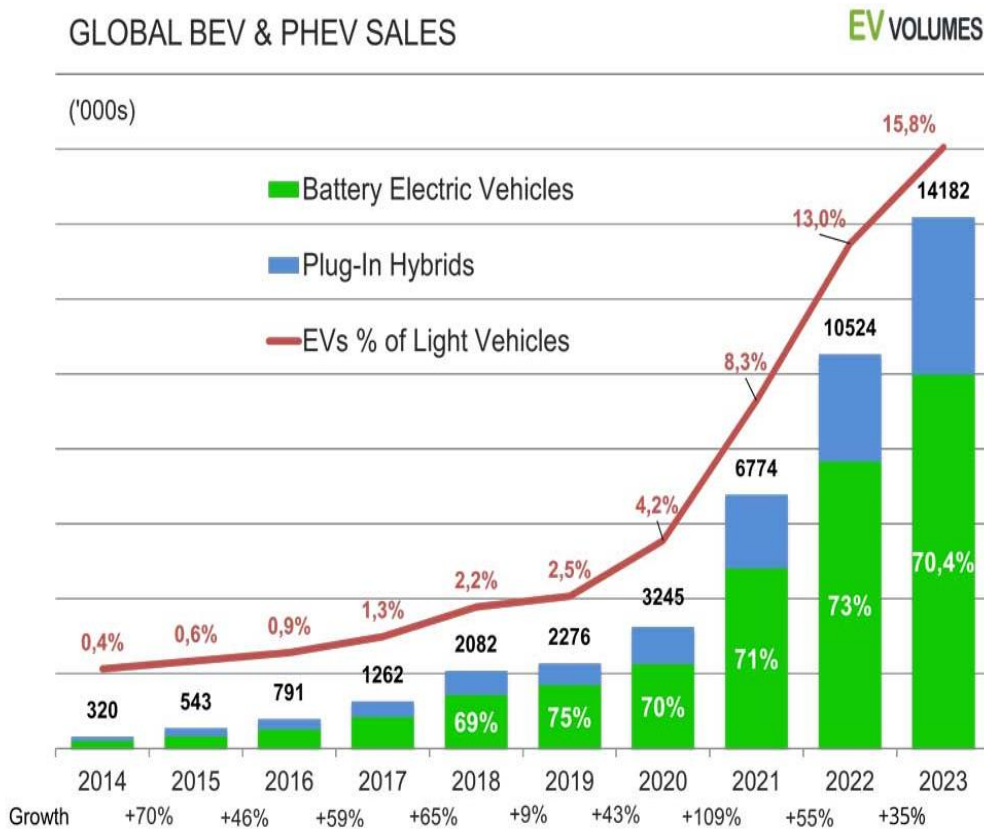
The global scenario for electric vehicles (EVs) is rapidly evolving as countries around the world work to reduce greenhouse gas emissions, combat air pollution, and transition toward more sustainable forms of transportation. While the pace and nature of EV adoption vary by region, key trends and developments are shaping the future of electric mobility globally.

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- Global EV Sales Growth:** According to the International Energy Agency (IEA), the number of electric cars on the road surpassed 10 million globally in 2020, and EV sales have continued to grow year over year. In 2023, EVs accounted for about 14% of global car sales, and the market share of EVs is expected to continue increasing, with projections suggesting that EVs could represent over 30% of global vehicle sales by 2030.
- Shift to Full Electrification:** Major automakers are setting ambitious targets to shift toward electrification. Companies like Volkswagen, General Motors, Ford, BMW, Toyota, and Hyundai are investing heavily in EV production. Several automakers, including Volvo and General Motors, have announced plans to go fully electric by 2035 or 2040.
- China:** China is the world's largest EV market, accounting for over 50% of global EV sales. The country has aggressively promoted EV adoption through incentives, local manufacturing, and infrastructure investments. The Chinese government aims to have 25% of all vehicles in the country be electric by 2025 and achieve carbon neutrality by 2060.
- Europe:** Europe is another major market for EVs, with countries like Norway, Germany, the UK, France, and Netherlands leading the way. Norway, for example, is on track to phase out the sale of new internal combustion engine (ICE) cars by 2025.
- Subsidies and Tax Credits:** Many countries offer financial incentives to consumers to encourage EV purchases. For example, the U.S. offers tax credits of up to \$7,500 for the purchase of a new EV, depending on the model and manufacturer. China provides subsidies to EV buyers, along with incentives for manufacturers to produce electric vehicles domestically. The European Union offers various incentives at the national level, with countries like Germany providing up to €9,000 for the purchase of a new electric car.



Source: [www.ev-volumes.com/country/total-world-plug-in-vehicle-volumes/](http://www.ev-volumes.com/country/total-world-plug-in-vehicle-volumes/)

In year 2023, selling of electric vehicles jumped about 35% compare to the previous year. A total of 14.2 million new Battery Electric Vehicles (BEV) and Plug-in Hybrids (PHEV) sold, from that 10 million were pure electric BEVs and 4.2 million were Plug-in Hybrids (PHEV).

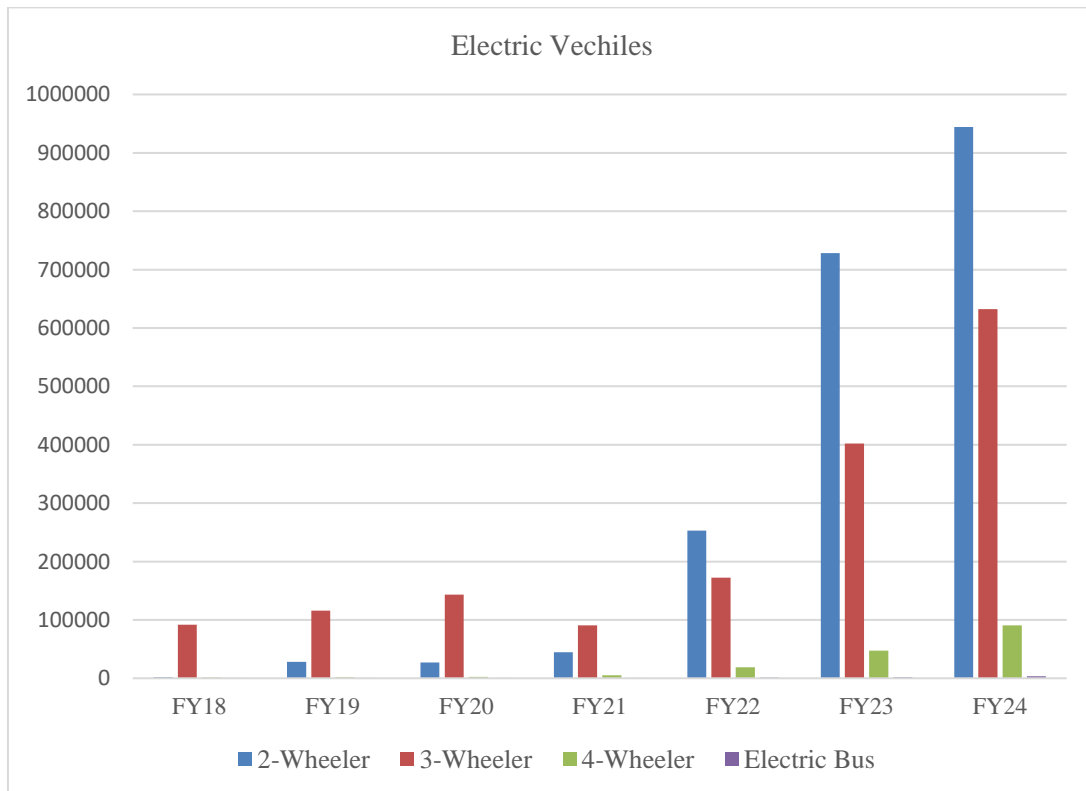
**Indian Scenario Electric Vehicles**

India has surpassed Germany and Japan to become the world's third-largest vehicle market in terms of sales. Manufacturers and legislators are now being urged to work together to change consumer preferences in favour of greener products. With 7.1 percent of the country's GDP and many jobs, the automobile industry plays a vital role in India's economy. According to the Economic Survey 2023, the domestic electric vehicle industry in India is expected to develop at a compound annual growth rate (CAGR) of 49% between 2022 and 2030, reaching 10 million yearly sales by that time. Furthermore, by 2030, it is anticipated that the electric car sector would provide about 50 million direct and indirect jobs.

The Indian government has taken several steps to encourage the adoption of electric vehicles, with various incentives and policy frameworks aimed at reducing carbon emissions and promoting sustainable mobility:

- FAME India Scheme (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles):** Launched in phases (FAME I in 2015, FAME II in 2019), this scheme offers financial incentives for purchasing electric vehicles, charging infrastructure development, and manufacturing of electric vehicles and batteries. Under FAME II, the government allocated ₹10,000 crore (~\$1.3 billion) to promote electric mobility in India, offering subsidies for electric buses, 2-wheelers, 3-wheelers, and 4-wheelers.
- PLI Scheme for EVs and Batteries:** The government introduced a Production-Linked Incentive (PLI) scheme to boost domestic manufacturing of electric vehicles and advanced batteries. This aims to reduce India's dependency on imported EV components and batteries, creating a more sustainable local EV ecosystem.
- State-Level Policies:** Many Indian states, including Delhi, Maharashtra, Tamil Nadu, and Uttar Pradesh, have rolled out state-specific EV policies that offer additional incentives like road tax exemptions, reduced registration fees, and subsidies on EV purchases. For example, Delhi's EV policy offers a direct subsidy of ₹30,000 for 2-wheelers and ₹1.5 lakh for electric cars.

**Total Electric Vehicles Sales**



| Sr No | Year | 2-Wheeler | 3-Wheeler | 4-Wheeler | Electric Bus | Total   |
|-------|------|-----------|-----------|-----------|--------------|---------|
| 1     | FY18 | 2005      | 91970     | 1204      | 19           | 95198   |
| 2     | FY19 | 28007     | 116031    | 1885      | 66           | 145989  |
| 3     | FY20 | 26834     | 143051    | 2377      | 434          | 172696  |
| 4     | FY21 | 44803     | 90898     | 5154      | 373          | 141228  |
| 5     | FY22 | 252641    | 172543    | 18622     | 1194         | 445000  |
| 6     | FY23 | 728054    | 401882    | 47499     | 1984         | 1179419 |
| 7     | FY24 | 944126    | 632485    | 90432     | 3693         | 1670736 |

Source - <https://www.smev.in/statistics>

In the Year 2024, Total Electric Vehicles sales around 16.7 lakhs which is 70.5% more than the previous year 2023. In the Year 2023, the sales around 11.7 lakhs which is 37.7% more than the previous year 2022 and in the year 2022 its 4.45 lakhs which is 31.7% more than the previous year 2021.

#### Importance of usage of Electric Vehicles

- **Reduction of Greenhouse Gas Emissions:** Electric vehicles can lower greenhouse gas (GHG) emissions, which is one of its biggest advantages. Global emissions from transportation are largely caused by automobiles with internal combustion engines (ICE), which are propelled by gasoline and diesel. In contrast, EVs emit little to no pollutants from their tailpipes. Even when power generation is taken into consideration, EVs often have a lower carbon footprint.
- **Improved Air Quality:** EVs have zero tailpipe emissions, which means they do not release air pollutants and smog-causing substances including particulate matter, nitrogen oxides (NOx), and volatile organic compounds (VOCs). This is especially crucial in cities where public health can be greatly impacted by air quality. Lowering automobile emissions can help prevent heart disease, respiratory issues, and other air pollution-related illnesses.
- **Reduction in Noise Pollution:** Comparing electric and conventional automobiles, the former are significantly quieter. Engine noise reduction helps to lower total sound pollution, especially in urban areas where traffic noise may be upsetting and detrimental to one's health and well-being.
- **Decreased Dependence on Fossil Fuels:** EVs can lessen dependency on fossil fuels like petroleum. This is especially crucial considering international initiatives to lessen reliance on oil and to lessen energy-related geopolitical disputes. Since EVs require electricity to function, renewable energy sources like solar, wind, and hydroelectric power may be used to power them, creating a more robust and sustainable energy system.
- **Cost Savings Over Time:** While the initial cost of an EV may be more than that of a regular automobile, its operational costs are often cheaper. Because they have fewer moving parts, do not need oil changes, and often have fewer mechanical problems, EVs are less expensive to maintain. Furthermore, electricity is typically less expensive to power an EV than gasoline or diesel for a traditional car. These savings may eventually lower the cost of EVs for buyers.
- **Climate Change Mitigation:** Reducing transportation emissions is a crucial component of the solution, especially considering the pressing need to address climate change. Clean energy-powered electric cars contribute to lowering the transportation sector's carbon footprint, which is one of the biggest causes of global warming.
- **Energy Security:** Electric vehicles help to increase energy security by shifting away from fossil fuels and diversifying energy sources. Numerous nations depend significantly on imported oil, which is vulnerable to changes in price and geopolitical threats. EVs enable more stable and localized energy supply chains, particularly when paired with renewable energy.

#### Negative Effect of Carbon Emission

- **Global Warming:** CO<sub>2</sub> is a major greenhouse gas, which traps heat in the Earth's atmosphere, leading to an overall increase in global temperatures. This phenomenon, known as global warming, has far-reaching impacts.
- **Extreme Weather Events:** Rising temperatures increase the frequency and intensity of extreme weather events such as hurricanes, droughts, floods, and wildfires. These events disrupt ecosystems, damage infrastructure, and result in loss of life.

- **Melting Polar Ice and Rising Sea Levels:** Higher temperatures cause polar ice caps and glaciers to melt, contributing to rising sea levels. This can lead to coastal erosion, flooding of low-lying areas, and the displacement of millions of people worldwide.
- **Health Effects:** While CO<sub>2</sub> itself is not directly harmful in the concentrations found in the atmosphere, the activities that emit CO<sub>2</sub>, such as burning fossil fuels, often release other pollutants like particulate matter (PM), nitrogen oxides (NO<sub>x</sub>), and sulphur dioxide (SO<sub>2</sub>). These pollutants contribute to respiratory problems, heart disease, and premature death.
- **Changing Growing Conditions:** Climate change caused by carbon emissions can alter rainfall patterns, leading to droughts in some regions and flooding in others. This impacts agricultural yields and food security, especially in vulnerable regions.
- **Damage to Infrastructure:** Extreme weather events and rising sea levels can damage infrastructure, including roads, buildings, and energy systems, leading to significant economic costs for repair and reconstruction.
- **Loss of Agricultural Productivity:** Reduced agricultural output due to climate impacts can increase food prices, threaten global food security, and reduce the availability of resources for poorer communities.
- **Disruption of Ecosystem Services:** Ecosystems provide essential services like water purification, soil fertility, pollination, and climate regulation. Carbon emissions lead to climate shifts that can compromise these services, impacting human populations who depend on them for survival.

The negative effects of carbon emissions are wide-ranging and interconnected, affecting the environment, public health, biodiversity, and global economies. Addressing carbon emissions is critical to mitigating these impacts and moving toward a more sustainable future.

Electric vehicles are one of the most effective tools we must reduce carbon emissions in the transportation sector, which is one of the largest contributors to global greenhouse gas emissions. By shifting from gasoline and diesel-powered cars to EVs, we can significantly lower both direct and indirect carbon emissions, improve air quality, and help mitigate climate change. However, to maximize these benefits, EV adoption must go hand in hand with a cleaner, more sustainable energy grid and efforts to address environmental and social issues associated with battery production.

#### Carbon Dioxide Emission Calculator

CO<sub>2</sub> emissions reductions during the lifecycle of the **2-Wheeler vehicle** If daily travelling of vehicle is **average 25 km** than

| Sr No | Year | CO <sub>2</sub> emissions reductions during the lifecycle of the vehicle (Tonnes) | NO of Vehicles | CO <sub>2</sub> Emission Reduction (Tonnes) |
|-------|------|---|----------------|---|
| 1     | FY18 | 1.67  | 2005           | 3348.35                                     |
| 2     | FY19 | 1.67  | 28007          | 46771.69                                    |
| 3     | FY20 | 1.67  | 26834          | 44812.78                                    |
| 4     | FY21 | 1.67  | 44803          | 74821.01                                    |
| 5     | FY22 | 1.67  | 252641         | 421910.47                                   |
| 6     | FY23 | 1.67  | 728054         | 1215850.18                                  |
| 7     | FY24 | 1.67  | 944126         | 1576690.42                                  |

Source - <https://e-amrit.niti.gov.in/co2-calculator>

CO<sub>2</sub> emissions reductions during the lifecycle of the **3-Wheeler vehicle** If daily travelling of vehicle is **average 40 km** than

| Sr No | Year | CO <sub>2</sub> emissions reductions during the lifecycle of the vehicle (Tonnes) | NO of Vehicles | CO <sub>2</sub> Emission Reduction (Tonnes) |
|-------|------|---|----------------|---|
| 1     | FY18 | 9.72  | 91970          | 893948.4                                    |
| 2     | FY19 | 9.72  | 116031         | 1127821.32                                  |
| 3     | FY20 | 9.72  | 143051         | 1390455.72                                  |
| 4     | FY21 | 9.72  | 90898          | 883528.56                                   |
| 5     | FY22 | 9.72  | 172543         | 1677117.96                                  |
| 6     | FY23 | 9.72  | 401882         | 3906293.04                                  |
| 7     | FY24 | 9.72  | 632485         | 6147754.2                                   |

Source - <https://e-amrit.niti.gov.in/co2-calculator>

CO<sub>2</sub> emissions reductions during the lifecycle of the **4-Wheeler vehicle** If daily travelling of vehicle is **average 50 km** than

| Sr No | Year | CO <sub>2</sub> emissions reductions during the lifecycle of the vehicle (Tonnes) | NO of Vehicles | CO <sub>2</sub> Emission Reduction (Tonnes) |
|-------|------|---|----------------|---|
| 1     | FY18 | 12.03   | 1204           | 14484.12                                    |
| 2     | FY19 | 12.03   | 1885           | 22676.55                                    |
| 3     | FY20 | 12.03   | 2377           | 28595.31                                    |
| 4     | FY21 | 12.03   | 5154           | 62002.62                                    |
| 5     | FY22 | 12.03   | 18622          | 224022.66                                   |
| 6     | FY23 | 12.03   | 47499          | 571412.97                                   |
| 7     | FY24 | 12.03   | 90432          | 1087896.96                                  |

Source - <https://e-amrit.niti.gov.in/co2-calculator>

### Findings

Total CO<sub>2</sub> emissions reductions from FY18 to FY24 in India:

| Sr. No | Vehicles Category | CO <sub>2</sub> Emission Reduction (Tonnes) |
|--------|-------------------|---|
| 1      | 2-Wheeler         | 3384204.9                                   |
| 2      | 3-Wheeler         | 16026919.2                                  |
| 3      | 4-Wheeler         | 2011091.19                                  |
|        | Total             | <b>21422215.29</b>                          |

Reducing **21,422,215 tons** of carbon dioxide (CO<sub>2</sub>) emissions by using electric vehicles (EVs) would have significant environmental, health, and economic benefits. Here is a detailed breakdown of the positive impacts of such a reduction:

- **Reduction in Global Warming:** CO<sub>2</sub> is a **greenhouse gas** (GHG) that contributes to the warming of the Earth's atmosphere. By reducing emissions by **21.42 million tons** of CO<sub>2</sub>, this would help slow the rate of global warming, making it easier to meet international climate goals, such as those set in the **Paris Agreement**.
- **Carbon Budget:** Every ton of CO<sub>2</sub> emitted adds to the **global carbon budget**, the maximum amount of CO<sub>2</sub> the planet can emit before it reaches dangerous levels of warming. Cutting **21.42 million tons** contributes to keeping global temperature rise well below **2°C**, which is a critical threshold for avoiding irreversible climate impacts.
- **Health Benefits:** Air pollution is linked to respiratory and cardiovascular diseases, such as asthma, bronchitis, and heart attacks. By reducing harmful emissions, public health improves, potentially leading to fewer cases of chronic diseases and hospital admissions. A study by the **World Health Organization (WHO)** estimates that air pollution is responsible for over **7 million deaths** globally each year.
- **Lower Fossil Fuel Consumption:** A reduction of **21.42 million tons** of CO<sub>2</sub> by using EVs suggests a reduction in the consumption of fossil fuels, particularly **gasoline and diesel**. This helps reduce a country's dependence on imported oil, which is a major cost for many nations.
- **Decarbonizing the Transport Sector:** The transport sector is one of the largest sources of global carbon emissions, responsible for nearly **25-30%** of global CO<sub>2</sub> emissions. By reducing emissions by **21.42 million tons**, this represents a meaningful step in decarbonizing transportation, which is essential for meeting global climate targets.

### Conclusion

Reducing 21.42 million tons of CO<sub>2</sub> by adopting electric vehicles (EVs) would have widespread environmental, economic, and health benefits. Mitigating climate change and contributing to global carbon neutrality efforts. Improving air quality, reducing health risks, and lowering healthcare costs. Decreasing reliance on fossil fuels, fostering energy security, and creating new jobs in the green economy. Promoting sustainability by improving energy efficiency, encouraging renewable energy use, and advancing technological innovation.

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