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Economic and Environmental Aspects of Electric Vehicles in India

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Abstract

The economic and environmental effects of electric cars (EVs) in India are briefly discussed in this paper. A few factors that have sped up the development of EVs include the growing risks of global warming, an unhealthy dependence on petrol, constantly rising fuel prices, and driving tendencies. This is because the transportation industry accounts for a significant portion of greenhouse gas emissions. The purpose of this study is to evaluate and analyse how the EV industry has grown and how the government has assisted in fostering and speeding the trend to protect the country and the Planet from Pollution. Environmental concern leads to demand for electric vehicles. Users see enormous possibilities in electric automobiles. Along with shared mobility, mass transit, etc., EVs will play a significant part in smart cities and smart transportation in the upcoming years. Therefore, further work is required to improve batteries and make the charging procedure easier. India is actively encouraging the use of EVs as part of a push to encourage new age technologies and reduce its carbon emissions to zero by the year 2070. By 2030, India wants to convert 30% of its private automobiles, 70% of its commercial vehicles, and 80% of its two- and three-wheelers to electric vehicles. This study will persuade decision-makers in government, business, and industry to promote the usage of electric vehicles in India in order to cut greenhouse gas emissions.

Keywords: *e-vehicles, environment, Pollution, Economic impact, greenhouse gases.*

1. Introduction

One of the greatest consumers of fossil fuels, notably oil, is the transportation sector, which includes land, air, and marine transports [3]; this sector greatly contributes to our environmental concerns. Numerous initiatives have been taken to lessen the environmental impact of the transportation industry. Electric vehicles (EVs) have the potential to address a number of interconnected issues, including air pollution, the depletion of non-renewable energy sources, growing oil prices, oil imports, and the need for "green" development.(Singh et al., 2021) India is the sixth-largest commercial vehicle producer in the world, but it hasn't had a big impact on the electric car market. India is the leader in the automobile sector for internal combustion engines. It is the world's biggest maker of tractors and two-wheelers. India is the second-largest producer of buses on the international market. It is also the sixth-largest vehicle manufacturer in the world and the third-largest heavy truck manufacturer(Digalwar et al., 2021). As a result, humans has quickly begun to look for new, clean, and renewable energy sources, notably for powering cars. In this context, electric vehicles (EVs), much as in the past, are without a doubt the most significant replacement for conventional internal combustion engines. Electric cars have seen a sharp rise in popularity in recent years, with a manufacturing growth of 1500% over the previous ten years(Ağbulut & Bakir, n.d.). Frequently, electric vehicles are touted as a green transportation alternative.

2. India's need for electric vehicle adoption

- The Indian government has supported a number of alternative transportation alternatives, with electric cars playing a key role, in response to the country's rising pollution issue. In fact, they use electricity as fuel rather than fossil fuels, hence they hold the solution to India's escalating air pollution issue.
- Electric vehicles don't make any noise like conventional vehicles since they don't have an internal combustion engine and have fewer parts. As a result, it aids in lowering noise pollution, particularly in densely populated metropolitan areas. In comparison to cars powered by fossil fuels, electric vehicles provide a quieter ride and faster acceleration.

- In the long run, owning and maintaining electric cars is simpler and less expensive. Because a battery electric vehicle (BEV) has fewer parts than a typical petrol or diesel vehicle, its maintenance and upkeep is far less expensive than that of a fuel vehicle and automobiles with diesel engines.
- Electric vehicles go through the same testing processes as traditional vehicles that run on petrol. Due to their lower centre of gravity, which increases their stability in a collision, electric vehicles are safer to operate.

3. Review of literature

(Nanaki & Koroneos, 2013) in his study titled as Comparative economic and environmental analysis of conventional, hybrid and electric vehicles taking Greece as case study by using secondary data. According to the study, hybrid and electric automobiles outperform conventional vehicles in three distinct power generating scenarios—high, medium, and low carbon. By examining both the Indian EV market and the overall development of EVs,(Singh et al., 2021) this study examined the policies, tactics, and technological factors for developing EVs. The development and research status of EVs in India was also taken into account in this study. The Indian government should increase research funding for the development of EVs and the infrastructure for charging them, it was decided. In order to promote the developing Indian EV industry, the federal government may also play a significant role in coordinating the efforts of the states and companies with an interest in EVs. (Palaniswamy Sivakumar, n.d.)Social, Economic and Environmental Impact of Electric Vehicles in India presents a broad picture of how electric cars (EVs) affect India's social, economic, and environmental conditions. The objective of this study is to compare and evaluate the growth of the electric vehicle market and the government's encouragement of the trend and its acceleration in India in order to protect the country and the globe from pollution.

A Research study(Chen et al., 2021) is performed to do a thorough analysis of the adoption of BEVs. A computable general equilibrium model is used to assess the effects of various scenarios using demand estimates obtained from a discrete choice experiment. Researcher reported Changes in fuel prices and manufacturer incentives have minimal effects on GDP growth, but subsidies have a significant influence on both GDP and the adoption of BEVs since they have a stimulative effect on both. (Prud'homme & Koning, 2012) studied the additional expenses of an electric automobile, as comparison to a fuel-powered car of equivalent size, are calculated using a straightforward model, together with the CO2 savings it provides. These magnitudes depend on a number of factors, including the price of the car, the cost of the battery, the electric efficiency, the cost of electricity, the CO2 content of electricity (for an electric car), the price of the car, the cost of fuel, the cost of local pollution, the CO2 emission (for a fuel car), the lifespan of the car, and the amount of miles it is driven. Using Sensitivity analyses researcher concluded that almost always, they are insufficient to reduce unnecessary expenses or considerably boost CO2 gains.

The study's goal is to get a general understanding of the government of India's and its state governments' policies on electric vehicles in order to determine their applicability and potential effects on EV adoption in India. In the current situation the researcher used exploratory research is employed to do the investigation. (Das & Bhat, 2022). (Pg Abas et al., 2019)With the use of life cycle cost analysis, examined whether EV introduction to the Brunei market is feasible and identifies key elements that affect this decision. Despite the usage of local data, the study concluded that EVs are still costly compared to ICEVs and HEVs now available on the market, with the cost of procurement significantly increasing the Life Cycle Cost (LCC) of the vehicle.(Ağbulut & Bakir, n.d.) The study compares internal combustion engines with electric cars, but it also attempts to teach readers on how these two types of propulsion affect the global ecological balance. Finally, concluded Turkey's nuclear energy strategy as a countermeasure to the nation's fast rising power demand.

4. Need and objectives of Research

This study aims to provide comprehensive information on the current Indian EV status and government initiatives for future spread of EV's. EV's widespread adoption is still one of the foremost national objectives, despite the awareness of environmental pollution from conventional vehicles and the depletion of fossil fuels. A portion of the study is devoted to check the Impact of EV's on co2 emission and challenges to EV's in India.

5. Current status/ economic overview of EV sector in India

- Globally, the Indian car industry is ranked fifth, but by 2030, it's projected to move up to third. India is the world's largest manufacturer of two- and three-wheelers, the second-largest producer of buses, and the largest producer of agricultural equipment like tractors.
- At now, India's Gross Domestic Product (GDP) and 49% of its manufacturing GDP are both contributed by the car sector. This indicates that the nation's economy will be adversely impacted. This means that various auto ancillaries and related industries will expand with the

EV industry in the next years as they keep up with the trends.

- The Indian automobile sector is worth around $ 222 billion, and the country's EV market is anticipated to reach $2 billion in sales by 2023 and $7.09 billion by 2025. Additionally, 8% of all exports from the country come from the automobile sector. 40% of the $31 billion in global research and development spending comes from this industry.
- As of August 2022, there were 13, 92,265 electric vehicles (EVs) in total on Indian roads, according to the Ministry of Road Transport and Highways. There will probably be 45–50 million more EVs on the road by 2030.
- The automobile industry now employs over 37 million people, and by 2030 it hopes to create 50 million direct and indirect employment.
- Between 2022 and 2030, the EV market is projected to develop at a compound annual growth rate (CAGR) of 49%, reaching 10 million annual sales.
- The industry received $32.84 billion in equity inflows from FDI between April 2000 and March 2022, or 6% of all FDI in stocks during that time.

6. A view to electric vehicles in India

In the EV industry, India has already met one of the standards. Bharat Heavy Electricals Limited (BHEL) has installed 20 solar-powered EV chargers on the highway between Delhi and Chandigarh, making it the first in the country to be e-vehicle friendly. In the financial year (FY) 2022, India's total number of charging stations increased by 285% year over year; aggressive government action is anticipated to hasten the expansion to 4 lakh stations by FY 2026.

Table:1
The number of electric vehicles currently being used on the roads of India, State wise as on 14-7-2022

Sr.No	***State Name***	***Total Electric Vehicle***	***Total Non-Electric Vehicle***	***Total***
1	Andam & Nicobar Island	162	1,46,945	1,47,107
2	Arunachal Pradesh	20	2,52,965	2,52,985
3	Assam	64,766	46,77,053	47,41,819
4	Bihar	83,335	1,04,07,078	1,04,90,413
5	Chandigarh	2,812	7,46,881	7,49,693
6	Chhattisgarh	20,966	68,36,200	68,57,166
7	Delhi	**1,56,393**	76,85,600	78,41,993
8	Goa	3,870	10,71,570	10,75,440
9	Gujarat	45,272	2,06,05,484	2,06,50,756
10	Haryana	37,035	1,07,78,270	1,08,15,305
11	Himachal Pradesh	1,175	19,64,754	19,65,929
12	Jammu & Kashmir	2,941	18,69,962	18,72,903
13	Jharkhand	16,811	64,86,937	65,03,748
14	Karnataka	1,20,532	2,68,70,303	2,69,90,835
15	Kerala	30,775	1,57,74,078	1,58,04,853
16	Ladakh	26	38,302	38,328
17	**Maharashtra**	**1,16,646**	**3,10,58,990**	**3,11,75,636**
18	Manipur	586	4,99,324	4,99,910
19	Meghalaya	49	4,59,001	4,59,050
20	Mizoram	21	3,15,626	3,15,647
21	Nagaland	58	3,39,129	3,39,187
22	Odisha	23,371	98,45,073	98,68,444
23	Puducherry	2,149	12,13,735	12,15,884
24	**Punjab**	**14,804**	**1,24,63,019**	**1,24,77,823**
25	Rajasthan	81,338	1,73,27,388	1,74,08,726
26	Sikkim	21	97,189	97,210
27	Tamil Nadu	82,051	2,98,42,376	2,99,24,427
28	Tripura	9,262	6,50,026	6,59,288
29	**DNH&DD**	**183**	**3,07,671**	**3,07,854**
30	Uttarakhan d	31,008	33,12,041	33,43,049
31	Uttar Pradesh	**3,37,180**	4,00,92,490	4,04,29,670
32	West Bengal	48,767	1,41,34,171	1,41,82,938
	G. Total	**13,34,385**	**27,81,69,631**	**27,95,04,016**

***Source:** Ministry of Heavy Industries*

Table 1 shows Only 0.48% flow of electric vehicles is on Indian roads. State wise data shows Uttar Pradesh is at top in use of EV's followed by Delhi, Karnataka and Maharashtra at second, third and fourth place respectively.

7. Government Initiatives

By 2030, the Indian government wants all of its vehicles to be electric vehicles. But with only 308 network EV charging stations nationwide, this objective needs further backing.

7.1. National Electric Mobility Mission Plan 2020: In India National Electric Mobility Mission Plan 2020 was introduced in 2013 by Ministry of heavy industries and public enterprises with an objective of 50-70 lakhs of electric vehicles on Indian roads by 2020. But this target was never achieved even in 2022 as table no. 1 is also indicating that only 13,34385 vehicles were on Indian roads by July, 2022.

7.2. Government Subsidies and Restrictions: The Indian government is providing electric car owners with rebates of INR 140 crore. To encourage the production of electric vehicles in India, the government has also raised import taxes. A total of 14 crore rupees have been set up for the construction of charging infrastructure across India. Incentives for hybrid and electric vehicles are also available through the Faster Adoption and Manufacturing of Hybrid and Electric Vehicle (FAME) India initiative, ranging from Rs. 1,800 to Rs. 29,000 for scooters and motorcycles and Rs. 1.38 lakhs for automobiles. (Delhi SI. Fame-India Scheme).

7.3. Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India Phase-I

7.3.1. FAME-I: FAME-I was launched in April 2015. The main emphasis of FAME-I was Demand generation, technology base, experimental projects, and basic facilities of charging system to promote EV. Main attraction of "FAME-I." was Incentive for reduced purchase price.

7.3.2. FAME-II : It was introduced in 2019 for 3 years. "FAME II" focused on Various incentives on the purchase price and development of changing infrastructure. It was further amended on 11 Jan 2021 by the Department of Heavy Industry considering subsidy of two wheeler electric vehicle will depend on battery size, subsidy increased to 15000/kwh, minimum range of 80KM on single change and min top speed of 40 km/h , discount on eligible E-2 vehicles.

7.4. Andhra Pradesh electric mobility policy 2018: Under this policy by Andhra Pradesh Government announced Refund of road tax and registration fee for the sale of EVs until 2024. Celebration of green day to aware people about environment Protection. State government proposed e buses as compulsory public transport by 2024 in its four cities, Also proposed establishment of 100000 charging stations by 2024.

7.5. Maharashtra electric vehicle policy 2021: By 2025, 10% of new car registrations are to be electric vehicles. to have public transit in six designated city districts run at least 25% on electricity by 2025. conversion of 25% of state-owned buses to electric buses. to increase Maharashtra's production of electric vehicles to the maximum level. to build 2375 charging stations across a number of urban regions and on major thoroughfares. From April 2022 onward, the government will buy the sole EV. By 2025, one-fourth of the full footprints of businesses involved in logistics, distribution, and e-commerce will be EVs. tax breaks for real estate for privately built charging infrastructure. For different types of EVs, there are financial incentives ranging from INR 29,000 to INR 275,000. Fast and slow charging infrastructure incentives of Rs 10,000 and Rs 500,000.

7.6. Production linked Incentive Scheme: To promote domestic production of high-tech automotive products and attract capital to the industry's value chain, the Production Linked Incentive (PLI) scheme (with a $3.5 Bn budget) for the automotive industry proposes financial incentives of up to 18%. The PLI programme encourages domestic EV battery production and reduces reliance on imports. This will drastically cut the cost of EVs and provide the required infrastructure to sustain the EV sector.

8.Tax benefits/ Incentives:

8.1. Goods and Service Tax (GST): Since its inception in 2017, electric cars, which are greener substitutes for gasoline-powered vehicles, have been subject to GST. The 36th GST Council Meeting in 2019 changed the GST rates for electric vehicles (EVs) in an effort to promote their production and purchase**.** GST exempt on the employment of electric buses for transportation purposes by public agencies with a carrying capacity of more than 12 passengers.

Table no. 2: GST rates on Electric vehicles

Date	**GST rate**	
	Electric Vehicles	**Electric Vehicle Chargers and Charging Stations**
Before	12%	18%
After 1st August 2019	5%	5%

Source: GST ACT.

8.2. Income tax law: Section 80EEB allows for a total tax exemption of up to Rs 1,50,000 when paying off an EV loan subject to some conditions as The loan must be taken from a financial institution or a non-banking financial company for buying an electric vehicle.The loan must be sanctioned anytime during the period starting from 1 April 2019 till 31 March 2023. Both purchases of four-wheeled and two-wheeled electric vehicles are eligible for this tax credit.

9. Challenges in electric vehicle in India

There are several advantages of EVs but with their advantages some obstacles are also associated with the EVs**.**

9.1. Rang anxiety: A major source of friction, everyone has this doubt before making an EV purchase. The capacity of EV drivers to get to their destinations before the battery runs out and the lack of infrastructure for charging are two common concerns among EV buyers. In remote or less inhabited places, the charging infrastructure is very inadequate**.**

9.2. Uneven distribution of electricity: There are still certain areas in the nation that lack access to power since it has not yet been electrified nationwide. India still has some areas without access to electricity, and many electrified villages experience power outages. The adoption of electric vehicles in India would be severely hampered by this inequitable energy delivery.

9.3. Charging duration: An enormous challenge for EV manufacturers to overcome is the length of time required to charge an electric car. Not all automobiles that have been released to date include flash charging technology. The primary mode of transportation is public transportation, which detests waiting while travelling for a recharge. Due to the low number of charging stations, not all of them are equipped with a proper fast charger.

9.4. Battery efficiency: India should produce the lowest Wh/Km cars first. This will allow for smaller batteries, better motors, better tyres, and better aerodynamics. Second, the manufacture of battery packs (30%), battery cells (30%), and materials and chemicals (40%) will sustain the battery eco system. Thirdly, infrastructure is needed for battery switching, quick charging, and slow charging. Temperature has a complete impact on battery life and reduces it by 20% to 30%. Battery life is longer for slow charging batteries than for quick charging ones. The oldest form of battery still in use today is a lead acid battery. It has a poor volume/stored energy ratio. Ni-cadmium batteries have the longest lifespan; however, the usage of the heavy metal cadmium has negative environmental implications.

9.5. Lightweight materials: The primary goal of conventional or electric vehicles (EVs) is to lower the energy consumption of the vehicle. The electric portions of the EV will interact dynamically with the air and mechanical sections of the vehicle. In EVs, various components are replaced by the electric parts. The energy produced by the input will be used to power the heavy weight of the vehicles, which will need a significant portion of the energy required by the heavy weight of the parts. As a result, manufacturing of lightweight and energy-efficient automobiles is necessary. A vehicle is made from a variety of lightweight materials, including glass, plastics, rubber, and specialty fibres. The vehicle's weight is significantly reduced by these materials.

9.6. Motors and their Suitability for EVs: Typically, dc motors, permanent magnet motors, induction motors, and switching reluctance motors are taken into consideration for traction applications. The fundamental benefit of a DC motor is its straightforward and reliable control, but it also has certain drawbacks, such as brush wear and heat losses in the rotor.

9.7. Safety: EV producers are primarily concerned about safety. Electrical and mechanical components both have a bearing on safety. Protection from collisions, vibrations, shocks, and fire, among other hazards, is connected to mechanical safety. Electrical safety is concerned with managing the EV's electrical system while maintaining control over its operations. Electrical safety measures include external short circuit protection, overcharge, overdischarge, and overcurrent protection, among others. International Organisation for Standardisation (ISO) and the International Electro-technical Commission (IEC) are often responsible for developing international standards for electric cars.

10. The impact of switching to electric vehicles on carbon emissions

Table no. 3:

India – CO2 emissions per capita

Year	CO2 emissions (metric tons per capita)	Annual share of Global Co2 emission **
2006	1	4.11%
2007	1.1	4.31%
2008	1.2	4.56%
2009	1.3	5.11%
2010	1.3	5.02%
2011	1.4	5.16%
2012	1.5	5.61%
2013	1.5	5.77%

Table no. 3: ***India – CO2 emissions per capita***		
Year	**CO2 emissions (metric tons per capita)**	**Annual share of Global Co2 emission ****
2014	1.6	6.15%
2015	1.6	6.39%
2016	1.6	6.71%
2017	1.7	6.75%
2018	1.8	7.06%
2019	1.8	7.08%
2020	1.73	6.93%
2021	1.9	7.30%

Source: 1. WDI World bank database

*2. **Our world in data **

3.G20: CO2 emissions per capita by country 2020 | Statista

When compared to petrol vehicles, about 1.62e 2.22 tonnes (or 60e90%) of the annual CO2 emissions per vehicle can be reduced. The CO2 emissions of electric vehicles are calculated using the CO2 emissions associated with the electricity demand for driving the EVs, which is highly dependent on electricity generation mix(Zhang et al., 2013).

Conclusion

In the upcoming years, both the supply and demand for electric cars in the nation will increase. Poor charging infrastructure and taxes on extra batteries, essential parts, and other components used in EV production are two obstacles to a growing business. Batteries for backup systems are still billed at the 18% GST rate slab.

Due to efficiency gains in modern coal-fired and LNG-fired power production technologies, CO2 emissions might be further decreased by roughly 5% and 20%, respectively. Government should take more initiative for EV sector growth.

References

[1] Ağbulut, Ü., & Bakir, H. (n.d.). The Investigation on Economic and Ecological Impacts of Tendency to Electric Vehicles Instead of Internal Combustion Engines

[2] Chen, Z., Carrel, A. L., Gore, C., & Shi, W. (2021). Environmental and economic impact of electric vehicle adoption in the U.S. Environmental Research Letters, 16(4). https://doi.org/10.1088/1748-9326/abe2d0

[3] Digalwar, A. K., Thomas, R. G., & Rastogi, A. (2021). Evaluation of Factors for Sustainable Manufacturing of Electric Vehicles in India. Procedia CIRP, 98, 505–510. https://doi.org/10.1016/j.procir.2021.01.142

[4] Nanaki, E. A., & Koroneos, C. J. (2013). Comparative economic and environmental analysis of conventional, hybrid and electric vehicles - The case study of Greece. Journal of Cleaner Production, 53, 261–266. https://doi.org/10.1016/j.jclepro.2013.04.010

[5] Pg Abas, A. E., Yong, J., Mahlia, T. M. I., & Hannan, M. A. (2019). Techno-economic analysis and environmental impact of electric vehicle. IEEE Access, 7, 98565–98578. https://doi.org/10.1109/ACCESS.2019.2929530

[6] Palaniswamy Sivakumar, D. R. S. S. S. M. ,Anand M. (n.d.). social, economic and environmental impact of electric vehicles in india.

[7] Prud'homme, R., & Koning, M. (2012). Electric vehicles: A tentative economic and environmental evaluation.Transport Policy,23,60-69. https://doi.org/10.1016/j.tranpol.2012.06.001

[8] Das, P. K., & Bhat, M. Y. (2022). Global electric vehicle adoption: implementation and policy implications for India. Environmental Science and Pollution Research, 29(27), 40612–40622. https://doi.org/10.1007/s11356-021-18211-w

[9] Singh, V., Singh, V., & Vaibhav, S. (2021). Analysis of electric vehicle trends, development and policies in India. In Case Studies on Transport Policy (Vol. 9, Issue 3, pp. 1180–1197).ElsevierLtd.https://doi.org/10.1016/j.cstp.2021.06.06

[10] Zhang, Q., Mclellan, B. C., Tezuka, T., & Ishihara, K. N. (2013). A methodology for economic and environmental analysis of electric vehicles withdifferent operational conditions.Energy,61,118– https://doi.org/10.1016/j.energy.2013.01.025

[11] GST On Electric Vehicles In 2022: Check Tax Rates & HSN Codes Here! (okcredit.in)

[12] The Electric Vehicle (EV) sector in India to boost both the economy and the environment (investindia.gov.in)

[13] Delhi SI. Fame-India Scheme—Putting E-Mobility on Road. Auto Tech Review. 2015 May 1;4(5):22-7

[14] Press Information Bureau (pib.gov.in) Ministry of Heavy Industries

[15] WDI World bank database

[16] G20: CO2 emissions per capita by country 2020 | Statista

[17] Society of Manufacturers of Electric Vehicles (SMEV) official website 2018. Available from: https://www.smev.in/ev-sales [Assessed on Dec 12, 2018]