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ELECTRIC VEHICLES THEIR VIABILITY AND THEIR FUTURE IN UTTAR PRADESH

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Abstract: *Owing to the impacts of climate change and growing environmental, economic, and social restrictions, sustainable development has developed into a strategic priority for cities all over the world. Sustainability is now essential to combating climate change and promoting economic, security, and social well-being and is not just a "good to have" supplement to development as usual. And one of the major contributors to climate change is the transportation sector. According to UNECE, CO2 emissions from the transportation sector account for 30% of CO2 emissions in developed countries and 23% in developing countries. Recent Intergovernmental Panel on Climate Change (IPCC) studies, Climate Change Conferences (COP), and eight United Nations Development Goals all point to transportation decarbonization. Recent technologies and innovations have the potential to decarbonize the Earth by 2050. Electric vehicles are one example of such technology (EV). Governments all across the world are enacting regulations, incentives, and tax rebates to encourage stakeholders to choose electric vehicles. This study attempts to analyze EVs, the current state of EVs in Uttar Pradesh, the viability of EVs in terms of carbon footprint, and finally, the socioeconomic statistics of EVs.*

Keywords: electric vehicle; carbon-footprint; buying trend; incentives; socio-economic statistics of EV.

1. INTRODUCTION

The current upward trend in global temperatures appears inevitable. The IPCC assessments have been very specific about a 1.5-degree Celsius rise in the Earth's temperature, which would put the Earth in an irreversible damage phase, when nothing could be done to reverse the devastation. Meanwhile, we've already passed the 1.0-degree Celsius barrier ((IPCC, 2022)). Transportation is one of the major contributors to global warming, thus there is an urgent need to regulate what we can. Recent conferences have emphasised its significance. With the Paris Agreement, governments agreed to decreasing emissions and actively working on the decarbonization of urban transportation in order to meet climate targets (Paris Agreement, 2015). On the other hand, in CoP26, nations pledged their de-carbonization targets and India pledged to reduce the total projected carbon emissions by one billion tonnes from now onwards till 2030 (CoP26, 2021).

At the 2017 Paris Process on Mobility and Climate conference, the main messages and agreements were that investments in sustainable low carbon transport offer great value for money, innovative solutions have the potential to transform current transport systems into efficient, low carbon people-oriented solutions, action on low carbon transport supports eight of the Sustainable Development Goals (SDGs), and the global transport community stands ready to support countries in achieving their low carbon transportation goals. Hence, our keen focus will be on electric vehicles and their impact on the environment as they have the following advantages:

1. Electricity generated from renewable energy and the shift to an EV-dominated market can both result in independence from fossil fuels.
2. Zero emission when driving, making it an environmentally benign mode of transportation.

3. The EV transition brings up new research fields and career prospects.
4. The low noise also has a good effect by addressing noise pollution, another urban problem.

2. LITERATURE REVIEW

According to (Wien Im März , 2011) the main elements affecting the economic competitiveness of hybrid and electric vehicles are fuel prices and battery costs. As per cost projections from 2010 to 2050, hybrid systems will be the most affordable choice up to 2020. Electric propulsion systems (PHEVs and BEVs) are the greatest mid- to long-term choice due to falling battery costs and rising fuel prices (after 2020). In his conclusion he states that the main drivers of this growth are fiscal policies and increased fossil fuel prices and higher taxes on fossil fuels and on low efficient cars are driving a huge market share of electrified cars in the near future. Due to all of these impacts, the fleet's energy needs are significantly reduced, and electricity is becoming a more important fuel. The significant potential of electricity as an energy carrier for road transport with respect to decarbonization and energy supply diversification is highlighted by the fact that the ensuing electricity demand might be satisfied using domestic renewable electricity potentials.

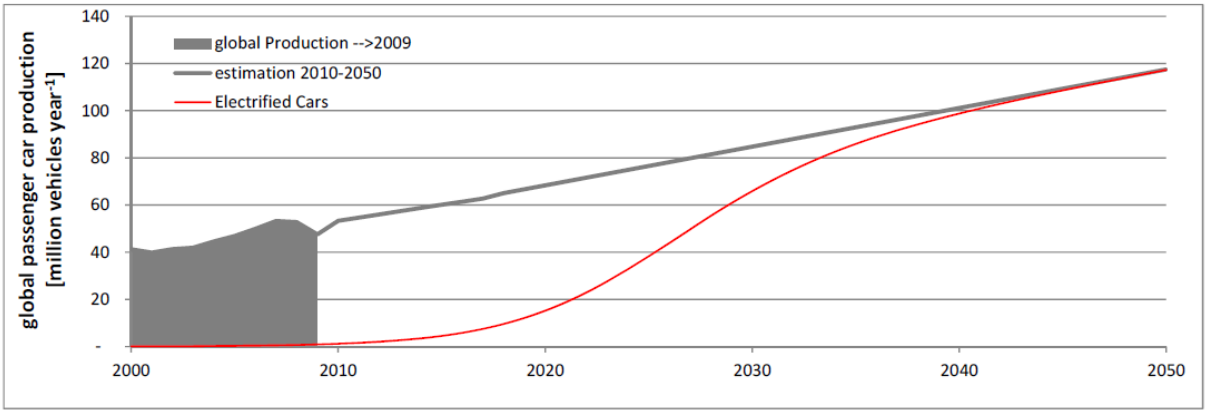


Figure 2-1 Estimates for global production of electrified cars HEVs & EVs
Source: (Wien Im März , 2011)

(Dr. Makena Coffman, 2015) in his article He pointed out some internal factors which are a cause of concern for adoption of EVs, driving range, price (battery, purchase, maintenance), charging time, and battery performance along with it he mentioned some external charging stations network, consumer characteristics, fuel prices and policy mechanism.

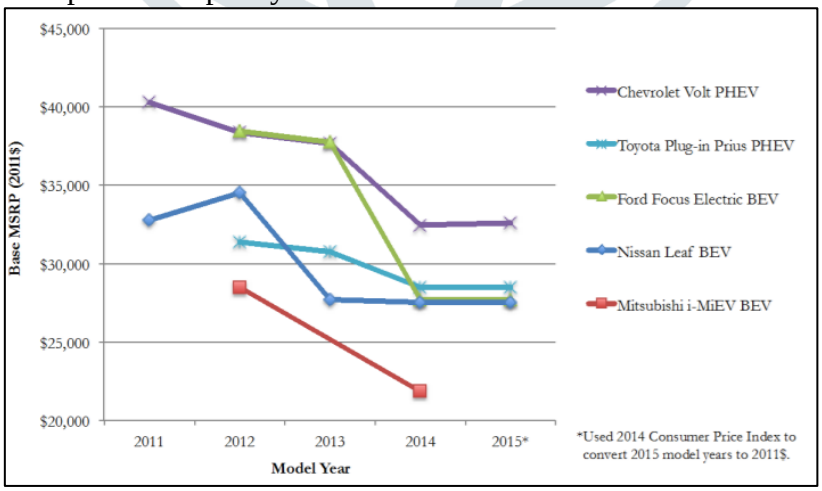


Figure 2-2 EV's Purchase Price over Time Since 2011
Source: (Dr. Makena Coffman, 2015)

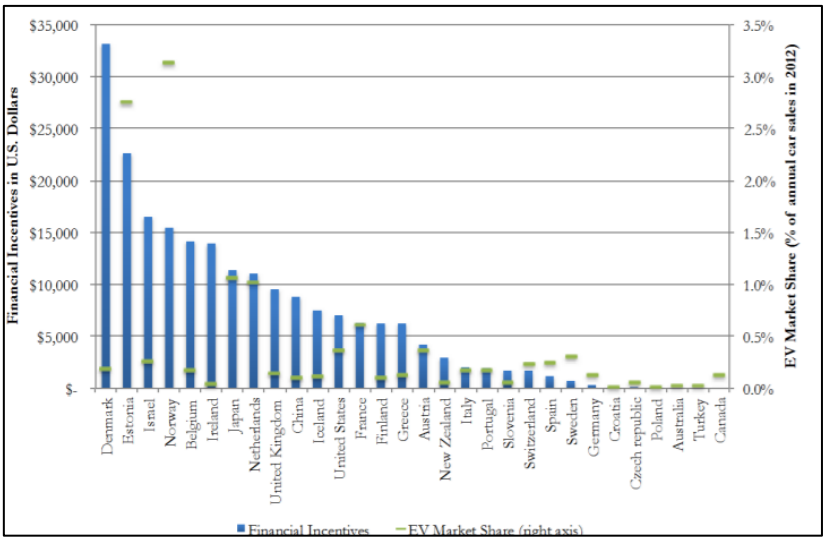


Figure 2-3 Financial Incentives and EV market Share by Country
Source: (Dr. Makena Coffman, 2015)

Countries with higher incentives have started to switch to EV. Denmark is known for its energy production and advanced technology is currently a leader in electric vehicle adoption.

(Government of India, 2015 & 2019) in its FAME scheme has launched various incentives. Although the first phase of scheme failed to achieve its objectives. Government of India modified its scheme and increased the incentives for Electric two-wheeler (E2W) purchase incentives have been raised by 50% to INR 15,000 per kWh of battery capacity. Additionally, the cap on this incentive was raised from 20% of the ex-showroom price to 40% of the ex-showroom price.

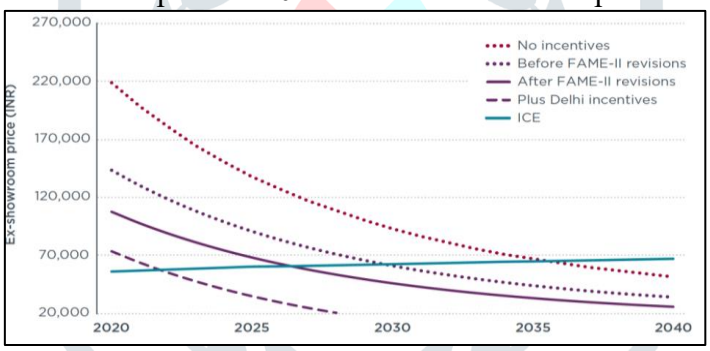


Figure 2-4 Upfront cost parity for mid-range electric motorcycles.
Source: (icct.org, 2021)

With current FAME-II revisions, the prices of EV will become lower than Internal Combustion Engines vehicle (ICE) in 2025, whereas with Delhi state incentives the prices of EV have already come below the ICE vehicle cost.

According to the Uttar Pradesh Electric Vehicle Policy published in August 2019 talks about the roll out a total of 10 lakh (one million) EVs by 2024 across all vehicle segments and launch 1,000 electric buses, and by 2030, all public transit in the 10 EV cities will be 70% electric vehicles. In the ten EV cities that have been designated, all cities will have 50% EV mobility in goods transportation by 2024, and all conventional commercial fleets and logistical vehicles will be phased out.

2.1 A CASE STUDY OF MEXICO CITY, 2021

This study (Fuentes & González, 2021) focused on costs occurred at various life phase of Electric Vehicle and evaluated its acquisition cost, operation cost, maintenance cost and depreciation cost. Apart from that Environmental Impact Analysis of was also done. With the conclusion that acquisition of EV is comparatively very high with respect to ICE vehicles, whereas the cost during operation phase of the vehicle is comparatively lesser than the ICE vehicle.

Maintenance cost on the other hand for EV is more than the ICE vehicle. Hence, this paper concluded that cost of EV is very high when compared to ICE. As EVs are in the initial phase of development in Mexico, hence the cost as compared to other parts of the world is very high.

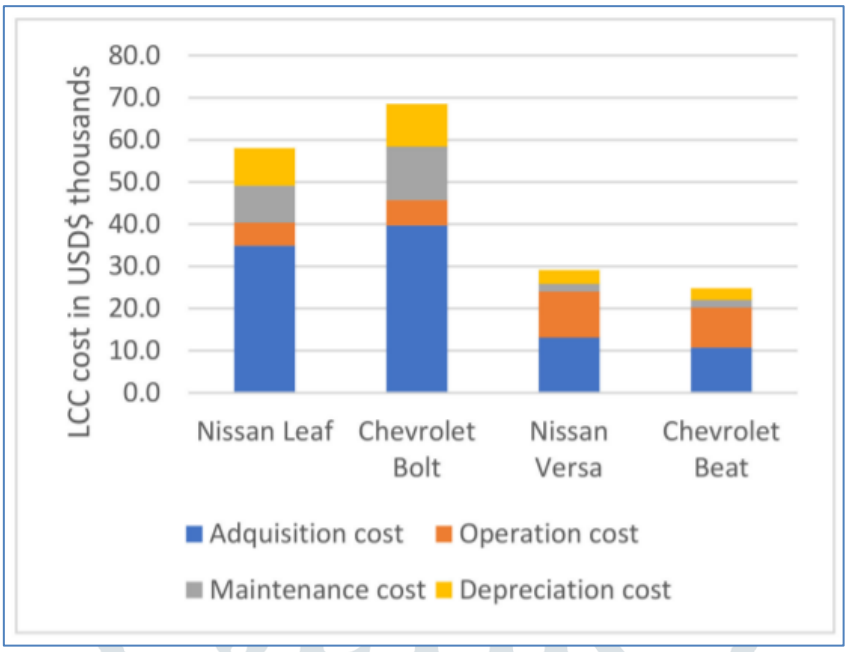


Figure 2-5 Life Cycle Cost Analysis
Source: (Fuentes & González, 2021)

2.2 A Case Study from Poland, 2021

The Impact of Fleet Electrification on Carbon Emissions (Zamasz, St˛echły, Komorowska, & Kaszy´nski, 2021) published with a primary goal to analyse and compare carbon emissions in life cycle of Electric Vehicle. The conclusions from this study were over an eight-year period, emissions of CO2 equivalent decreased by between 15% and 17% and due to the variations in weight and battery size, it was discovered that the CO2 equivalent emissions of EVs during the production stage were higher than those of ICVs. A reduction in tonnes of CO2 of between 22 and 27 percent annually compared to the situation before ICVs were employed, which translates to a 4 to 5 percent decrease in the transport sector's share of overall CO2 emissions.

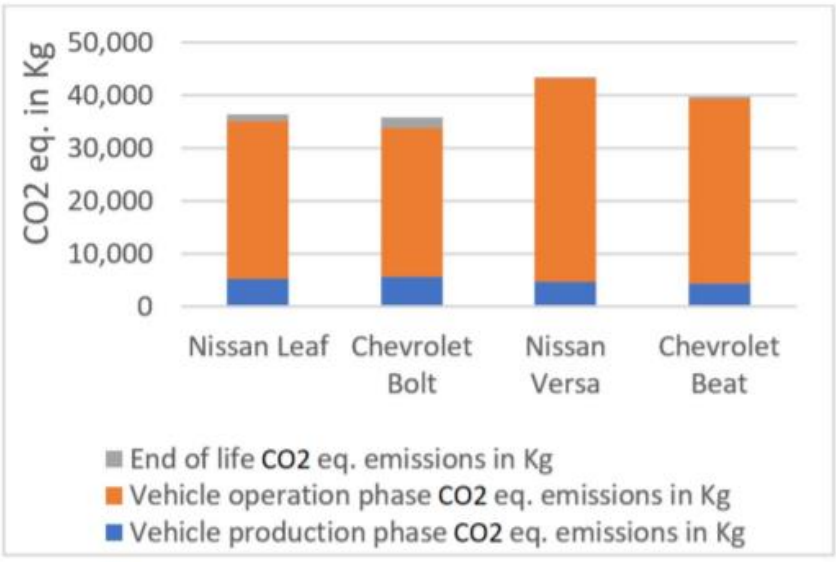


Figure 2-6 CO2 Equivalent Emissions of Different Vehicles
Source: (Zamasz, St˛echły, Komorowska, & Kaszy´nski, 2021)

2.3 CASE STUDY OF INDIA, 2018

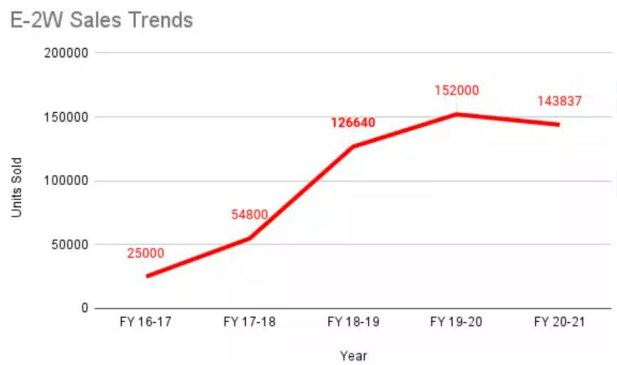
(Vidhi & Shrivastava, 2018) analyzed the life cycle of Electric Vehicle in their paper "A Review of Electric Vehicle Lifecycle Emissions and Policy Recommendations to Increase EV Penetration in India." The five stages are:

1. Production: These are the emissions produced during the making of a car. This stage of emissions includes emissions from producing chemical-based batteries as well as mechanical parts like gears and engines. At this time, emissions from hydrocarbon-based and electric vehicles are equivalent.
2. Car Use: A automobile can emit vehicular emissions when it is in use by burning hydrocarbons or by needing routine maintenance. Electric vehicles do not have emissions in this stage.
3. Car Disposal: At the end of their useful lives, mechanical components of hydrocarbon and electrical vehicles both produce recycling waste and emissions, primarily through the incineration of municipal and hazardous waste.
4. Fuel Production: GHG emissions from non-renewable energy sources are extremely high.
5. Electricity Generation: Power demand will rise as the number of electric vehicles rises, which will increase electricity production. If not from renewable sources, this additional electricity generation could lead to more air pollution.

3 ANALYSIS

3.1 Two-wheelers

1. As battery costs decline, 2-W electric vehicles' operational expenses are catching up to those of fuel vehicles.
2. The announcement of incentives by the Centre government, including a price cut to Rs. 15,000 per KWh from Rs. 10,000 per KWh, is very encouraging. Additionally, GST is at its lowest level at 5% compared to a 28 % rate.
3. Uttar Pradesh has the most registered EVs out of all the states that adopt electric vehicles monthly.
4. No Start-up from the UP state has yet entered.



Sale of top 10 players of registered E Two-wheelers Jan- Dec 2021		
Hero Electric	46,214	34%
Okinawa	29,868	22%
Ather	15,836	12%
Ampere	12,417	9%
Pure EV	10,946	8%
TVS	5,368	4%
Revolt	4,687	3%
Bajaj	4,532	3%
Benling India	4,421	3%
Jitendra New EV	1,930	1%
Total of top 10 players	1,36,219	

Figure 3-1 EV Sales Trend
Source: (Economic Times, 2021)

3.2 Four-Wheeler

According to CEEW Centre for Energy Finance, Uttar Pradesh (UP) has become the leading state in the nation for the sale of electric vehicles (EVs) in the fiscal year 2020–21. Major Players: Toyota Kirloskar Motor, MG Motor India, Tata Motors Limited, Mahindra & Mahindra Limited, and Maruti Suzuki India Limited.

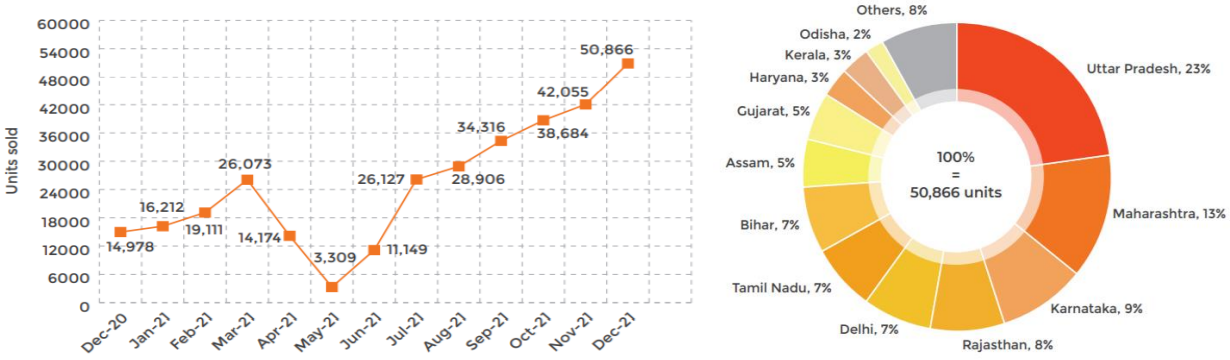


Figure 3-2 Registered EV sales Trend in India and State Wise Contribution (Dec-2020-Dec-2021)

Source: (JMK Research and Analytics, 2021)

3.3 Three-Wheeler

In December 2021, recorded E3W sales (including passenger and cargo-type) were 23.73 units, an increase of 29.8% month-over-month. Sales of passenger E3W rose 30% from one month to the next. E3W cargo sales, however, saw a 33 percent increase over the previous month's revenues.

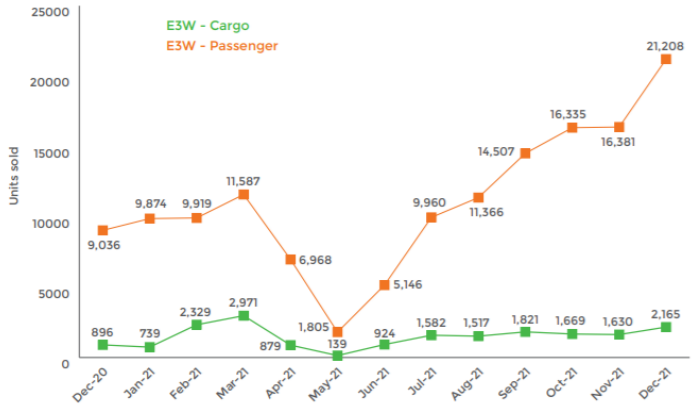


Figure 3-3 Sales Trend of Cargo E3W and Passenger E3W
Source: (JMK Research and Analytics, 2021)

4. CONCLUSION

Form the above mentioned literature studies, case studies and analysis it can be concluded that the Fast paced 2-W are gaining momentum in UP, on the contrary slow speed vehicles are losing their ground, Cost of EVs will be subsequently less in the Operation Phase further particle emissions will be very less too, Policies currently in place have led to increase in sales of EVs, Lack of Charging infrastructure and policies regarding them are creating hindrance to EV adoption, Case studies on impact of EVs on air pollution in several countries showed an overall reduction in emissions, According to case studies, NOx emissions from automobiles can be decreased by 7 to 25 percent depending on the energy source used to charge them, while CO and CO2 emissions can be lowered by up to 85 percent if the energy source is renewable, If the charging energy comes from fossil fuels, SO2 emissions can increase by 11%, Policies regarding recycle of batteries or reuse of batteries needs to be placed so as to ensure future dump of batteries, Technology related research for battery recycle needs to be promoted. To summarize, EVs are gaining momentum in Uttar Pradesh, but until the energy comes from renewable sources, the real purpose of EVs would not be achieved.

5. ACKNOWLEDGEMENT

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