Driving India's Growth: A Statistical Assessment of the Automotive Industry's Socio-Economic Impact

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Abstract:

India is one of the largest Automotive Industry by its important position in the global automotive industry ($116.86 billion market value in 2023 FY, contributing 7.1% to GDP in 2024 FY and supporting extensive employment) directly through the manufacturing, sales and employment opportunities and also by being an enabler of mobility that supports the growth of other industries. The aim of this study is to understand the Automotive Industry through a volume of data on production, domestic and export sales and its correlation analysis, the changing lifestyle of its population along with the environment that aligns and intertwined with the Sustainable Development Goals(SDGs) for the period duration from the year 2018 to 2024.

Further, the analysis extends to the financial dimensions of vehicle ownership, focusing on affordability, evolving lending mechanisms, and shifts in consumer preference across vehicle segments such as small cars, SUVs, MUVs, and luxury vehicles in recent years. A critical component of the study assesses the environmental consequences of rising vehicle sales, particularly in terms of air and noise pollution. Finally, the study evaluates the role of government interventions, regulatory frameworks, and environmental policies aimed at mitigating adverse environmental impacts, including the promotion of renewable energy vehicles, CNG vehicles, and battery electric vehicles. These aspects are examined using appropriate statistical tools to understand their effectiveness during the study period.

***Key Words*:** Economy, Environment, Society, GDP, Correlation, Export, Automotive, SDGs

INTRODUCTION:

The Automotive Industry has come a great way from its emergent state at the time of India's Independence in 1947 to its present form. India is one of the growing economies and provides a big market for automotive industry in the World. Since the Automotive Industry contributes 40% to India's Manufacturing GDP, thereby its growth, its service for both growing domestic sales and export opportunities of Automotive Industry are positioned to be critically analysed. The year 2019-2020 is considered to be an economic crisis of the whole world, even though the Indian Automotive Industry stood 5th largest in the world. Basically consisting of five primary sectors namely and its respective market share in 2024 are**,**

1. **Two-wheelers-75.3%**
2. **Passenger Vehicles-17.6%**
3. **Commercial Vehicles-4.05%**
4. **Three-wheelers-2.8%**
5. **Quadricycles-0.003%**

Globally, the country's automotive Industry played a noteworthy performance over several years, which induced the government to develop India as a hub for manufacturing as well as Research and development for the automotive Industry. The size of the industry is to predicted to expand at USD 137.06 Billion in 2025 and it is expected to reach USD 203.25 Billion by 2030,by experts. These are a few among the several reasons which stimulated to broaden this study.

Objectives:

The primary objective of the research is to:

- To understand the revolutions within the Indian automotive sector between 2018 and 2024, considering its economic significance and employment.
- To understand the correlation of Automotive production with sales trends considering the growing demographics.
- To Compare buyer trends between two-wheelers and passenger vehicles also to analyse the factors influencing these purchasing decisions.
- To show a comparative analysis of transport-sector emissions across selected Asia–Pacific countries over different years, particularly on India and the estimate of its future emissions.
- To Evaluate emissions associated with petrol and diesel consumption in India also to examine the correlation between fuel consumption and emission levels.
- To Examine different solutions and technological innovations adopted by India to mitigate transport-related emission challenges.

REVIEW OF LITERATURE

Automotive industry serves as key contributor in shaping our country’s economic, social and environmental landscape. It also acts as a major driving force in the growth of our country’s GDP and employment. According to the data by IBEF (2023), 7.1% of total GDP is contributed by the automotive sector. Several studies highlight the automotive industry ‘s booms and busts and how this sector took various steps to mitigate disruptions faced during the pandemic period.

As a significant employment generator, this sector supports over 30 million jobs in 2019-20 (SIAM). Despite its substantial workforce, this industry also faces notable downslides such as persistent skill mismatch, where workers lack the right skills for job, suggesting the need for stronger vocational training and education that matches industry needs are necessary to address this issue (Scholar Sharma, 2021).

According to RBI data, the loans for cars have increased to 137%, especially over the past three years, positioning them as second highest loan segment after home loans. This explains about people’s purchasing power, which further helps to understand broader segment of people to own their personal vehicles. Despite buying vehicles for their social needs, cars often reflect one’s social status or success. For many, buying a car is a source of pride or a

sense of achievement. Another main thing is that people prefer to own vehicles is the rising of urban population, safety concerns and the need for more comfort and independence (Livemint, 2024).

Meanwhile an Environmental impact created by automotive industry is counterproductive increasing the emissions and increasing the global temperatures. Looking into Comparative analysis of emission in the Asian Pacific countries forecasting the India's emission in it we come to know that the enormous increase rate in the transport emissions of China followed by India based on the data drawn from Ministry of Fuel and Petroleum Consumption data for the Drawing the emission from the fuel consumption view.

METHODOLOGY:

This part of the study includes the chronological data of Indian Automobile Industry as well as its respective interpretation. The data has been analysed with the help of various statistical methods such as Correlation, Percentage, Annual Growth Rate, Trend line. Besides, tables and graphs are used to present and interpret the data. The data used for the analysis is Secondary data obtained from SIAM and other various sources.

RESULTS AND ANALYSIS:

Statistical Analysis on Impacts of Automotive Industry on Economy

The data highlights the domestic automobile sales of various types of vehicles such as passenger cars, commercial cars, two-wheelers, three-wheelers, and quadricycles for the period between 2018-19 and 2023-24

Table 1: Domestic Sales of Automotive Industry

Category	2019	2020	2021	2022	2023	2024
Passenger Vehicles	3377389	2773519	2711457	3069523	3890114	4218746
Commercial Vehicles	1007311	717593	568559	716566	962468	967878
Three Wheelers	701005	637065	219446	261385	488768	691749
Two Wheelers	21179847	17416432	15120783	13570008	15862087	17974365
Quadricycles	627	942	-12	124	725	725
Grand Total	26266179	21545551	18620233	17617606	21204162	23853463

Source: Society of Indian Automobile Manufactures

. On analyzing the data, the overall sales of vehicles have experienced fluctuations in the form of growth and decline. There has been a decline in the overall sales of the automobile industry in the year 2020 and 2021. This is mainly because of the COVID-19 outbreak. The massive reduction in the demand for vehicles due to the outbreak of the COVID-19 pandemic has resulted in the halt of production for several years and hence has affected the overall sales and revenue of the automobile industry. This is evident by the substantial growth in the overall sales of the industry in the subsequent years as shown in the data.

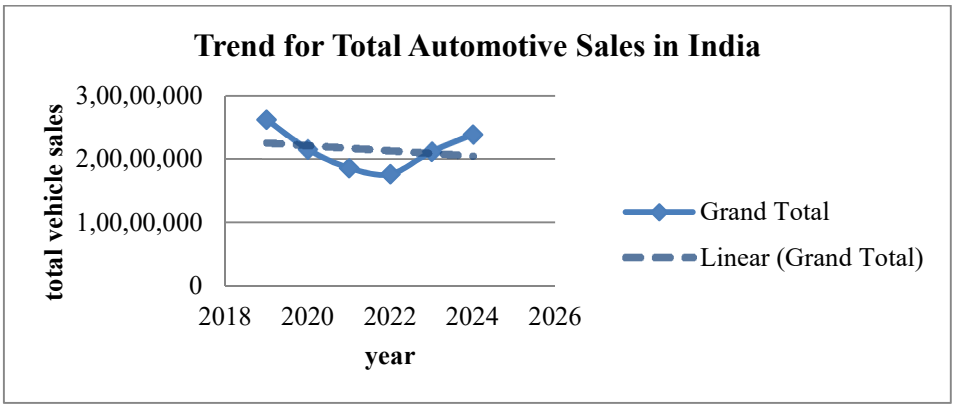

Figure 1: Trend for Total Automotive Sales in India

Coming to the various types of vehicles sold in the Indian automobile industry, the most prominent aspect is the substantial growth in the sales of the two-wheelers. These two-wheelers account for most of the overall automobile industry in the year 2024 with sales of over 21 million units. This is an evident indication of the high demand and preference for the two-wheelers as these two-wheelers are affordable and cost-effective and provide high manoeuvrability in the congested traffic of the cities. This is the reason why most of the people prefer to buy two-wheelers.

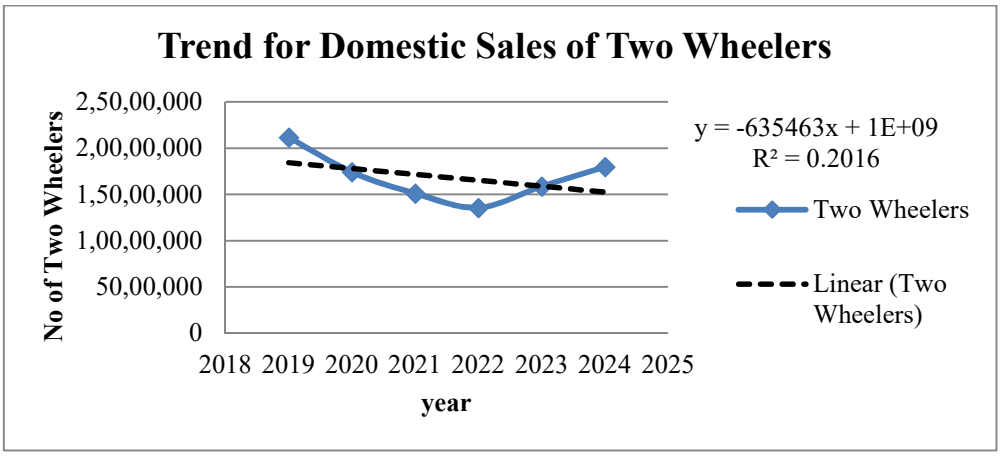

Figure 2: Trend line for domestic Sales of Two-Wheelers

Even if quadricycles are cheaper than cars, people do not prefer to buy quadricycles as they do not possess the facilities of air conditioning, electronic stability control, safety measures, and many such aspects. This is the reason why people who have the capacity to spend and require enhanced measures of safety and comfort prefer to buy cars. There has been a substantial reduction in the sales of the passenger cars due to the COVID-19 outbreak between the period of time between the years 2018 and 2020. There has been an overall growth in the sales of the industry after the year 2021.

Employability in Automotive Industry

The Indian automobile industry is an essential source of employment for the people of the nation as it provides jobs in the direct and indirect fields such as the automotive industry and tourism. This is further enhanced by the increasing demand for skilled employees in industry and the advancement in the education and technology sector of the nation. There is an overall growth of around 57.44% of the B.E. and B. Tech graduates who have the skills to work in the automotive industry as per the SIAM study. As per Lok Shaba of SIAM, employment provided by the automobile

industry is 28.3 million jobs (direct as well as indirect employment) in 2018-2019, which increased to 30.7 million jobs in 2019-20. In 2020-21, there is no available data due to the pandemic. Employment growth, based on economic trends as well as technological developments, is expected by SIAM. Under the Production-Linked Incentive Scheme, The Ministry of Heavy Industries plans to develop growth, thereby creating jobs of over 750,000 jobs between FY 2022-23 to FY 2026-27. This employability directly contributes to development of the Indian economy, which is associated with World Bank's report of substantial reduction of poverty. The automobile industry provides opportunities to individuals to transition from Below Poverty Line to Above Poverty Line, the automobile industry provides many avenues which ensure financial soundness as well as economic growth through a wide array of jobs, from unskilled to skilled. In addition, Automotive services as well as transportations are essential to rural life.

Automotive Export Trend

India is shining as a leading car exporter globally, which is showing growth path to achieve in near future. The export performance of various types of vehicles, namely, Passenger Vehicles, Commercial Vehicles, Three Wheelers, Two Wheelers, as well as Quadricycles, from 2019 to 2024 is provided below.

YEAR	Annual Growth rate of PV	Annual growth rate of commercial vehicles	Annual growth rate of three-wheeler	Annual growth rate of two-wheeler	Annual growth rate of quadricycles	Grand Total	Annual growth rate of total export
2019						46,29,049	
2020	-2.08	-40	-12	7	18	47,48,738	2.585607
2021	-38.92	-17	-22	-7	-32	41,34,047	-12.9443
2022	42.90	83	27	35	23	56,17,359	35.88039
2023	14.71	-15	-27	-18	-47	47,61,487	-15.2362
2024	1.39	-16	-18	-5	83	45,00,492	-5.48138

Table 2: Export Trend of Vehicles from 2018-2024

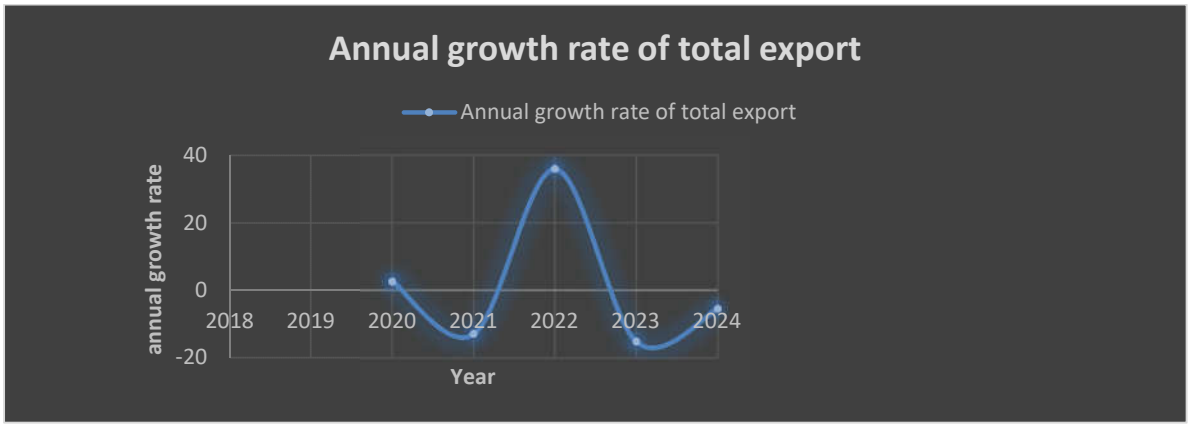

Figure 3: Growth of Export in Automotive Industry

The growth of exports of Automobile Industry of India between 2019-2024 experienced a paradigm shift. In 2021, sales of Passenger vehicle faced a drastic drop of 38.9% but showed a substantial 42.9% growth in 2022, showing signs of recovery. Exports of Commercial vehicle as well as Three Wheelers faced a drop in 2020 as well as 2021, but

again showed signs of recovery, which is irregular. Quadricycles faced irregular exports. Because of ongoing vulnerabilities of exports, exports faced instability. Exports show there is substantial growth of 2022, but not showing steady growth. Because of ongoing vulnerabilities of exports, exports faced instability. Global demand, ease of adapting to global standards, as well as supremacy of Indian Passenger vehicle manufacturers are generally cited as reasons by exports of passenger vehicles, as they remain dominant. On the other hand, two-wheelers, three-wheelers, and commercial vehicles have some challenges in getting global recognition due to the differences in the international norms and regulations.

Correlation Analysis between Total Sales and Production

The dataset provides a comprehensive analysis of domestic sales, export sales, and production in the Indian automobile industry over the period 2019–2024. An examination of domestic sales reveals a sharp decline during the pandemic years, reaching a low of 17.6 million units in 2022. The highest level of domestic sales was recorded in 2019, prior to the outbreak of COVID-19. Sales declined significantly in 2020 and 2021 due to pandemic-induced disruptions but subsequently recovered, increasing to 21.2 million units in 2023 and further to 23.8 million units in 2024. In contrast, export sales peaked in 2022, coinciding with the recovery of the global economy and a renewed increase in international demand for goods and services. However, the export trend remains highly unstable and exhibits considerable fluctuations throughout the study period. Production levels also display fluctuations, with a notable decline at the end of 2021, followed by a steady recovery, ultimately reaching their highest level by the end of 2024. Since total sales closely track production levels, sales similarly experienced a decline around 2022 before showing a consistent upward trend thereafter.

Correlation analysis further supports these observations. The correlation coefficient between domestic sales and production is 0.9903, indicating a strong positive relationship and confirming that increases in domestic sales are closely associated with increases in production. Conversely, the correlation coefficient between export sales and production is −0.2177, representing a weak negative relationship. This suggests that production is not significantly influenced by export sales and reinforces the conclusion that domestic demand is the primary driver of production decisions in the Indian automobile industry.

Table 3: Production, Export and Domestic Sales Comparison

Year	Domestic Sales	Export Sales	Production	Total
2018-19	26,266,179	4,629,049	30,914,874	30,895,228
2019-20	21,545,551	4,748,738	26,353,293	26,294,289
2020-21	18,620,233	4,134,047	22,655,609	22,754,280
2021-22	17,617,606	5,617,359	23,040,066	23,234,965
2022-23	21,204,162	4,761,487	25,940,344	25,965,649
2023-24	23,853,463	4,500,492	28,434,742	28,353,955

Source*: Society of Indian Automobile Manufactures*

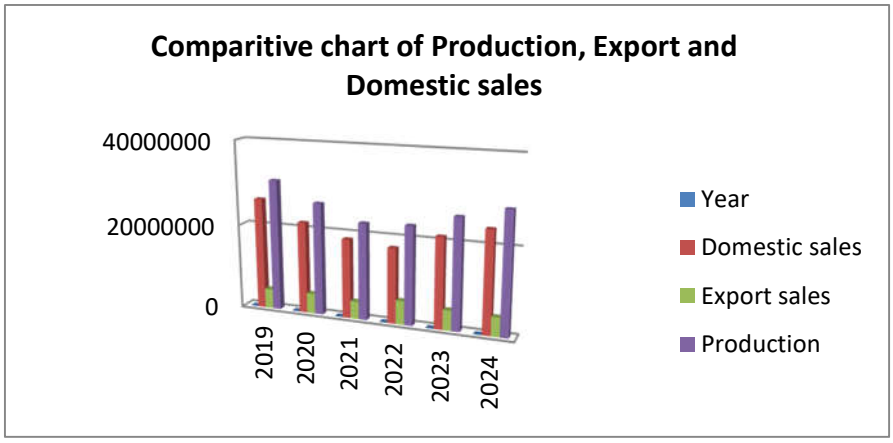

Figure 3: Comparative Chart of Production, Export, And Domestic Sales

The graph shows all four variables: Year, Domestic sales, Export sales, and Production. Domestic sales are greater than export sales. Production is always greater than the domestic as well as the export sales. Production sometimes exceeds the sales as companies have installed huge production units for future sales. Domestic sales are influenced by consumer demands and government regulations, while exports are influenced by international restrictions. Moreover, some production units for autos produce autos as well as components for foreign production units. It can be deduced from the data that the companies rely heavily on domestic sales, which exerts a considerable influence on production. The aspect of export sales does not have any major influence on the production aspect since the demand for all cars in the international market is not much higher. There are also costs such as tariffs and transportation associated with exporting.

Statistical Analysis on Impacts of Automotive Industry on Society

The study initially focused on the economic impacts of the automotive sector, we got it that social and psychological factors also play a significant role. The changing patterns of affordability, buyer behaviour and increased consumerism has not only influenced the sales and purchases of vehicles but also made an influence on banking and other financial institutions, as they are ready to provide easier access to loans and other financial products. These trends are being examined by comparing the annual growth rates of passenger vehicles and commercial vehicles from the financial year 2019–20 to 2023–24.

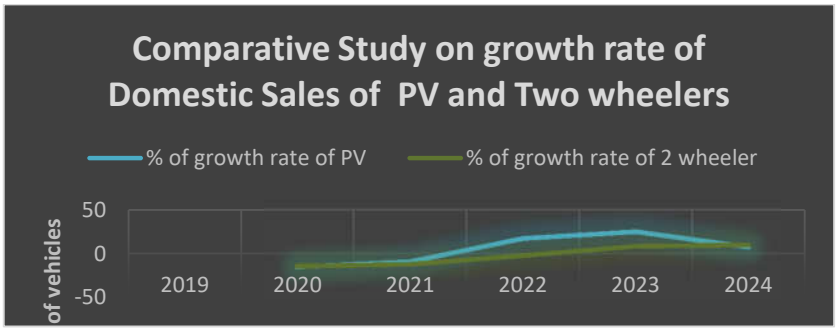

Figure 4: Comparative Study on Growth rate of PV and Two Wheelers

Comparison:

*** PV Growth Rate is more volatile in comparison to 2-Wheeler Growth Rate.** This indicates that there are more fluctuations in the PV industry.

*** PV Outperformed 2-Wheelers in 2022 & 2023:**

The PV market has outperformed the 2-wheeler market in terms of growth in 2022 & 2023.

*** Potential Market Shift in 2024:** It is clear that the market growth for PV in 2024 is much lower compared to the past years. This could be an indication that the industry may undergo a market shift. Such as Traffic congestion ,shared mobility of popularity, unemployment and inflation, Wars and Global Tensions, Geopolitical Tensions, Stricter Emission Norms can be some reasons

OEM	FY24	FY23	Growth (y-o-y)
Maruti	17,59,881	16,06,870	9.50%
Hyundai	6,14,721	5,67,546	8.30%
Tata	5,70,955	5,38,640	6%
Mahindra	4,59,877	3,59,253	28%

Table 4: Sales Comparison of top Automotive Companies between 2024 and 2023 in India

Despite the uncertainties in the export markets in the year 2024, Maruti, Hyundai, Mahindra, and Tata showed growth in domestic sales because of the high demand for passenger cars (cars, SUVs, minivans, and small cars). Among the domestic sales of these cars in the financial year 2024, the highest was of SUVs at 50.4%, followed by hatchbacks at 27.8%, thereby reaffirming the importance of cars in overall sales. Analysis of the overall sales of these top automobile companies in a year shows a significant rise of 28% for Mahindra. The high demand for these cars is because of their emotional and utility aspects in the Indian market, which is cherished for their safety, advanced technology, and comfort aspects, thereby fulfilling the esteem needs. Accessibility of auto loans has also helped in the adoption of cars, as evident by the data of the RBI, which shows a significant rise in car loans, the second-largest loan category after home loans because of the rising importance of personal transportation.

According to a Reserve Bank of India (RBI) report, the reason why people are taking more loans is because of car acquisitions rather than home acquisitions. This is because people are increasingly becoming attracted towards the idea of owning a personal vehicle for transportation. In addition to that, RBI data also shows that car loans have registered a massive increase of 137% over the past three years. This is because car loans are the second-largest loans taken by people after home loans. (Auto Finance Industry in India: Market Size, Search Trends and Strategies, https://www.livemint.com/sponsored-post/auto-finance-industry-in-india-market-size-search-trends-and-strategies-11722312867984.html).

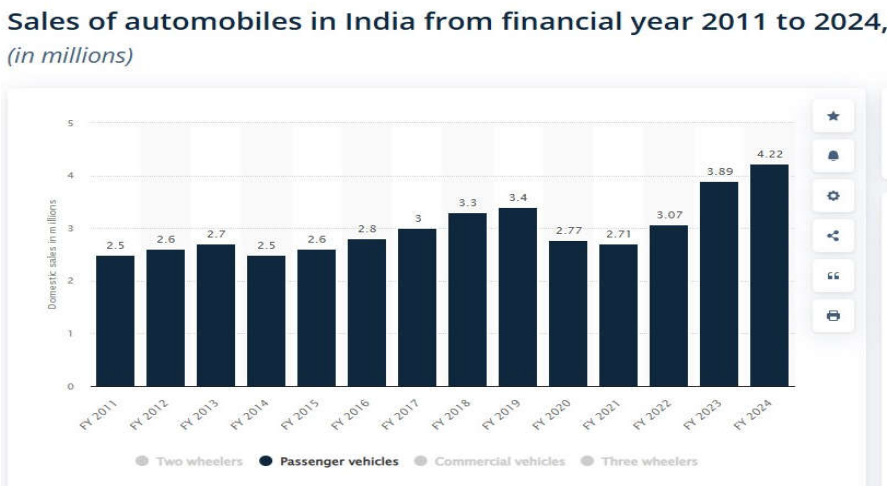

Figure 5: Sales of Automobiles in India from Financial Year 2011 to 2024(in millions)

From the graph, the growth in the first years (2011–2016) is relatively slow and steady. There are some points of decline and resurgence in sales in this period (2017–2020), and this could be affected by the economy and policies in place. The point of the lowest sales is in 2020.

(This may be affected by the pandemic.)

• From the graph above, the increase in the sales of the vehicles is visible in the latter years, indicating the recovery trend. The statistics on the passenger car provide some insight into the behavior of the customers and the growing demand for the transportation services. The highest sales statistics are visible in the final year (2024), indicating the peak during the period thereby determining the affordability of the customers purchasing the vehicles.

•Buying a car is a significant investment, and there are many good reasons for people to buy them. With a car, you can go anywhere you want, at any time you want, without having to depend on the schedules of public transportation and ride-sharing services. This is especially true in areas where there is little to no public transportation available, as well as in situations where your schedule may be irregular. With a car, you can reduce your traveling time to a significant extent, whether you're traveling to and from your office, running some errands, and traveling to other places. In some cases, even your personal safety may depend on your car, especially at night and in areas you may not know very well. You also get to control your environment to some extent. Families with children may also find a car absolutely essential to take their children to school and other places. Some jobs also involve traveling and the transportation of goods, and in these cases, having a car may be essential. These are some reasons to consider car as a necessary vehicle other than a status symbol. Cars, which were once a symbol of progress, have become major sources of pollution, traffic, and economic problems, and thus, there is a need to move away from car-based lifestyles. The negative consequences of car dependence, in terms of pollution, traffic, and sprawl, force us to reevaluate our attitudes and values regarding transportation.

Statistical Analysis on Impacts of Automotive Industry on Environment

- The Automotive industry is the crucial stepping stone and a revolutionary sector for the development of economy and transport although it has constructive and productive phase socially and economically.
- The major counter problem caused by this industry are air pollution, greenhouse gas emission, energy consumption, global warming etc., are to be considered. As demand of transportation increases, it is necessary to take into account all of these impacts to fix those. The degradations must be studied and analyzed to find a better way to correlate the sustainable and economic development.
- This is a data driven analysis on fuel consumption and carbon dioxide emission by the transports. It forecasts the fuel consumption and carbon emission via transport sector.

- These imprints are in need to be mitigated with certain Eco innovations, NBS (nature-based solution) and with many innovative ideas.

Analysis of Asian-pacific countries in transport emission

The below visual (figure 6) represents the transport emission data of Asian Pacific countries. It shows that USA and China have the highest transport emission as compared to India.

Table 5: Road Carbon Transport Emission for Asian Pacific Countries

Country	Road Carbon Emissions in 1990 (million tons)	Road Carbon Emissions in 2016 (million tons)	Road Carbon Emissions in 2019 (million tons)	Overall percentage increased
Australia	56.68	82.29	102	179.957657
Canada	100.36	146.6	169.8	169.1909127
China	60.58	728.49	1274	2103.004292
India	46.95	247.94	403.4	859.2119275
Russia	156.77	177.94	247.8	158.0659565
United states	1184.39	1606.24	1,924	162.4464914
Total	1605.73	2989.5	4121	256.6433958

When compared, the geographic representation indicates a rapid rise in CO2 emissions from China and India than other pacific countries, highlighted by the varying thickness of colors. India, being a developing country it can be a huge threat if the same situation continues by 2030.

Source: The International Energy Agency Database

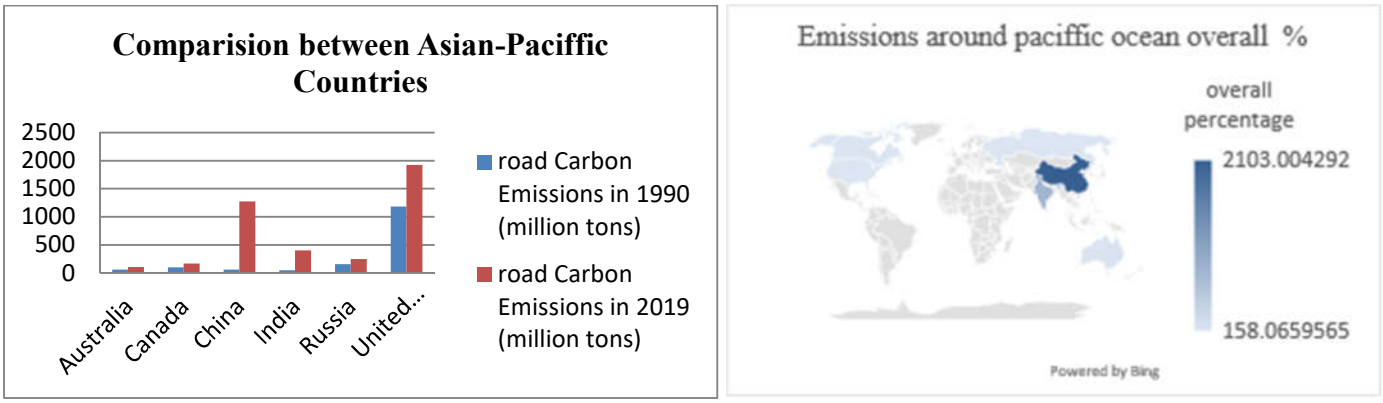

Figure 6: Comparison and Growth rate of Asian Pacific Countries

The growth hike of emission in India is mainly because of its increasing population, transport and growth of many other sectors. While developing countries like India, China has a rapid growth rate of CO_2 emission but the developed countries like USA emit a larger amount but the rate of emission is up to the limit. If the same situation continues, by 2030,assuming exponential growth [$Et=E_0*(1+r)^t$] will have 951.0125501(approx.) million tons of CO_2 emissions (with 1990 and 2019's data) which is an 2.5 times increase as that was before pandemic at the peak. We can conclude that, the above chart depicts the urgent need for India to adopt sustainable strategies to mitigate the impact of rising emissions.

Due to the Automobile Escalation, the emissions has consequently influenced on people's life and wellbeing, examples such as the poor air quality in Delhi and Bangalore.

The transport emissions are caused by fuel usage, thus the study further aims to analyse the fuel usage.

Analysis Over Fuel Usage and Emissions

The growing trend of automobiles induces fuel consumption and further implies carbon emission. This is a crucial factor for impact on environment, energy efficiency and sustainability.

The petrol Million barrel per day (Mb/d) and diesel (Mb/d) consumption is given below. The data here represents consumptions of petrol and diesel from the year 2009 to 2019, which is further used to predict emissions and to fit a trend lines.

Table 6: Petrol and Diesel Consumption in India

Year	Diesel Consumption (Mb/d)	Petrol Consumption (Mb/d)
2009	1.109141489	0.250746824
2010	1.183995879	0.277665797
2011	1.274730608	0.293275989
2012	1.359111715	0.307976564
2013	1.34486497	0.335044011
2014	1.365031068	0.373138356
2015	1.468179616	0.427363233
2016	1.495761534	0.464882466
2017	1.596175833	0.512015823
2018	1.645648718	0.553287403
2019	1.627652076	0.586372741

Source: https://datasource.kapsarc.org/explore/dataset/consumption-of-diesel-and-petrol-in-india

***Calculation*:**

First convert Mb/d → Mb/yr. (multiply by 365). Then convert barrel to litre multiply by 158.99 (1barrel=158.99L). To find a litre of diesel emission multiply (Mb/yr.) by 2.6391 and 2.3035 for petrol respectively. Now we sum up petrol, diesel consumption and emission which can be visualized clearly through a graph.

The years analysed (2009 to 2019) are free from any kinds of economic and financial crisis, so the emission forecast could be accurate. After COVID 19, the emissions had taken its rate again higher. The trend line below shows the growth of consumption.

Table 7: Calculation and Prediction of Road Carbon Emission

Year	Diesel Consumption (Mb/d)	Petrol Consumption (Mb/d)	MB/Yr(petrol)	CO_2 emitted by petrol (Million tons)	MB/Yr(diesel)	CO_2 emitted by diesel(million tons)	Total emissions in fuel usage in transport (in million ton)	total fuel usage(MB/YR)
2009	1.109141489	0.250746	91.522590	33.52	404.83664	169.87	203.38	496.359234
2010	1.183995879	0.277665	101.34801	37.12	432.15849	181.33	218.45	533.506512
2011	1.274730608	0.293275	107.04573	39.20	465.27667	195.23	234.43	572.322408
2012	1.359111715	0.307976	112.41144	41.17	496.07577	208.15	249.32	608.487222
2013	1.34486497	0.335044	122.29106	44.79	490.87571	205.97	250.75	613.166778
2014	1.365031068	0.373138	136.1955	49.88	498.23634	209.06	258.93	634.43184

2015	1.468179616	0.427363	155.98758	57.13	535.88556	224.85	281.98	691.87314
2016	1.495761534	0.464882	169.6821	62.14	545.95296	229.08	291.22	715.63506
2017	1.596175833	0.512015	186.88577	68.44	582.60417	244.46	312.90	769.4899547
2018	1.645648718	0.553287	201.94990	73.96	600.66178	252.03	325.99	802.611684
2019	1.627652076	0.586372	214.02605	78.38	594.09300	249.28	327.66	808.1190584
2030	2.250043301	0.957319	349.42165	127.9	821.26580	344.60	980.63	2445.5

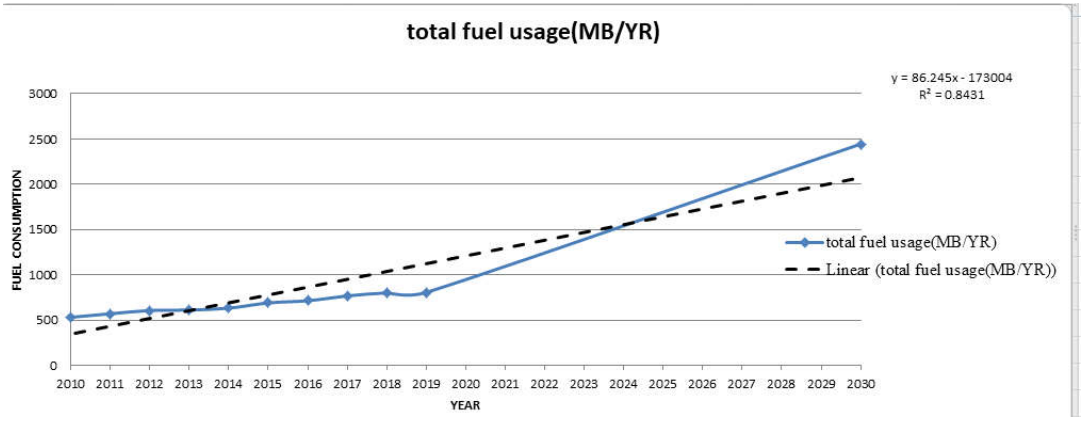

Figure 6: Total Fuel Usage (Mb/yr) of year and 2030 Rapid Growth

The increasing trend implies the consumption increase year on year. The R^2 (coefficient of determination) bespeaks the dependency of consumption over time specified that conditions are stable. As R^2=0.9952 we can conclude that most of the values occur almost around the trend line implying the dependency of consumption on time.

The coefficient of correlation is 0.9999, which is nearly a perfect correlation. It means each one of them is strongly correlated with each other. Thereby, there exists a strong positive correlation between fuel consumption and emission. However the correlation doesn't implies causation here The coefficient of determination is 0.99997, expresses that the regression model between CO_2 emission and fuel usage well predicts the outcome.

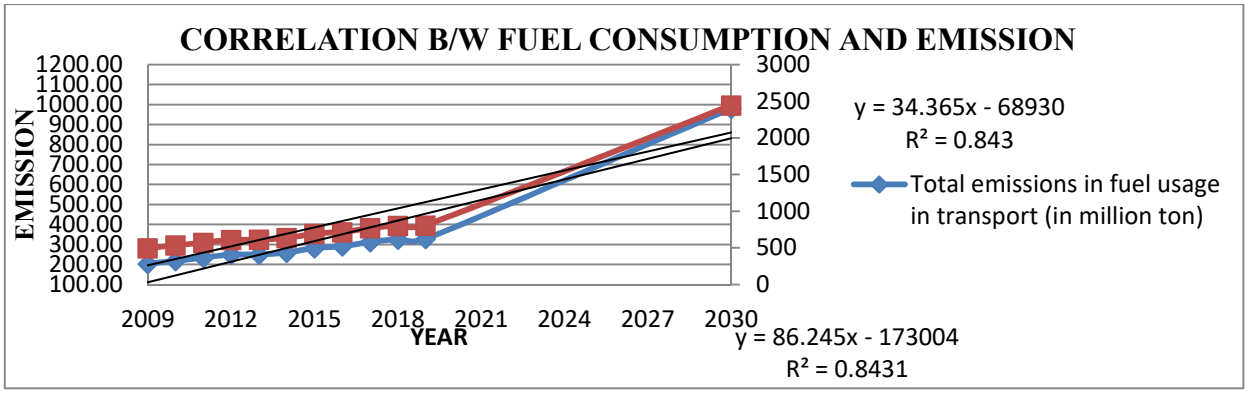

Figure 7: The Correlation Analysis between Fuel Consumption and CO_2 Emission by year

The fuel consumption data of 2030 is taken and the targeted year to control emission is 2030, the value of carbon emission in the year 2030 is forecasted. If the same level of consumption prevails till 2030 then fuel consumptions would be 1.5 times more than 2019. Accordingly, in 2030 the emissions are hugely increased simultaneously with the fuel consumption. It is a devastating impact as only the transport emission of 2030 stands nearly half of total emissions of 2019. Indian Government to commit that 30% of the new vehicles sales in India would be electric by 2030. "Indian Government commits that 30% of the new vehicles sales in India would be electric by 2030", this analysis aids the statement. Therefore, the focus is to shift on electric vehicles to reduce emissions.

Eco Innovation:

As we have inferred that emission and fuel consumption would get a rapid increase by 2030 so there is a requirement to fix these issues. So, such eco innovations are discussed below.

Eco innovations refer to the implementation of new processes and products in the economy in order to boost the sustainable development with economic development that is not to compromise environment for economic and social well-being, which further contributes a coordination process of economy, society and environment. Automotive Eco innovations are aimed to analyse theoretically on EVs, BS [1, 2, 3, 4, and 6], carbon market and carbon credit, etc.

Electric vehicles

- Electric vehicles are a revolutionising step towards net zero emission target. The step is till now a growing phase. The electric vehicles are increasing year by year. The government taking much initiatives to achieve the goal that penetrating 30% of electric vehicles into the automobiles by 2030.
- Initiatives taken by the government:
  1. FAME INDIA (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India): This is a two-phase project on encouraging people to use electric vehicles, the scheme is a government subsidy program part of national electric mobility mission plan (phase 1- 2015, phase 2- 2019). Phase1 focusing on generating demand, advancing technology, piloting projects and developing charging infrastructure. In this phase 529crore was budgeted for 4years facilitating 2.78lakhs of electric and hybrid vehicles. Phase 2 focusing on making public and other transportations electric it was budgeted 1869crores aiding 470000 electric vehicles, 6315 e-buses
  2. Production Linked Incentive (PLI) Scheme: this focuses on increasing and attracting investments on innovative automotive industries
  3. Reduction of GST on EVs from 12% to 5%
  4. The government of India also advised state to waive road taxes of EVs

And many other schemes were introduced this consequently boosted the growth of EVs in India.

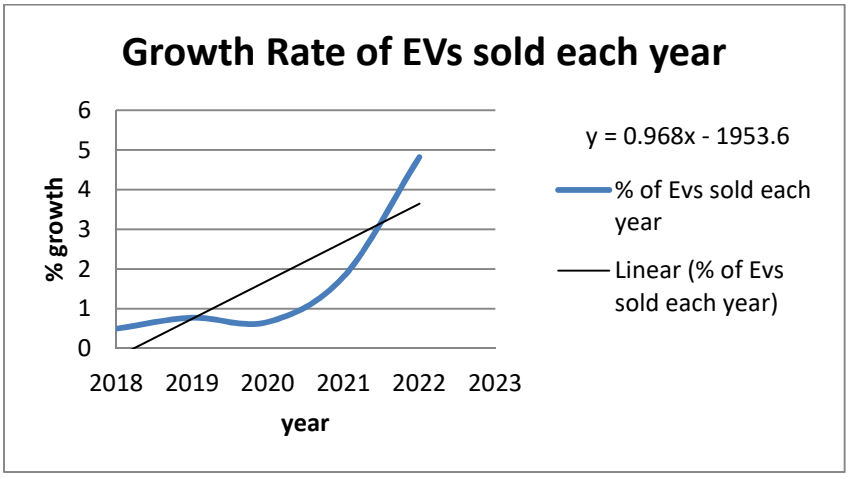

Figure 12: Percentage of EVs Sold year on year

The EV sales had shown a huge growth as the people and government are getting aware of the threats of emissions. Government's encouragement through subsidies had made many buy EV in affordable rates thus increasing its sales. The increased sales in 2022 might be due the PLI scheme. As electricity from coal also emits CO_2, but this CO_2 is much lesser than those emitted by fossil fuels. But this emission due to electricity must be took into account and solved in still an sustainable way by various innovations thus encouraging young sustainable green innovations

Bharat Stage Norms:

- BS notates Bharat Stage Emission Norms which indicates the emission standards for vehicles in India instituted by government of India to regulate air pollution. There are 6 iterations namely BS1, BS2, BS3, BS4, BS6 which were introduced from 2000. The 5^{th} iteration is skipped to balance the delay of introducing 4^{th} iteration. The 6^{th} iteration includes the emission norms, sulphur content, certain innovations like EGR and SCR.

Carbon credit:

- Carbon credits are unique and innovative idea in emission control. In this context, each company buy carbon credits which are generated by carbon sequestering where the company is strictly restricted to emit only that amount of carbon which is to be sequestered. The carbon credits can be generated in many ways such as building up a forest, decreasing CO_2 emissions, capturing and destroying GHGs and so on. Such generated carbon credits can be sold to a high emitting companies
- The EV industry had played a huge role in carbon credits in automobile industry by reducing emissions caused by fossil fuels.

5. Conclusion:

This study provides a comprehensive analysis of the Indian automotive sector by examining the economic, social, and environmental factors influencing vehicle sales and industry growth. Transportation being a fundamental requirement for mobility, the development of the automotive sector plays a vital role in meeting the mobility needs of the population. The study offers valuable insights into key industry indicators, including domestic sales, exports, production, and employment, highlighting their interrelationships and overall impact on the Indian economy.

The findings underscore the dominant role of the domestic market in sustaining the Indian automobile industry, while also identifying both challenges and emerging opportunities within the export segment. The analysis further emphasizes the significant contribution of the automotive sector to employment generation and economic growth, reinforcing its importance as a key driver of national development. Finally, the study highlights the critical role of the automotive industry in India's transition towards a sustainable mobility future through the adoption of environmentally friendly innovations. These findings provide empirical support for government initiatives promoting electric vehicles and the enforcement of stringent emission norms, aligning the sector's growth with long-term environmental sustainability goals.

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