EV Market Opportunities and Analysis in India

Introduction

The Indian automotive sector ranks fifth globally and is expected to become the third largest in the world by 2030. India is the world's largest producer of two and three-wheelers and the second-largest manufacturer of buses. The automotive industry currently accounts for 7.1% of India's Gross Domestic Product (GDP) and 49% of its manufacturing GDP. India is one of the partners of the global EV30@30 campaign, which targets to have at least 30% of new vehicle sales be electric by 2030 and is currently 11th among 15 countries ranked in terms of market readiness for EV adoption, according to ADL's Global Electric Mobility Readiness Index called GEMRIX. With its flagship Faster Adoption and Manufacturing of Electric Vehicles (FAME) policy, GoI has set an ambitious target of 30% EV penetration for passenger cars, 70% for commercial vehicles, and 80% for two- and three-wheelers by 2030. As announced at the COP26 event, held in Glasgow in 2021, India stands committed to reducing the Emissions Intensity of its GDP by 45% by 2030, from the 2005 level and achieving about 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030.

Category	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Passenger Vehicles	32,88,581	33,77,389	27,73,519	27,11,457	30,69,523	38,90,114
Commercial Vehicles	8,56,916	10,07,311	7,17,593	5,68,559	7,16,566	9,62,468
Three Wheelers	6,35,698	7,01,005	6,37,065	2,19,446	2,61,385	4,88,768
Two Wheelers	2,02,00,117	2,11,79,847	1,74,16,432	1,51,20,783	1,35,70,008	1,58,62,087
Quadricycles	0	627	942	-12	124	725

Grand Total	**2,49,81,312**	**2,62,66,179**	**2,15,45,551**	**1,86,20,233**	**1,76,17,606**	**2,12,04,162**

Table: *Automobile domestic production sales*

Indian Electric Vehicles (EV) Market Scope

Study Period 2019-2031
CAGR 23.47%
Historical Period 2019-2021
Forecast Period 2023-2031
Base Year 2022
Base Year Market Size USD 8,674.45 Million
Forecast Year 2031
Forecast Year Market Size USD 23514.54 Million

Electric Vehicle Category-wise Distribution

Below is the data for different categories of EVs in India from 2018-2023:

Sl. No.	Vehicle Category	2018 - total	2018 - EV	2018 - %	2019 - total	2019 - EV	2019 - %	2020 - total	2020 - EV	2020 - %	2021 - total	2021 - EV	2021 - %	2022 - Total	2022 - EV	2022 - %	2023 (Till 01-08-2023) - Total	2023 (Till 01-08-2023) - EV	2023 (Till 01-08-2023) - %
1	Two-Wheeler	19576235	17067	0.09	18644700	30389	0.16	14305129	29113	0.2	13926217	156243	1.12	15592118	631181	4.05	9276337	489637	5.28
2	Three Wheeler	764806	110133	14.4	765867	133489	17.43	400893	90385	22.55	390820	158129	40.46	677034	350247	51.73	572654	300114	52.41
3	Four Wheeler	2999288	1047	0.03	2822782	962	0.03	2396428	3207	0.13	2945340	12259	0.42	3346973	33205	0.99	2020459	40186	1.99
4	Goods Vehicles	886047	658	0.07	799661	54	0.01	503358	15	0	602805	1118	0.19	804409	653	0.08	490920	1512	0.31
5	Public Service Vehicle	79317	50	0.06	81022	508	0.63	40328	88	0.22	15434	1177	7.63	45448	1972	4.34	47058	985	2.09

The EV sector is expected to grow at a Compound Annual Growth Rate (CAGR) of 49% between 2022 and 2030 to an annual sale of about 10 million units. This growth will help the EV industry have about 45 million – 50 million EVs on Indian roads by 2030. India will be among the top 10 EV markets 7 globally by 2030 and nearly one in every 10 EVs sold worldwide by 2030 will be sold in India. According to an independent study by the CEEW Centre for Energy Finance (CEEW-CEF), the EV market in India will grow to US$206 billion (£173 billion) opportunity by 2030 if India sustains its progress to meet the ambitious 2030 targets. This projected growth would require a cumulative investment of over US$180 billion (£151 billion) in vehicle production and charging infrastructure.

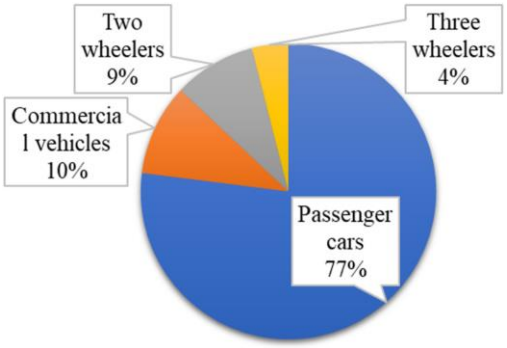

Fig: The electric vehicle segment forecasted sales

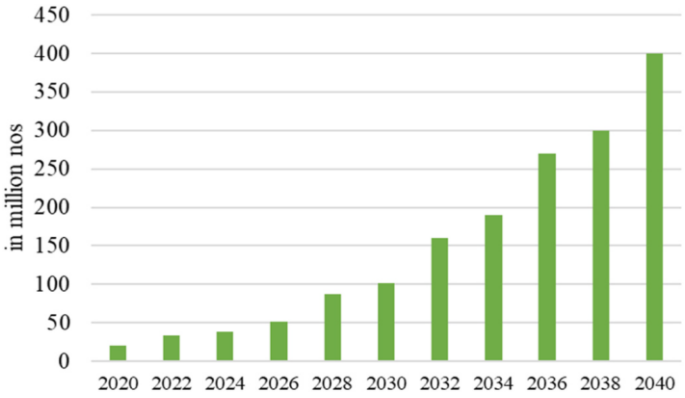

Fig: Forecasted electrical vehicle sales in India.

In 2023, India, the world's largest two and three-wheeler manufacturer, sold almost 24 million vehicles, including commercial and personal four, three, and two-wheelers, according to the latest data on the government's Vahan portal. Of the total number of vehicles registered, more than 1.5 million were EVs, capturing 6.35% of the total base, including 813,000 electric two-wheelers. While the overall growth was nearly 10% from about 22 million vehicles sold in 2022, EV sales grew by close to 47% from 1.03 million EVs sold last year. This brings the total number of electric vehicle sales in the country to nearly 3.5 million. Two-wheelers accounted for more than 47% of sales, four-wheelers represented about 8% and the rest came from e-rickshaws and three-wheelers.

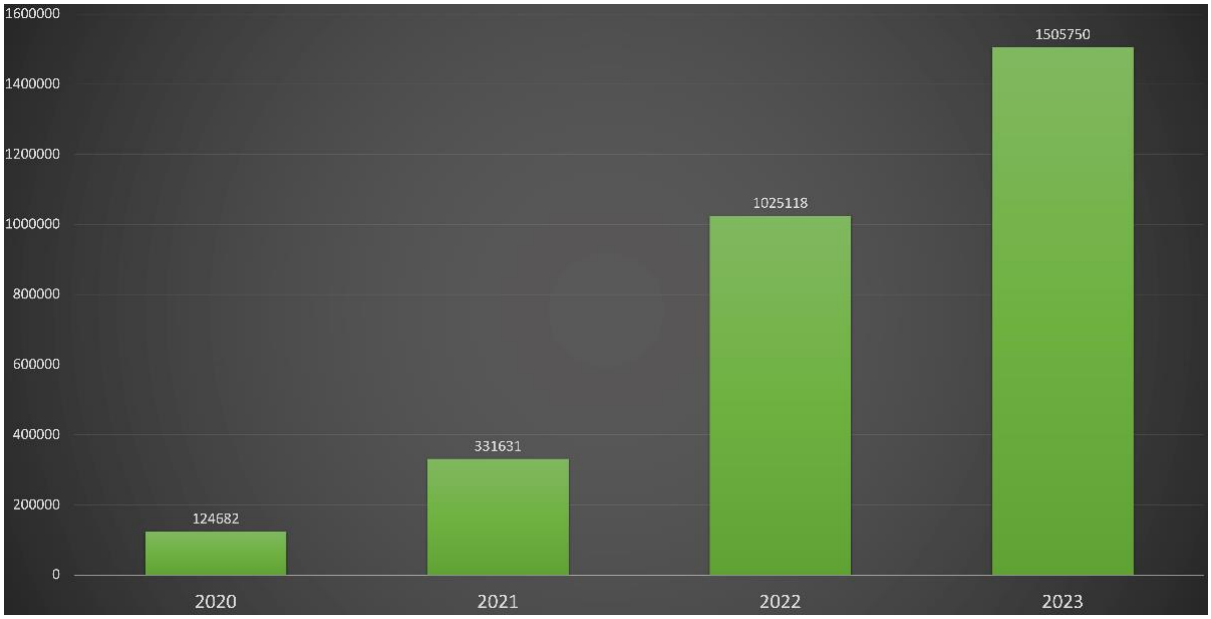

Fig: *India's EV sales grew from nearly 125,000 in 2020 to over 1.5 million in 2023*

India's electric vehicle (EV) market is at an inflection point. EVs accounted for about 5% of total vehicle sales between October 2022 and September 2023—and could reach more than 40% penetration by 2030, driven by strong adoption (45%+) in both two-wheeler (2W) and three-wheeler (3W) categories. 2W EVs form the majority of EV sales today, accounting for 85%–90% of all EV units sold in India, followed by 4W EVs (7%–9% of sales) and 3W EVs (5%–7% of sales). While Phase II of the Faster Adoption and Manufacturing of Electric

Vehicles (FAME) scheme was recently revised, 2W EV penetration has remained stable at around 5% in line with Jan–Mar 2023 levels (and only a marginal decline in Jun–Jul 2023). 3W EV and 4W EV penetration levels experienced an upswing, with volumes more than doubling over the past 12 months, driven by low total cost of ownership (TCO).

A mid-segment EV scooter product could enable 50%+ penetration in scooters, a huge jump from 10%–15% penetration today. While EVs have already achieved 40% penetration in the premium scooter segment, the dominant mass/ economy segment—constituting ~75% of the market—is largely untapped.

Sl. No.	Segment	Total Claim Incentive Approved in 2022 (January to December 2022)
1	e-2w	1280.07
2	e-3w	168.93
3	e-4w	55.17
4	e-buses	364.39
Total	**Total**	**1868.56**

Table: Incentives regarding different categories of EV segment

Metro and Tier 1 cities currently drive the majority of EV sales. For example, metro/Tier 1 cities account for 80%–90% of 3W EV sales, compared to only 55%–65% of comparable 3W ICE sales. This is driven by a lower EV distribution footprint in Tier 2 cities, limited customer understanding of EVs' TCO benefits, and high range anxiety among Tier 2 customers. EV models have lower service requirements, with a lower number of components, hence service revenues only comprise 10%–15% of EV dealer revenues (compared to 30% or more for ICE dealers).

The electric car market is divided into passenger and commercial segments. Commercial electric vehicles are still a relatively niche market. But the passenger segment has seen some strong development. In this segment, Tata holds most of the market offering some of the most prominent EVs in India. Electric three-wheelers also have seen a similar growth trajectory during the last few years, reaching a market volume of more than half a million units in 2023. Most of the three-wheelers are used commercially as e-rickshaws and goods carriers. Coincidently, this segment is also led by a conventional automobile manufacturer, Mahindra.

The latest trend in the two-wheeler industry is the introduction of electric vehicles. Combined with city congestion and environmental concerns, electric two-wheelers are estimated to change the face of the industry. In 2023, close to 410 thousand electric 3-wheelers were sold in the country. November 2023 becomes the 14th month in a row that India EV Inc has exceeded the 100,000-unit sales mark. Having first notched the milestone in October 2022 (117,200 units), the sales momentum continued in November 2022 (121,602 units) and December (105,003 units) last year and through each of the first 11 months of CY2023, hitting a high in May 2023.

Cumulative EV industry sales, comprising the two- and three-wheeler, passenger vehicle and commercial vehicle sub-segments, for the first 11 months of 2023 are a record 13,87,114 units, which constitutes strong 50% year-on-year growth (January-November 2022: 924,111 units).

INDIA EV INC REPORT CARD: RETAIL SALES IN THE FIRST 11 MONTHS OF CY2023												
Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Total
CY2023	1,02,872	1,07,219	1,40,912	1,11,351	1,58,420	1,02,533	1,16,481	1,27,056	1,28,349	1,39,311	1,52,610	13,87,114
CY2022	51,504	58,120	83,133	77,631	69,948	75,876	80,880	89,012	98,910	1,17,499	1,21,598	9,24,111
% change	100%	84%	70%	43%	126%	35%	44%	43%	30%	19%	26%	50%

RETAIL SALES OF THE INDIA ELECTRIC VEHICLE INDUSTRY IN THE FIRST 11 MONTHS OF CY2023												
Category	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Total
2Ws	64,691	66,088	86,345	66,870	1,05,536	46,065	54,588	62,743	64,017	74,942	91,243	7,83,128
3Ws	34,333	36,032	45,284	38,051	44,633	48,052	53,749	56,759	57,452	56,838	53,766	5,24,949
PVs	3,442	4,757	8,831	6,033	7,708	7,968	7,763	6,990	6,318	7,437	7,043	74,290
Goods	137	163	340	304	233	235	244	291	299	343	273	2,862
Buses	97	98	87	84	274	200	135	269	258	239	268	2,009
Others	172	81	25	9	36	13	2	4	5	13	17	377
Total	**1,02,872**	**1,07,219**	**1,40,912**	**1,11,351**	**1,58,420**	**1,02,533**	**1,16,481**	**1,27,056**	**1,28,349**	**1,39,812**	**1,52,610**	**13,87,615**
Data: Vahan / November 4, 2023												

There are some prominent companies in India working in the field of Electric Vehicle manufacturing. Below is the list of top companies and their locations operating in India.

Company name	Location of factory / manufacturing facility
Greaves Electric Mobility Private Limited	Ranipet, Tamil Nadu
Ather Energy Private Limited	Bengaluru, Karnataka; Hosur, Tamil Nadu
ATUL Auto Limited	Shapar, Gujarat
Bajaj Auto Limited	Waluj and Chakan in Maharashtra; Pant Nagar in Uttaranchal; Akurdi in Pune, Maharashtra
Electrotherm (India) Limited	Ahmedabad, Gujarat
Hero Electric Vehicles Pvt. Ltd.	Near Ludhiana, Punjab (new facility); Mahindra facility at Pithampur, Madhya Pradesh
Hyundai Motor India Ltd (HMIL)	Sriperumbudur near Chennai, Tamil Nadu; Talegaon factory in Maharashtra (starting operations in 2025)
JBM Group	Multiple locations in India and other countries
Mahindra & Mahindra Limited	Pune, Maharashtra; Zaheerabad, Telangana
MG Motor India Private Limited	Halol, Gujarat
Okinawa Autotech International Private Limited	Bhiwadi and Karoli, Rajasthan
Olectra Greentech Limited	Seetharampur, Hyderabad – Telangana
Omega Seiki Mobility	Faridabad, Haryana; Pune, Maharashtra; and Chennai, Tamil Nadu
Piaggio & C. S.p.A.	Baramati, Pune district – Maharashtra
Tata Motors Ltd.	Tata Group facility at Sanand, Gujarat; Ford's Sanand facility

TVS Motor Company	Hosur, Tamil Nadu
VE Commercial Vehicles Limited	Indore, Madhya Pradesh

Table: *Existing EV production capacity in India*

India's EV sales have witnessed a remarkable uptick, reaching 1.3 million units in the initial eleven months of CY2023, representing a 50% increase over the previous annum. Most electric vehicles purchased are two- and three-wheelers used for shared and smaller mobility. Two-wheelers have a share of 56%, and three-wheelers have a share of 38% in the Indian EV pie. Let's take a closer look at the individual categories:

1) **Two-wheelers:**

ELECTRIC TWO-WHEELER RETAIL SALES IN INDIA (JANUARY-NOVEMBER 2023)												
EV OEM	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Total**
Ola Electric	18,353	17,773	21,434	22,065	28,728	17,678	19,391	18,739	18,695	23,821	29,808	2,36,485
TVS Motor Co	10,464	12,674	16,891	8,758	20,433	7,867	10,398	15,482	15,600	16,462	18,935	1,53,964
Ather Energy	9,227	10,071	12,183	7,800	15,427	4,600	6,680	7,143	7,183	8,415	9,171	97,900
Bajaj Auto	2,626	1,219	2,207	3,720	9,995	3,007	4,125	6,579	7,100	9,052	11,681	61,311
Ampere Vehicles	4,370	5,851	9,348	8,324	9,621	1,602	1,414	773	586	358	281	42,528
Okinawa Autotech	4,408	3,846	4,510	3,218	2,908	2,619	2,265	2,001	1,791	1,474	1,604	30,644
Hero Electric	6,400	5,863	6,662	3,333	2,109	1,137	779	783	843	666	821	29,396
Greaves Electric	87	153	382	551	1,155	1,440	2,159	2,925	3,612	4,174	4,411	21,049
Okaya EV	1,265	1,232	1,764	1,563	3,877	424	784	1,153	885	866	1,298	15,111
Bgauss Auto	716	667	781	771	1,814	191	661	923	935	1,170	1,606	10,235
Hero MotoCorp	157	304	298	145	751	465	990	915	532	1,935	3,031	9,523

Table 2: Sales of Electric two-wheelers in India (Jan- Nov 2023) [3].

2) **Three-wheelers:**

EV OEM	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Total**
Mahindra Last Mile Mobility	2,957	3,754	4,478	3,515	4,029	4,496	5,339	5,254	5,040	5,099	5,563	49,524
YC Electric Vehicle	2,275	2,583	3,095	2,838	3,244	3,472	3,593	3,986	3,991	4,068	3,691	36,836
Saera Electric Auto	1,743	1,854	2,244	1,856	2,060	2,363	2,723	2,856	3,142	3,133	2,701	26,675
Dilli Electric Auto	1,474	1,552	2,061	1,729	2,078	2,140	2,473	2,719	2,338	2,186	2,028	22,778
Piaggio Vehicles	1,071	1,058	1,444	1,416	1,664	1,776	1,971	1,919	1,976	2,209	2,217	18,721
Mini Metro	1,117	942	1,265	1,037	1,203	1,504	1,568	1,701	1,395	1,355	1,342	14,429
Champion Polyplast	1,146	1,241	1,312	987	1,219	1,175	1,420	1,357	1,317	1,259	1,142	13,575
Unique International	845	825	1,150	883	1,122	1,161	1,300	1,447	1,325	1,105	1,191	12,354
Hotage Corporation	720	634	782	802	990	1,234	1,246	1,337	1,262	1,193	1,308	11,508
JS Auto	701	810	828	770	837	897	1,001	1,011	1,225	1,016	984	10,080

Table 3: Electric three-wheeler sales in India (Jan- Nov 2023) [3].

3) **Private Vehicles:**

ELECTRIC PASSENGER VEHICLE RETAIL SALES IN INDIA (JANUARY-NOVEMBER 2023)												
EV OEM	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Tata Motors	2,471	3,916	7,302	4,491	6,006	5,479	5,459	4,766	4,297	5,480	4,824	54,491
MG Motor India	435	362	517	350	464	1,157	1,236	1,199	887	922	891	8,420
Mahindra & Mahindra	0	7	258	536	389	412	381	405	358	270	494	3,510
PCA Automobiles	0	0	209	240	324	336	223	118	141	172	121	1,884
BYD India	140	242	300	163	146	184	118	104	148	137	122	1,804
Hyundai Motor India	117	50	48	54	170	160	116	186	212	194	160	1,467
BMW India	126	59	55	67	75	100	105	84	75	93	262	1,101
Volvo Auto India	29	36	52	36	45	44	35	46	54	51	66	494
Mercedes-Benz India	44	33	35	30	19	37	37	21	73	34	53	416
Kia India	48	30	23	38	47	39	29	28	35	49	29	395
Audi India	8	9	7	5	7	7	9	14	26	19	11	122
Porsche India	4	1	7	5	6	2	4	13	5	15	5	67
Jaguar India	1	1	1	2	2	1	1	0	0	0	0	9
Data: Vahan / December 3, 2023												

Table 4: Sales of private vehicles in India (Jan- Nov 2023) [3].

4) **Commercial Vehicles:**

LEADING ELECTRIC COMMERCIAL VEHICLE MANUFACTURERS IN INDIA – JANUARY-NOVEMBER 2023												
OEM	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total
Tata Motors	7	29	44	92	228	300	222	303	364	455	390	2,434
Mahindra Last Mile Mobility	12	47	22	16	22	39	34	36	26	25	25	304
PMI Electro Mobility	48	53	6	16	48	19	20	37	34	0	0	281
Olectra Greentech	2	13	24	32	39	13	26	2	20	36	63	270
BYD India	0	0	183	42	0	0	0	2	36	0	0	263
Mytrah Mobility	9	0	12	10	21	10	11	54	14	11	13	165
Switch Mobility	35	18	31	13	5	5	9	10	12	9	7	154
JBM Auto	2	14	0	13	52	0	5	0	8	2	23	119
Piaggio Vehicles	4	18	25	16	14	11	4	7	4	3	0	106
VE Commercial Vehicles	0	0	1	0	0	0	0	57	0	7	4	69
Omega Seiki	10	1	3	17	18	3	7	13	15	2	10	99

Table 5: Sales of private vehicles in India (Jan- Nov 2023) [3]

Electric Vehicle Region-wise Distribution

Amongst the Indian States, Uttar Pradesh, Maharashtra, Karnataka, Bihar, and Delhi were the top EV-selling states between FY2014 and FY2023, collectively accounting for more than 60 percent of the market share, mostly driven by the large volume of sales of electric three-wheelers and electric two-wheelers in these States. In terms of share of the sales in the Indian States in FY2023, Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, and Delhi were the top-selling States.

First, we will mention the data for Electric and non-electric vehicles from two different sources in different regions of the country.

Sl.No.	State/UT	Electric	Non-electric
1	Andaman and Nicobar Islands	190	161258
2	Andhra Pradesh	67905	16553509
3	Arunachal Pradesh	28	303673
4	Assam	120423	5312457

5	Bihar	161060	11631081
6	Chandigarh	7964	841172
7	Chhattisgarh	54848	7413951
8	Delhi	233212	13994966
9	Goa	12615	1206476
10	Gujarat	138410	22804558
11	Haryana	69271	12062205
12	Himachal Pradesh	2410	2178827
13	Jammu and Kashmir	10896	2055765
14	Jharkhand	36759	7057289
15	Karnataka	248747	29785247
16	Kerala	98332	16781110
17	Ladakh	65	44430
18	Madhya Pradesh	96151	19616269
19	Maharashtra	305006	34323748
20	Manipur	1203	554994
21	Meghalaya	139	519714
22	Mizoram	118	355369
23	Nagaland	62	418529
24	Odisha	62567	10638175
25	Puducherry	4588	1330320
26	Punjab	35727	13196875
27	Rajasthan	180670	18857703
28	Sikkim	20	109988
29	Tamil Nadu	173152	31618002
30	Tripura	14839	707543
31	Dadra and Nagar Haveli and Daman and Diu	354	374489
32	Uttar Pradesh	574967	43852548
33	Uttarakhand	49491	3647377
34	West Bengal	68376	15227219
Grand Total	**Grand Total**	**2830565**	**345536836**

Below is the state-wise distribution of data from GOI till 2023.

Sl. No	State/UT	To date State-wise - Total Number of Vehicles Registered	To date State-wise - Total Vehicle Registered as Electric	Proportion of Electric Vehicles (in percentage)
1	Andaman and Nicobar Island	160375	186	0.12
2	Andhra Pradesh	16517516	66500	0.4
3	Arunachal Pradesh	299371	25	0.01
4	Assam	5393542	116605	2.16
5	Bihar	11728184	155457	1.33
6	Chandigarh	843049	7628	0.9
7	Chhattisgarh	7431353	52813	0.71
8	Delhi	8457200	229305	2.71
9	Goa	1204110	12139	1.01
10	Gujarat	22799866	134273	0.59
11	Haryana	12092054	67812	0.56
12	Himachal Pradesh	2145062	2362	0.11
13	Jammu and Kashmir	2048212	10225	0.5
14	Jharkhand	7056955	35331	0.5
15	Karnataka	29855843	239948	0.8
16	Kerala	16643512	94346	0.57
17	Ladakh	43757	65	0.15
18	Madhya Pradesh	19604968	92388	0.47
19	Maharashtra	34371551	296885	0.86
20	Manipur	554096	1198	0.22
21	Meghalaya	511744	129	0.03
22	Mizoram	349287	114	0.03
23	Nagaland	414439	60	0.01
24	Odisha	10637750	60097	0.56
25	Puducherry	1329787	4421	0.33
26	Punjab	13175075	34162	0.26
27	Rajasthan	18914170	175595	0.93
28	Sikkim	108442	20	0.02
29	Tamil Nadu	31643747	167216	0.53
30	Tripura	711282	14379	2.02
31	Dadra and Nagar Haveli and Daman and Diu	372133	345	0.09
32	Uttarakhand	3626246	48250	1.33
33	Uttar Pradesh	43943230	556629	1.27
34	West Bengal	15020616	67111	0.45
Grand Total	**Grand Total**	**340008524**	**2744019**	**0.81**

Consumer Behaviour

Confirmatory factor analysis revealed ten latent variables that impact the adoption of electric vehicles, out of which eight variables, viz. social image, social influence, anxiety (or perceived risks), perceived environmental benefits, performance expectancy, effort expectancy, facilitating conditions, and attitude, are used for segmenting and profiling potential vehicle buyers into clusters, and the other two latent factors viz. environmental enthusiasm and

technological enthusiasm are used to measure and analyze the differences in personality traits across the different clusters.
A survey was done which uses a multi-item questionnaire to collect data from young educated Indian students, which is used to understand the factors that affect the adoption of electric vehicles among potential vehicle buyers. Below is the survey report for a sample size of 660.

N=660

DEMOGRAPHICS		**Percentage**
AGE	18-22	16.23
	23-28	60.86
	29-35	20.00
	36-45	2.6
	>45	0.31
GENDER	Male	76
	Female	24
FAMILY ANNUAL INCOME	< 2 lakhs	11.73
	(2 – 6) lakhs	35.80
	(6-12) lakhs	32.17
	(12-18) lakhs	11.01
	>18 lakhs	9.27
EDUCATION LEVEL	Under-Graduate	14.06
	Post-Graduate	41.30
	Doctorate	42.02
	Post-Doctorate	2.61
EXPERIENCE WITH EV	Yes	70
	No	30
KNOWLEDGE OF EV	Yes	69.96
	No	30.04

The final list of item statements with a sample size of 660 respondents, was analyzed using confirmatory factor analysis (CFA). This analysis was employed to evaluate the legitimacy, dependability, rationality, reliability, and sufficiency of the multi-item survey instrument.
The questionnaire covered all the conformational and latent factors. Based on the survey results clustering can be performed for dividing customer behaviours into different clusters.

Another survey was performed where a sample size of 1021 respondents was recorded and categorized as shown in the table below. The questionnaire was on the same factors as above.

Categories	**Percentage**	**Characteristics**	**Percentage**
Marital Status		Education Level	
Married	55.01	Below Bachelor	11.7
Single	44.0	Bachelor	41.6
Others	0.9	Master or above	46.7

Age		Income Amount	
18-30	48.5	< 500000	20.8
31-40	37.1	500000-1000000	25.1
41-50	10.2	1000001-2000000	35.8
51-60	3.1	2000001-3000000	12.5
>60	1.1	>3000000	5.8

Family		Car Ownership	
<=2	8.7	No car	31.7
3	24.4	1 car	47.3
4	33.3	2 cars	16.5
>=5	33.6	>=3	4.5

No. of Children		Employment Type	
0	68.6	Private Sector	73.4
1	20.8	Unemployed	10.2
2	4.5	Self-employed	8.6
>=3	6.1	Govt. Sector	7.8

Gender	
Male	76.4
Female	23.6

Based on the above surveys results were analyzed and categorized into 3 categories based on the response to questions. They were Idlers, Indifferent, and Leads. It is found that the mean cluster values of respondents in cluster 1 are less than the mean values for all eight clustering variables and hence have been labeled as “innovation adoption idlers”. In contrast, cluster 3 respondents have the highest values for all variables and hence have been classified as “innovation adoption leads”. Similarly, the mean cluster values of eight factors for cluster 2 respondents lie between those of cluster 1 and cluster 2 (mostly close to zero) and hence have been tagged as “innovation adoption indifferent”.

Socio-demographic variable	**Cluster 1 (Idlers)**	**Cluster 2 (Indifferents)**	**Cluster 3 (Leads)**
Gender			
Male	76.23%	77.32%	78.20%
Female	23.77%	22.68%	21.80%
Age			
18 – 22	14.35%	16.19%	16.54%
23 – 28	64.36%	59.79%	60.90%
29 – 35	18.81%	20.96%	18.80%
>36	2.97%	2.75%	4.51%
Annual household income			

(INR)			
Less than 2 lakhs	10.40%	12.37%	12.30%
2 lakhs – 6 lakhs	33.17%	38.14%	35.34%
6 lakhs – 12 lakhs	35.15%	30.93%	31.58%
Above 12 lakhs	21.29%	18.56%	21.05%
Education			
Undergraduates	11.39%	13.40%	13.53%
Postgraduates	40.10%	45.02%	47.37%
Doctorates	48.51%	41.58%	39.10%
Knowledge of electric vehicles			
Little or no	84.65%	70.45%	46.62%
Good amount of knowledge	15.35%	29.55%	53.38%
Experience with electric vehicles			
No EV experience	35.15%	28.87%	71.13%
Experienced EV	64.85%	27.07%	72.93%

Market Segment Analysis

Based on the data collected above, here is the market segment analysis conclusion shown below.

Geographic Segmentation:

- **Urban areas:** Major metro cities like Delhi, Mumbai, Bengaluru, Chennai, and Hyderabad are potential hotspots due to higher pollution levels, traffic congestion, and increasing sustainability awareness. These cities currently drive the majority of EV sales.
- **Tier 1 and 2 cities:** As urbanization increases and EV distribution networks expand, cities like Pune, Ahmedabad, Lucknow, Jaipur, etc. may present opportunities for EV adoption, especially for commercial fleets and last-mile delivery.

Demographic Segmentation:

- **Income level:** Upper-middle and high-income households (annual income above INR 12 lakhs) are more likely to afford EVs initially, given their higher upfront costs.
- **Age:** Younger demographics (18-35 years) may be more open to adopting new technologies like EVs.
- **Family status:** Families with children may be more inclined towards eco-friendly transportation choices.

Psychographic Segmentation:

- **Environmental consciousness:** Consumers with strong environmental values and concerns about carbon emissions are potential early adopters of EVs.
- **Tech-savviness:** Tech enthusiasts and early adopters of new technologies could be potential targets for EV adoption.
- **Social status:** EVs may appeal to consumers who perceive them as a symbol of social status and modernity.

Behavioral Segmentation:

- **Daily commute patterns:** Consumers with predictable commutes within the range of EVs could be potential targets.
- **Charging accessibility:** Consumers with access to charging facilities at home or workplaces may find EVs more convenient.
- **Vehicle usage:** Fleet operators, ride-sharing services, e-commerce companies, and commercial vehicles could benefit from the lower operating costs of EVs.

Industry/Commercial Segmentation:

- **E-commerce and logistics:** Companies seeking sustainable last-mile delivery solutions could be potential customers for electric commercial vehicles.
- **Corporate fleets:** Organizations aiming to reduce their carbon footprint and promote sustainability could adopt EVs for employee transportation.
- **Shared mobility services:** Ride-sharing and car-sharing companies may find EVs economical and environment-friendly.
- **Government agencies:** Agencies looking to adopt EVs as part of their sustainability initiatives could be potential customers.

Potential Target Segments:

- Urban, upper-middle to high-income households (annual income above INR 12 lakhs) with environmental consciousness and tech-savviness, aged 18-35, living in metro cities with access to charging infrastructure.
- Fleet operators, e-commerce companies, shared mobility services, and corporate organizations in urban areas seeking cost-effective and sustainable transportation solutions.
- Government agencies looking to adopt EVs as part of their sustainability initiatives.

GitHub Link: https://github.com/Mac1211/Assign_2.git

I am providing the basic Python construct by assuming a single data file containing all the information.

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