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Green Wheels, Different Deals: Comparative Insights into Indian State EV Policies

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Abstract
Electric vehicles (EVs) have become a vital tool in the global transition of the transportation sector to reduce carbon emissions and reliance on fossil fuels as we move closer to a sustainable future. The EV policies of Delhi, Haryana, Punjab, and Uttar Pradesh—four northern Indian states—are compared in this research. The study identifies gaps and inconsistencies in current policies by looking at a number of policy parameters, including employment creation, skill development, green zone promotion, manufacturing incentives, research and development funds, subsidy support, road tax exemptions, charging infrastructure development, and battery recycling. The results are intended to assist state legislators in improving their electric vehicle (EV) plans and encouraging creativity, economy, and a quicker transition to environmentally friendly modes of transportation. The study emphasizes the significance of strong, well-coordinated regulations to encourage the widespread use of electric vehicles. This research provides useful suggestions for bettering policy in addition to highlighting the present level of EV adoption in different states.
***Keywords**: Electric Vehicles, EV, EV Policies, policies comparison.*

INTRODUCTION
The transition towards electrification of transportation has been aided by the exhaustion and rising reliance on fossil fuels, elevated environmental challenges resulting from the transportation sector's reliance on fossil fuels, advancements in battery technology, and the manufacturing process itself (**Gonul et al., 2021).** The automobile industry is accountable for 24 per cent of direct CO2 emissions resulting from fuel combustion **(Teter, 2020).** Approximately 75 per cent of transportation-related emissions are caused by road transportation, which includes automobiles, trucks, buses, two- and three-wheelers. Climate change is a result of rising global temperatures and poor air quality, which are caused by increased CO2 emissions **(Milev et al., 2021).**

Approximately 49% of oil resources are utilized by the steadily growing transportation sector. It is projected that if current trends in crude oil use and sources continue, by 2038, the world's oil reserves will run out **(Ehsani et al., 2010).** Consequently, it seems that replacing non-renewable energy sources with renewable ones and utilizing the proper power-conserving technologies are prerequisites. Many studies and investigations have been conducted on electric vehicles (EVs) serving a potential cure for the environmental issues

triggered by traffic **(Clement et al., 2009; Stephan & Sullivan, 2008; Hajimiragha et al., 2010).** An electric vehicle's key advantage over an internal combustion engine is its power source and drive mechanism.

The electric vehicle (EV) market is growing quickly, and models are now offered in a variety of car styles, including pickup trucks, SUVs, and compact and sedan cars. Certain electric vehicles (EVs) run exclusively on batteries, while others are plug-in hybrids, which fuse an internal combustion engine coupled with an electric motor. Three categories of electric cars exist:

1. Vehicles driven by batteries (BEVs)
2. EVs that are hybrids (PHEVs)
3. Vehicles powered by fuel cells (FCEV)

Evolution of Electric Vehicles Policy-

According to E-Amrit Portal, the adoption of electric vehicles has been extensively promoted by the Indian government. Both the federal and state levels of government have different EV policies. Timeline for the several actions that regulators and legislators have taken at National Level:

2011: The National Council for Electric Mobility was established as the highest authority responsible for formulating proposals to advance electric mobility and the production of electric automobiles.

2012: The National Automotive Board was established as the focal point for carrying out the FAME India initiative.

2013: An approximate budget of Rs. 14,000 crore was provided under the NEMMP 2020.

2015: NEMMP 2020, Phase 1 of the FAME India initiative was introduced and ran for two years, from April 2017 to March 2017.

2016: A technology platform for electric mobility was established for R&D consortium projects, and the Indian government's goal of 100% e-mobility by 2030 was announced by the minister of state for electricity and coal, new and renewable energy.

2017: DHI has discontinued providing benefits to mild hybrid cars across the nation under the FAME and is prolonging FAME 1 for a period of six months.

2018: In December, guiding principle and requirements for charging infrastructure for electric vehicles were informed, and in March, MOP changed the original target of becoming completely electric by 2030 to thirty percent.

2019: Phase 2 of FAME was started, and MOP released updated standards and recommendations for the infrastructure needed to charge electric vehicles. These

included a staged approach with measures including installing one charging station every three kilometres in towns and every twenty-five kilometres on highways and roads.

2020: Phased Manufacturing Program (PMP) for xEV parts is revised by DHI to make them eligible for the FAME 2 program, and 2636 EV charging stations were approved for Phase 2 of the FAME India Programme.

As of January 2021, a report highlighted that Karnataka was a forerunner, announcing its Electric Vehicle and Energy Storage Policy back in 2017. Following Karnataka, several other states including Delhi, Kerala, Maharashtra, Uttarakhand, Tamil Nadu, Punjab, Madhya Pradesh, Uttar Pradesh, Haryana and Telangana have also declared their EV policies.

The scope and complexity of these regulations vary significantly from state to state, and most policies are valid for five years from the date they are announced. However, there are exceptions: Delhi's EV policy is valid for just three years, whereas the plans for Tamil Nadu and Telangana extend up to ten years. Different states have assigned various departments to oversee these policies. In many cases, the Department of Industries is the primary organization responsible for the creation and implementation of EV policies. However, in Kerala, Punjab, and Delhi, the transport department has taken the lead for promotion of EV.

The objective of this study is to conduct a comparative study of the Electric Vehicle (EV) policies implemented by the northern states of India. Additionally, the study seeks to uncover any inconsistencies or gaps within these policies. By comparing the EV policies of various states, this study promotes a culture of innovation and efficiency, thereby expediting the nationwide shift towards sustainable transportation solutions. While numerous studies have explored the adoption and promotion of electric vehicles at a national level, limited research has focused on the comparative analysis of state-level EV policies in India, particularly in the northern region.

LITERATURE REVIEWS

Zhang et al. (2014), examined the different policy incentives that nations have placed to encourage the usage of electric cars (EVs). It emphasized how crucial financial incentives, technological assistance, and infrastructure for charging EVs are to promoting their use. They concluded with recommendations for nations like China, highlighting the need for open policies that welcome efficient EV models and foster manufacturer innovation. They compared the policy mechanisms across various nations, arguing that each nation should customize its approach based on its unique circumstances. **Steen et al. (2015),** explored various government strategies for supporting the release of plug-in hybrid electric vehicles and battery electric vehicles, analyzed policies in eight countries and California and suggested that current policies may not suffice for long-term e-mobility goals. They suggested that current policies may not suffice for long-term e-mobility goals. The authors recommend lessons from current policies to guide the next phase of e-mobility introduction, emphasizing the need for multi-level governance and stakeholder engagement. In their 2015 study, **Li et al**. focused on the interaction between government regulation and company

innovation when examining the commercialization of electric cars (EVs) in Shenzhen, China. They discussed the advantages of Shenzhen's approach, such as its innovative business models and financial sustainability, as well as areas for improvement, like standardizing EV technologies and investing in charging infrastructure. They also highlighted Shenzhen's unique model of government-enterprise cooperation, which has facilitated the adoption of EVs in public transportation, particularly buses and taxis. In order to boost the deployment of EVs, the authors proposed combining corporate innovations with favourable governmental laws. They also provided other cities and legislators with useful lessons**. Zhang et al. (2015),** evaluates the performance of electric vehicle (EV) policies in China, and identified defects in China's EV policy mechanism by comparing it with policies from other countries, suggesting that improvements are needed in subsidy and taxation policies, EV infrastructure goals, and R&D investment. They gave suggestion to enhance the performance of EV policies based on empirical analysis, such as establishing uniform standards for EV charging infrastructure and a charging pricing mechanism. **Tietge et al. (2016)**, studied electric vehicle (EV) policies and deployment in Europe, focusing on incentives and infrastructure. They analyzed the EV market shares and charging infrastructure in five major European markets: Germany, UK, France, Netherlands, and Norway. It provided a comparative analysis of EV markets and incentives across the countries studied, highlighting the importance of well-designed policies to ensure market uptake of electric vehicles. The paper concluded that financial incentives vary widely among the countries and cities, and well-designed policies are crucial for EV adoption. The study found that direct consumer incentives, such as subsidies, are crucial for EV uptake, alongside charging infrastructure availability. It suggested that transparent information and long-term policy support are essential for transitioning to electric mobility**. Bjerkan et al. (2016),** discussed Norway has been effective in promoting the use of battery electric vehicles (BEVs). They credit this achievement to the substantial subsidies that drive down the cost of BEVs relative to internal combustion engine vehicles (ICEVs). Notably, among these advantages are exemptions from VAT and purchase tax, which are significant considerations for more than 80% of BEV buyers in Norway. It has been observed that offering these up-front cost savings is the most effective approach to encourage the adoption of EVs. **Gujrathi et al. (2018),** discusses the current state of the EV market in India. Authors reviewed various government policies and initiatives aimed at promoting EV adoption, such as the National Mission for Electric Mobility (NMEM2020) and FAME India and identified challenges hindering EV growth in India, such as high vehicle expenses and lack of charging infrastructure, and suggests potential solutions like government incentives and infrastructure development. **Asran & Mohmad (2018**), explored the opportunities and confrontation of electric vehicles in India and the drive toward EVs as a sustainable replacement for fossil fuel-powered cars. They also emphasized the advantages EVs offer the environment and the widespread trend of EV adoption. They identified opportunities such as government initiatives, advancements in battery technology, and industry growth. Challenges include the cost and efficiency of EVs, demand generation, and infrastructure requirements. The study outlined India's progress and plans for EV implementation, aiming to transform its vehicle fleet to all-electric by 2030 as part of its commitment to reducing greenhouse gas emissions and oil expenses and concluded with the need for India to leverage opportunities and address

challenges to meet its ambitious EV goals, emphasizing the country's role in global environmental efforts. **Rietmann & Lieven (2019),** compared policy measures, such as tax breaks, traffic laws, and subsidies, put in place in 20 nations to encourage the adoption of electric vehicles (EVs). They evaluated the efficacy of these policies by looking at how they affected the market share of EVs in each nation. As case studies, the governing structures of the Netherlands and Brazil are examined, along with the effectiveness of their initiatives to promote electric vehicles. The significance of cooperative governance and a variety of governmental incentives for raising EV penetration was highlighted by the findings. **Barkenbus (2020),** discussed the ongoing transition from conventional vehicles to EVs, highlighting the uncertain timeline but inevitable shift towards electric transportation. It emphasized the role of governments in promoting EV adoption through consumer incentives and regulations, which are crucial for overcoming market forces that may resist the transformation. Author identified battery research and development as a pivotal factor that will likely make EVs more attractive to consumers, despite current limitations such as high costs and limited driving range. **Bansal & Goyal (2020),** investigated the need for EVs in India, the technologies available, and the government's policy decisions and investments in the EV segment and suggested that electrifying public transport and two-wheelers could significantly impact the EV market as they identified major barriers to EV growth in India, such as high prices, limited range, inadequate charging infrastructure, and the lack of a policy for battery recycling. **Goel et al (2021),** the lack of customer response to the Indian government's efforts to promote electric vehicles (EVs) is discussed. It attempts to determine and examine obstacles to India's adoption of EVs. The main issues impeding the adoption of EVs, they discovered, are unclear government policy and family factors. It's interesting to note that consumers are less concerned about EV pricing and more focused on post-purchase maintenance support. **Asif et al. (2021),** did a literature review on antecedents of electric vehicles policies and discussed the importance of comprehensive policies that address both consumer and manufacturer aspects, including incentives like soft loans, tax cuts, and rebates to stimulate electric vehicle (EV) adoption. **Singh et al. (2021),** reviewed the Indian EV market and global EV evolution, highlighting India's lag in EV deployment compared to countries like the USA, China, Norway, and Germany. The study emphasized the crucial role of the Indian government in providing research funding, developing charging infrastructure, and coordinating activities between states and EV-related businesses to support the EV sector. The paper advocates for policy changes to promote EV adoption and provides suggestions for the private sector and educational institutions to pursue faster adoption of EVs, highlighting the need for a strong research ecosystem and technological advancements in India. **Ansab & Kumar (2022**), investigated the indirect impact of government financial incentives on the adoption of electric cars by Indian consumers, as opposed to the direct effect. The authors recommended that policymakers persist in offering financial incentives because they have the potential to improve consumer confidence and attitude towards electric cars, which in turn may result in increased acceptance and adoption. **Hema & Venkatarangan (2022**), discussed the environmental and efficiency benefits of EVs compared to internal combustion engine vehicles, emphasizing their crucial role in reducing greenhouse gas emissions. Studies highlight significant barriers such as the need for advanced battery technology, efficient charging infrastructure, and effective EV-grid

integration. Research specific to India reveals rapid growth in EV sales, driven by government policies and consumer incentives, with a notable preference for BEVs. However, challenges like inadequate charging infrastructure and battery management persist. Future advancements in battery technology and grid integration are identified as critical to sustaining EV adoption and achieving broader environmental goals.

RESEARCH METHODOLOGY

For this study, we will compare the polices of 4 states namely Punjab, Haryana, Uttar Pradesh and Delhi. This study is descriptive in nature as it tries to methodically characterize and contrast the current policies and incentives. The study is entirely based on secondary data extracted from government reports and websites. The comparison's criteria include the following parameters that come from state-issued policies: the creation of jobs, the development of charging infrastructure, the promotion of green zones, manufacturing incentives, financing for R&D, support from subsidies, road tax exemptions, and battery recycling. This study will provide insights into the merits and drawbacks of the EV policies across the selected states.

ANALYSIS AND FINDINGS

Here are certain parameters of EV policies that can be broadly classified into the following:

Table 1: Shows the presence and absence of parameters in these 4 states EV Policy.

PARAMETERS	PUNJAB	HARYANA	U.P.	DELHI
SUBSIDY SUPPORT TO CUSTOMERS	✓	✓	✓	✓
ROAD TAX & EXEMPTIONS	✓	✓	✓	✓
MANUFACTURING INCENTIVES	✓	✓	✓	✓
RESEARCH & DEVELOPMENT FUNDS	✓	✓	✓	x
CHARGING INFRASTRUCTURE DEVELOPMENT	✓	✓	✓	x

BATTTERY RECYCLING	✓	✓	✓	✓
EMPLOYMENT GENERATION	✓	✓	x	✓
SKILL DEVELOPMENT	✓	✓	x	✓
GREEN ZONES CREATION AND PROMOTION	x	x	x	x
CONSUMER AWARENESS CAMPS	x	✓	x	x

- **EV PENETRATION TARGETS:** It outlines electrification goals for public transport and registered vehicles across Haryana, Punjab, Delhi, and Uttar Pradesh.

Table 1.1.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
• Complete electrification of public transportation buses by 2029; beginning in 2024 in places like Gurgaon and Faridabad. • By 2030, government fleets and logistical firms will only use electric vehicles.	• By 2027, 25% of annually registered vehicles will be electrified.	• Of all newly registered automobiles, 25% are electric. • By March 31, 2023, 50% of the delivery service providers' fleet operating in Delhi must be electric, and by March 31, 2025, 100% of the fleet must be electric.	• E-bus: 400, 2W – 2 lacs, 3W - 50,000, and 4W - 25,000 • Government fleets to be all electric

- **SUBSIDY SUPPORT FOR CUSTOMERS:** Details the financial incentives offered to buyers of electric vehicles, including subsidies based on vehicle type and price.

Table 1.2.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
• BEV: Up to 6 lakh for vehicles priced between 15 and 40 lakh, and up to 10 lakh for vehicles priced between 40 and 70 lakh. • HEV: Up to 3 lakh on vehicles priced between 15 and 40 lakh, and 5 lakh on vehicles priced between 40 and 70 lakh.	• 2W: Max subsidy of upto ₹10,000 per car • 3W: Max subsidy of upto ₹30,000 per car • 3W(N1): Max subsidy of upto ₹50,000	• 2W: Maximum subsidy of ₹30,000 for each car • 3W: Maximum subsidy of ₹30,000 for each car	• 2W: up to ₹5000 per car at 15% of the ex-factory price • 3W: up to ₹12000 per car at 15% of the Ex -factory price • 4W: up to ₹1 lakh per car at 15% of the Ex -factory price

- **ROAD TAX AND REGISTRATION EXEMPTION:** Lists the road tax exemptions and registration fees for electric vehicles in the four states.

Table 1.3.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
Road tax exemptions of 100% and 75% are available for 4Ws. For 2 and 3Ws, registration is ₹200, while for 4Ws, it is ₹500.	Complete Exemption	Complete Exemption	100% on every EV bought and registered in the UP during the three years following the policy's announcement.

- **SCRAPPAGE INCENTIVE:** This indicates the absence or presence of incentives for scrapping old vehicles in exchange for electric ones.

Table 1.4.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
Not Applicable	Not Applicable	2W: ₹5,000 and 3W: ₹7,500	Not Applicable

- **MANUFACTURING INCENTIVE:** This describes the financial support provided to EV manufacturers, including subsidies based on fixed capital investment.

Table 1.5.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
FCI in the following amounts: • For micro industries, about 25% of FCI up to a limit of ₹15 lacs. • 20% of fixed capital investment for small and medium-sized businesses, up to approximately of ₹40 and ₹50 lacs, respectively. • 10% of fixed capital investment, up to a maximum of ₹10 crore, for the first two units, under big industries, in each of the following segments: manufacturing of hydrogen storage and fueling equipment, battery and charging equipment, and electric vehicles (EVs) (two-wheelers, three-wheelers, four-wheelers, buses). • In addition, on a case-by-case basis, specific incentives will be granted to lithium battery production plants in accordance with their requirements for mega, mega integrated car plans and ultra-mega batteries. • A 25% subsidy, up to ₹50 crore, will be given for sustainable green measures on the project's total fixed capital investment (not including land acquisition and development costs, preliminary and pre-operative expenses, and consultation fees) for micro, small, and medium-sized businesses and major enterprises.	The 2017 Punjab Industrial & Business Development Policy would provide benefits to the EV manufacturing facilities.: additionally • Concessional land; assistance for the building of infrastructure; and repayment of stamp and registration duty fees • GST payback • Subsidy for employment • Special reductions for electric vehicle units in relation to Giga factory tractor and battery production units will be offered on an individual basis.	Not Applicable	• For the first two Ultra Mega Battery projects, a 30% qualifying fixed capital investment subsidy is available, up to a maximum of ₹1000 crore. • Up to ₹500 crore, the first five massive EV and battery projects will be eligible for a 20% discount on qualified fixed capital investments. • Up to ₹90 crore, or 18% of qualifying fixed capital investment, would go toward the large EV and battery project. • MSME qualifying FCI at 10%, up to a maximum of ₹5 crore

- **RESEARCH AND DEVELOPMENT FUND:** It highlights the funding available for EV-related technological research and development.

Table 1.6.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
Help up to 50%, or ₹1 crore , for the technologies related to charging and ₹5 crore for automotive technology.	Emphasis on car level and battery technologies	Not Applicable	Emphasis on battery, motor technology

- **CHARGING INFRASTRUCTURE INCENTIVE:** This summarizes the subsidies offered for setting up EV charging stations.

Table 1.7.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
A subsidy on capital of 25 per cent of the equipment or machinery value of charging station , up to a maximum of ₹10,000,000, is offered for stations above 100 volts, and a capital subsidy of 25% or ₹30,000,000 is offered for stations below 100 volts.	Level 1 chargers cost ₹3000 per charge point, whereas Level 2 chargers cost ₹10000 per charge point.	Up to ₹6000 per charging point, the Delhi government's National Capital Territory would fully fund the acquisition of charging equipment.	20% of the total cost as a capital subsidy, up to ₹10 lakh per unit station,

- **BATTERY RECYCLING AND REUSABLITY**: Shows the states' initiatives to promote and fund battery recycling**.**

Table 1.8.

HARYANA	PUNJAB	DELHI	UTTAR PRADESH
Actively encouraging and funding the recycling of batteries.	Actively encouraging and funding the recycling of batteries.	Intends to establish battery collection facilities and work with producers to engage in recycling.	Actively encouraging and funding the recycling of batteries.

- **EMPLOYMENT GENERATION INCENTIVES:** It details the subsidies provided to create jobs in the EV sector.

Table 1.9.

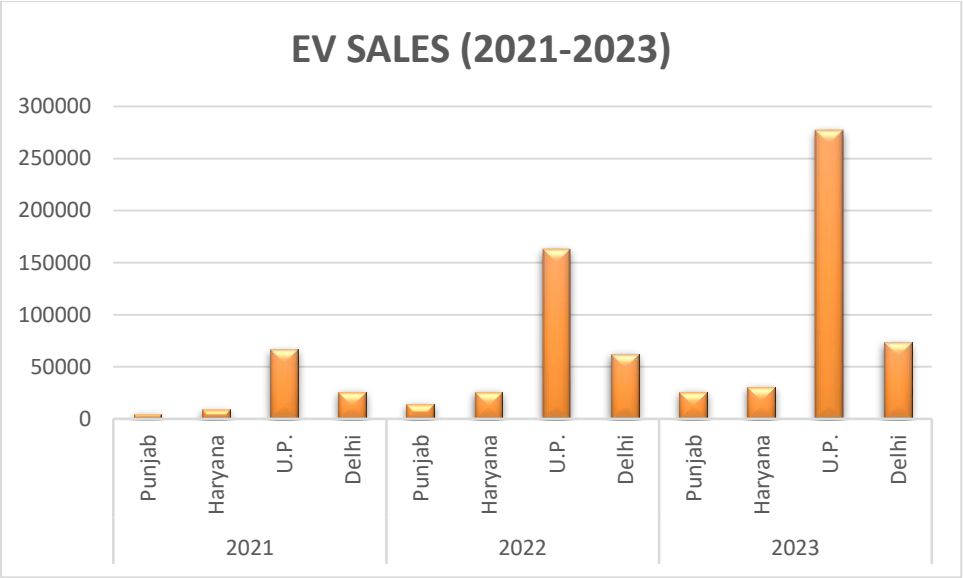
HARYANA	PUNJAB	DELHI	UTTAR PRADESH
• In order to strengthen the capability of Haryana residents who are skilled, semi-skilled, or unskilled and possess a Haryana Resident Certificate, the employment generating subsidy will be prolonged to manufacturing units solely created in category blocks B, C, and D. • For ten years, an annual subsidy of ₹48,000 per employee will be provided for direct payroll employment or contracts with valid ESI/PF.	A maximum of five years' worth of subsidies, totalling ₹36,000 for male employees and ₹48,000 for female, SC/ST, and OBC employees.	Not Applicable	For all specified manufacturing projects, stipend reimbursement will be given once at a rate of ₹5,000 per employee year, up to a limit of the first 50 employees.

- **FOCUS ON SKILL DEVELEOPMENT:** It discusses the training and skill development programs for various roles within the EV ecosystem.

Table 1.10.

HARYANA	PUNJAB	DELHI	UTTAR PRADERSH
Training provided by the state and ITI to enhance the skills of different players in the electric vehicle ecosystem	Encourage the development of skills by collaborating with pertinent parties. .	The establishment of skill centres for employment creation and training relevant to jobs in the EV eco-system.	Not Applicable

From the data presented in tables 1 to 1.10, it's evident that Haryana, Punjab, Uttar Pradesh, and Delhi all are working on four main parameters among all the parameters: subsidies for customers, road tax and registration exemptions, manufacturing incentives, and battery recycling initiatives. Each state offers varying levels of subsidy support based on the type of vehicle purchased. Notably, three states provide full exemptions on road tax and registration fees. Haryana's EV policy is the most comprehensive, covering a wide range of parameters, while Uttar Pradesh has the least extensive policy. None of the states are currently focusing on the creation and promotion of green zones. To boost EV adoption, consumer awareness about the benefits of EVs is crucial. Currently, only Haryana is actively working on this aspect. Additionally, Punjab, Haryana, and Delhi are implementing measures for employment generation and skill development in the EV sector.



(Source: EV Dashboard)

Table 2: Total EV Sales in Punjab, Haryana, U.P. and Delhi of period 2021-2023:

YEAR	PUNJAB	HARYANA	U.P.	DELHI
2021	4643	8661	66702	25815
2022	14054	25859	162857	62265
2023	25741	30489	277300	73487

The table presents the total sales of Electric Vehicles in four Indian states- Punjab, Haryana, Uttar Pradesh and Delhi from 2021 to 2023.

- Punjab: EV sales increased significantly from 4643 units in 2021 to 14054 units in 2022 and further to 25741 units in 2023.
- Haryana: The sales grew from 8661 units in 2021 to 25859 units in 2022, reaching 30489 units in 2023.
- Uttar Pradesh: This state saw a substantial rise from 66702 units in 2021 to 162857 units in 2022 with an even greater increase to 277300 units in 2023.
- Delhi: EV sales increased from 25815 units in 2021 to 62265 units in 2022, and then to 73487 units in 2023.

Uttar Pradesh exhibited the overall growth in sales while Punjab showed the largest percentage increase relative to its initial sales figure. This upward trend reflects a growing acceptance and adoption of EV in these regions.

CONCLUSION

This study examines the steps that Indian states have made to boost the use of electric vehicles, highlighting the variations in the breadth and longevity of their policies. The goal of this study is to support policymakers in selecting practical EV deployment strategies. Some possible recommendations and ideas that could be made in light of the study include State-by-state EV policy harmonization is necessary to maintain uniformity and prevent conflicts between producers and consumers. There is also a need to run awareness campaigns to debunk EV fallacies and inform the public about the advantages of these vehicles. To

increase battery life, charging efficiency, and overall performance, it is vital to support EV research and development.

LIMITATIONS OF THE STUDY

This study is confined to examining the EV policies in Haryana, Punjab, Uttar Pradesh, and Delhi, recognizing that these may not fully represent the entire Northern region of India. Furthermore, the research is based on secondary data sourced from government reports and official websites, which may not encompass the most current developments or provide a complete perspective.

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