ISSN (ELECTRONIC): 2945-3135

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH & REVIEWS

journal homepage: www.ijmrr.online/index.php/home

DRIVING CHANGE: E-VEHICLES AS DIGITAL CATALYSTS FOR SUSTAINABLE RURAL EMPOWERMENT

Vani Y. D[1] & Dr. Vilas M. Kadrolkar[2]

[1]Research Scholar and Associate Professor, Department of Economics, Government First Grade College, Channapatna, Bengaluru South District. Karnataka, India.

[2]Senior Professor, Department of Studies and Research in Economics, Tumkur University, Karnataka, India.

How to Cite the Article: Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

https://doi.org/10.56815/ijmrr.v5si2.2026.219-230

Keywords	***Abstract***
sustainability, empowerment, catalyst, potential, insight	The global push for sustainable and eco-friendly transportation solutions has made the adoption of electric vehicles imperative. In India, EV adoption has shown promise, fuelled by diverse product offerings and supportive government policies. However, rural India lags behind in EV adoption, despite being a significant market. To unlock the untapped potential, understanding the needs, attitudes, and barriers of rural consumers is crucial. This research conducts a study of rural Indian consumers and offers valuable design insights for automotive companies to formulate effective future strategies. Electric Vehicles (EVs) have emerged as powerful agents of transformation, particularly within the context of sustainable development. In rural India, where socio-economic advancement is closely tied to access and mobility, EVs offer a unique opportunity to bridge gaps in infrastructure, digital inclusion, and environmental sustainability. This paper explores the role of EVs as digital catalysts for rural empowerment, analysing their potential to drive change through green technology, create employment, enhance connectivity, and foster inclusive growth. Based on literature review and the secondary research, the study identifies key barriers and enablers to EV adoption in rural regions. It offers actionable insights for policymakers, manufacturers, and community leaders to accelerate the transition to clean mobility while addressing the unique challenges of rural India.

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

1. INTRODUCTION

Mobility has always been a significant driver of societal advancement throughout human history. While transportation has always played a vital role in shaping civilisations by fostering connectivity and trade, it also accounts for 24% of direct global CO2 emissions ("World Energy Investment 2023", 2023). As humanity grapples with climate change and urban congestion in the twenty-first century, transportation is undergoing a radical shift. Electric mobility, fuelled by clean and renewable energy sources, has emerged as a ray of hope for tackling these global issues. Globally, the four-wheeler EV market has experienced exponential growth ("World Energy Investment 2023", 2023), surpassing 10 million units sold in 2022. Major markets, including China, Europe, and the United States, have witnessed substantial increases in EV sales. In tandem, emerging markets like India, Thailand, and Indonesia have shown promising growth in EV adoption, supported by varied product offerings by automotive companies and supportive government initiatives. Around 65% of India's population lives in rural regions (Government of India and Ministry of Finance, 2023) and is a critical contributor to the nation's socio-economic fabric. Their mobility choices significantly impact the country's long-term development trajectory and are a critical segment for EV manufacturers. The attempts taken by the government and businesses to produce and promote EVs are commendable, but the focus has been on urban areas. Despite the potential, the penetration of EVs in rural areas lags behind that of urban regions. The rural Indian market poses a unique set of challenges and opportunities. Understanding rural consumers' specific needs and attitudes is crucial to bridging the adoption gap and driving EV uptake in these regions. This study thus seeks to dive into the often-overlooked domain of rural India and investigate the electric mobility ecosystem from their perspective. Through a comprehensive analysis of consumer needs, design implications that will enable original equipment manufacturers (OEMs) to effectively cater to rural Indian consumers are identified. The design implications delve into various aspects, including consumer preferences, fears, and satisfaction levels with current internal combustion engine vehicles. By providing in-depth insights into rural consumers' perceptions towards EVs, the research endeavours to bridge the knowledge gap surrounding EV adoption in rural India and drive a positive and transformative impact on India's transportation landscape

2. BACKGROUND

Electric vehicles are being introduced in the Indian market as an innovative eco-friendly product as an alternative to conventional vehicles. The efforts not only planned to mitigate greenhouse gas emissions, but also help reduce the country's oil imports. The concept of sustainability has gained considerable attention in recent years as individuals and organizations recognize the impact of their actions on the environment and society. In the automotive industry, this has led to a shift to electric vehicles (EVs), which have a smaller carbon footprint and lower emissions. However, the mere production of electric cars is not enough for a sustainable future. Companies that manufacture and market electric vehicles must also adopt sustainable marketing practices that appeal to

environmentally conscious consumers. Mobility has always been a linchpin in the development of civilizations. In rural India, where 65% of the population resides, the lack of reliable, affordable, and sustainable transport has long hindered economic progress and access to essential services. As climate change and environmental degradation become pressing global concerns, the need for sustainable transport solutions is more urgent than ever. Electric Vehicles (EVs), traditionally perceived as an urban phenomenon, are now emerging as a viable option for rural communities. When coupled with digital infrastructure, EVs can catalyse a broader transformation by enhancing access to markets, education, healthcare, and employment. This research investigates the potential of EVs to act not merely as transport solutions but as digital enablers in the rural landscape. It delves into how EVs, powered by renewable energy and smart technologies, can contribute to a more inclusive and sustainable rural economy.

3. OBJECTIVES:

- To understand the role of Electric Vehicles as Digital Catalysts for Sustainable Rural Empowerment.
- To assess the socio-economic and environmental impact of EV adoption in rural areas.
- To explore how EVs can facilitate digital inclusion and access to services.
- To identify challenges and opportunities in implementing EV infrastructure in rural regions.

4. METHODOLOGY

The study is based on secondary data collected from various reports. Other information is also collected from reference books, various journals, government publications, Centre for Science, Technology and Policy Studies CSTEP, e-AMRIT, industry journals, periodicals, newspapers, magazines, annual reports of companies, statistical information from RTO Office, etc., past research and literature review served as the basis for this investigation. A number of research articles that have been published and compiled online. Google, Google Scholar, news, websites, researches, journals and other sources were searched to obtain secondary data.

5. LITERATURE REVIEW

A considerable amount of research has been conducted to investigate the adoption of electric vehicles (EVs) across different countries. Initially, most studies, mainly from 2017, focused primarily on the USA, followed by other developed countries like Germany and the UK (Kumar and Alok, 2020; Li et al., 2017). Subsequently, research on EV penetration and acceptance expanded to emerging markets, such as China (Li et al., 2020), India (Shetty et al., 2020), and Malaysia (Asadi et al., 2021). A review of existing literature on EV adoption in various contexts, including both developing and adopting EVs, consumer perceptions towards EVs (Masurali and Surya, 2018; Navalagund et al., 2020; Nazneen et al., 2018), purchase intentions towards EVs (Asadi et al., 2021), and attitudes towards EVs in different country-specific contexts, such as India, Malaysia, China,

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

Spain, Poland and the European Union (Afroz et al., 2015; Junquera et al., 2016; Khurana et al., 2020; Lewicki and Drożdż, 2021; Lo, 2014; Wang et al., 2018) revealed that there remains a significant knowledge gap regarding EV adoption in developing countries as compared to their developed counterparts (Tunçel, 2022). In an India focussed literature search around 25 papers were reviewed and the findings from the most relevant papers are listed as follows. Some of the reviewed research papers (Bhat et al., 2022; Jaiswal et al., 2021) collected data from the students enrolled in various colleges and universities in Bengaluru and the National Capital Region (NCR), respectively. (Ali and Naushad, 2022; Malik, 2021) surveyed respondents from Delhi and NCR. (Jain et al., 2022) study comprised respondents who were either willing to purchase or had already purchased an EV residing in the NCR. (Sriram et al., 2022; Verma et al., 2020) collected data from Bengaluru. (Shankar and Kumari, 2019) conducted studies in the cities and their adjacent suburban areas of - Delhi, Chennai, Mumbai, Kolkata, and Bangalore. (Upadhyay and Kamble, 2023) selected the cities that had existing EV infrastructure being installed by public and private entities. The respondents were drawn from the cities of Mumbai, Pune, Nashik, Thane, Gandhinagar, Ahmedabad, Vadodara, Surat, Chennai, Tiruchirappalli, Madurai, Visakhapatnam, Hyderabad, Bengaluru, Hubli, Mangalore, Kochi, New Delhi, Agra, Faridabad, Noida, Gurugram, and Ghaziabad. (Singh et al., 2023) conducted their study in the Himachal Pradesh state of India. (Bhattacharyya and Thakre, 2020) conducted interviews with 11 managers (experts from automotive domains) and 27 EV consumers (across the cities of Mumbai, Pune and Bengaluru in India).

6. RESULT AND DISCUSSION

Electric Vehicle Adoption is gathering momentum in India. The proliferation of Electric Vehicles and charging capabilities has led to a notable increase in public charging stations within major metropolitan cities. However, there is a lot of opportunity for Electric Vehicle Adoption in the rural landscape. Tata Motors, leading manufacturer of electric four-wheelers in India, has disclosed that about half of their 2023 sales are from rural areas and small towns. In two-wheeler EV sales as well, the story is not different. “Two-wheelers account for a staggering 90% of India's EV market, with more than 65% traversing the rural terrain” says Hema Annamalai- founder of Ampere Motors. While urban areas have witnessed significant strides in the adoption of electric vehicles (EVs), the scenario in rural India presents a unique set of challenges and opportunities

Recent data from the Ministry of Road Transport and Highways reveals a striking trend: EV registrations in rural and semi-urban India have grown by 34% year-on-year, outpacing urban centres’ 28% growth. As we witness this transformative shift, TelioEV stands at the forefront of revolutionizing electric mobility across India's diverse landscape.

- **The Rural EV Revolution: Current State and Growth Trajectory**

The narrative of electric vehicles being primarily an urban phenomenon is rapidly changing. Rural India is embracing electric mobility at an unprecedented pace, driven by economic necessities and

environmental awareness. According to Inc42's 'India's Electric Vehicle Startup Report 2025', rural India now accounts for 55% of two-wheeler sales nationwide, marking a 13% year-on-year increase. Even established manufacturers like Tata Motors have reported that approximately half of their 2023 electric four-wheeler sales came from rural areas and small towns.

This growth is particularly significant considering that the Indian Council for Research on International Economic Relations (ICRIER) reports rural households spending approximately 18% of their monthly income on transportation, with fuel costs accounting for more than half of this expenditure. The shift toward electric mobility in rural India represents not just a technological transition but an economic necessity that could substantially improve rural livelihoods.

Global environmental consciousness has sparked a transformative phase, and electric two-wheeler adoption has surged dramatically. In India, between 2021 and 2023, an estimated 6,70,000 Electric two-wheelers were registered, with the segment expanding three-fold in FY 2022-2023. Today, India has approximately 1.4 million registered electric two-wheelers, highlighting a growing acceptance among consumers in the Indian market.

A key development in recent times has been the turnaround in consumer sentiment in rural markets, pushing demand for electric two-wheelers. The higher running costs of traditional internal combustion engine vehicles, subsidised power, homegrown innovation, engineering, and manufacturing, combined with strong government support and myriad other factors have led to people in rural areas embracing the trend of owning two-wheeler EVs. This remarkable uptick in the rural and semi-urban areas is poised to bring about a substantial positive impact.

Table -1: Growth of the Indian EV Industry

Year	Two wheelers	Three wheelers	Four wheelers	Buses	Goods carriers	Total	YOY growth(%)
2013	1,989	36	374	1	43	2,443	
2014	1,678	12	481	3	20	2,194	-10.19
2015	1,454	5,399	678	3	19	7,553	244.25
2016	1,459	46,561	621	4	54	48,699	544.76
2017	1,523	82,238	820	17	533	85,131	74.81
2018	16,572	1,08,289	988	49	657	1,26,555	48.65
2019	29,756	1,31,375	847	468	53	1,62,499	28.40
2020	28,632	88,227	3,179	88	13	1,20,139	-26.06
2021	1,53,523	1,53,679	12,112	1,177	1,084	3,21,575	167.66
2022	6,22,337	3,37,335	37,792	1,932	453	9,99,849	211.00
Total	**8,58,923**	**9,53,151**	**52,898**	**3742**	**2,929**	**18,76,637**	-

Source: Vahan Dashboard

From the above Table it is clear that,despite the challenges the EV market in India is growing steadily from 2013 till date with increasing awareness and the Government support.The EV (Electric Vehicle) industry is emerging as a transformative sector. Today, the environmental politics due to

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

climate change prioritize the need to use renewable energy. Referring to renewable energy, a noteworthy mention goes to Electric vehicle industry. Today, the key conquest for researchers is how Digitalization can transform the EV industry. EVs can facilitate digital inclusion and access to services by improving transportation accessibility, reducing reliance on traditional services, and promoting digital literacy. This is achieved through enhanced mobility, innovative digital interfaces, and the integration of smart technologies within the EV ecosystem.

- **Vast Digital Opportunities in the EV Industry**

When we explore Digital opportunities in the EV industry, there are no limitations. The technology relies heavily on electricity to integrate its systems. EVs are capable of assistance systems, health monitoring, battery management systems, big data analytics, auto-driving mode, and much more. We will explore these digital technologies with respect to the EV industry in detail later in this article. Hence, with greener & cleaner solutions, lower carbon emissions, and digital opportunities, the EV industry takes a strong edge over the current vehicle industry.

- **What Opportunities does Digitalization bring to the EV Industry?**

According to Robert McDonald, "With digital technology it is now possible to have one on one relationships with every consumer in the world." Digitalization improves business insights using the tools that the digital world offers to the EV industry. Whether it is about building collaborative spreadsheets to work on or presenting the growth chart of the year to the team, Digitalization makes the whole process flexible and efficient.

Digitalization also improves the overall supply chain process in EV organizations. Replacing the manual processes of the supply chain with digital technology enables streamlined operations, enhanced management, and boosted visibility.

Customer experience grows exponentially with the use of digital technologies. Customers can approach the websites of EV companies, book service slots, or buy equipment's. They can also consult with experts in case they face issues with their EV vehicle.

In a nutshell,

Digitalization Offers the following Opportunities:

- Better business insights with the use of technologies like big data
- Optimizes supply chain by eliminating manual processing
- Building better customer experience through mobile apps and websites
- Enabling better decision-making to eliminate the disconnected systems

- **How EVs Promote Digital Inclusion and Service Access?**

- **Improved Transportation Accessibility:** EVs, especially when integrated with smart city infrastructure, can enhance transportation accessibility for all, including those with disabilities or limited access to public transport.
- **Reduced Reliance on Traditional Services:** EVs can reduce the need for certain traditional services, such as taxis or public transport, by providing personalized and flexible transportation options.

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

- **Enhanced Digital Interfaces:** EVs and related services (like charging apps) can be equipped with accessible digital interfaces, including features like screen readers and voice navigation, to cater to individuals with diverse needs.
- **Promotion of Digital Literacy:** The adoption of EVs can encourage digital literacy as users navigate EV charging apps, smart features, and related services.
- **Integration with Smart Technologies:** EVs can be integrated with smart city infrastructure, including real-time vehicle tracking, intelligent traffic management, and advanced charging systems, to enhance overall accessibility and inclusivity.
- **Sustainable Transportation Options:** EVs contribute to a more sustainable transportation system, which can improve air quality and reduce emissions, benefiting all citizens, particularly those with lower incomes.

Examples:

- **Charging Stations:** Public charging stations, particularly those located in accessible locations, can make it easier for individuals to access and use EVs.
- **Mobile Apps:** EV charging apps and other related apps can be designed to be accessible to people with disabilities, including those with visual or cognitive impairments.
- **Smart City Integration:** Smart city infrastructure, such as intelligent traffic management systems, can improve transportation efficiency and reduce congestion, benefiting all users.

By addressing transportation barriers and promoting digital literacy, EVs can play a significant role in fostering digital inclusion and ensuring access to essential services for all members of society.

Economic Impact of Rural Electrification: The financial benefits of EV adoption in rural areas are compelling. Electric two-wheelers offer operating costs of roughly 0.15-0.20 rupees per kilometre, compared to 2-2.5 rupees for petrol vehicles. For a rural user traveling 40 kilometres daily, this translates to annual savings of approximately 25,000-30,000 rupees—a significant sum that can be redirected to education, healthcare, or agricultural investments.

Economic Empowerment: To ensure inclusive growth, it is imperative that economic advancement benefits everyone, including members of marginalised and underprivileged communities. Increasing EV adoption in rural India has the potential to democratise access to clean and affordable transportation. When it comes to costs, e-scooters are more affordable and require low maintenance. This addresses a major concern in rural areas where incomes are often limited. The low operational costs make electric two-wheelers an attractive option for local entrepreneurs, promoting micro-mobility businesses and last-mile deliveries. Furthermore, EV adoption empowers women to access work and education beyond their immediate surroundings, which further promotes an equal and more prosperous society.

An Ecosystem of Employment Opportunities: As India's EV ecosystem grows, it creates new job opportunities for rural communities. New income sources can be generated by small businesses, landowners, and households through establishing public EV charging stations. Manufacturing, maintenance, and sales, which form a part of EV-related businesses, present opportunities to generate additional employment across various skill levels.

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

Energy Independence: Rural development has often been hindered by a lack of transportation access, especially for areas on the periphery of Indian villages that remain remote and marginalised. In such regions, access to petrol can be unreliable, and nearly half of the rural population is forced to walk for work and education due to high fuel costs. Electric two-wheelers provide an alternative that is independent of fossil fuels and can be charged using solar power, in turn reducing costs and increasing energy security. Moreover, improved mobility can bridge communities and foster regional socio-economic development.

The interests in electric two-wheelers are rising, as India's EV market continues to grow and evolve. However, there is a long road ahead, and several challenges persist in the journey to electrify mobility, such as limited access to financial and technological resources, scarcity of charging infrastructure, and a lack of awareness of the benefits of owning electric vehicles. Policy formulation is an evolving process, and India's two-wheeler EV policy has the potential to transform India to become a global leader. Meanwhile, unlocking the full potential of India's EV ecosystem will be crucial, which not only promises a greener future but one that is prosperous and equitable for all.

- **Challenges Facing Rural EV Adoption**

Electric Vehicle Adoption is gathering momentum in India. The proliferation of Electric Vehicles and charging capabilities has led to a notable increase in public charging stations within major metropolitan cities. However, there is a lot of opportunity for Electric Vehicle Adoption in the rural landscape. Tata Motors, leading manufacturer of electric four-wheelers in India, has disclosed that about half of their 2023 sales are from rural areas and small towns. In two-wheeler EV sales as well, the story is not different. "Two-wheelers account for a staggering 90% of India's EV market, with more than 65% traversing the rural terrain" says Hema Annamalai- founder of Ampere Motors. While urban areas have witnessed significant strides in the adoption of electric vehicles (EVs), the scenario in rural India presents a unique set of challenges and opportunities.

Despite the promising growth, several hurdles impede the widespread adoption of electric vehicles in rural India:

Infrastructure Limitations: One of the primary challenges hindering rural e-mobility adoption is inadequate charging infrastructure. Unlike urban areas with developing charging networks, rural regions lack sufficient charging stations, creating range anxiety among potential EV users. This infrastructure gap is compounded by unreliable electricity supply in many rural areas.

Economic Constraints: Building and maintaining electrified road infrastructure requires substantial upfront costs. Integrating electrified roads into the existing power grid may necessitate upgrades and expansions, incurring additional costs.The high upfront cost of four-wheeler EVs poses a significant barrier in rural communities, where average incomes tend to be lower than in urban areas. Although government schemes like the Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) have offered incentives, the initial phases primarily benefited urban areas.

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

Awareness and Service Gaps: Samkit Shah, cofounder of Jitendra EV, notes that "The adoption of electric vehicles in rural India faces several significant challenges, including high upfront costs, limited charging infrastructure, and a general lack of awareness". The scarcity of maintenance services further discourages potential rural EV users, who may worry about vehicle servicing and repairs.

Technological Hurdles: Overcoming technical challenges and ensuring the reliability and efficiency of electrified road systems will require ongoing investment in research and development.

Even though electrified highways have enormous economic potential, maximising benefits and minimising dangers requires careful design, funding, and policy support. Governments and transport authorities throughout the world are likely to find electrified roadways to be a more appealing alternative as cost and technological advancements make them more economically viable.

- **EV's Rural Electrification Solutions:**

At TelioEV, we recognize these challenges and are developing tailored solutions to address the unique needs of rural EV users:

- **Comprehensive Route Planning for Rural Connectivity:** The TelioEV app's route planning feature considers factors including your EV's range, charging station locations, and real-time traffic conditions to create efficient routes specifically optimized for rural travel. This innovative tool calculates your vehicle's remaining range and suggests strategic charging stops, addressing the range anxiety that often discourages rural EV adoption.
- **User-Friendly Payment Solutions:** Managing payments for charging sessions is streamlined through the TelioEV app, which supports various payment methods including credit cards, debit cards, mobile wallets, UPI, and net banking. This payment flexibility is particularly valuable in rural areas where cash transactions have traditionally dominated.
- **End-to-End Charging Infrastructure Development:** As a one-stop shop for EV charging needs, TelioEV offers comprehensive turnkey services for establishing charging infrastructure. This holistic approach encompasses site assessment, equipment procurement, installation, and ongoing maintenance—essential services for developing reliable charging networks in underserved rural locations.

7. OPPORTUNITIES FOR ELECTRIC VEHICLES IN RURAL INDIA

Government Initiatives Powering Rural EV Growth:

The government has implemented several initiatives to boost rural EV adoption:

- **FAME II and Rural Infrastructure Development:** The FAME II scheme allocated 20% of its 10,000-crore rupee budget specifically to rural charging infrastructure, resulting in over 2,700 charging stations established in non-urban areas by the end of 2024. This strategic investment has begun addressing the critical infrastructure gap in rural regions.
- **Decentralized Renewable Energy Integration:** The Ministry of New and Renewable Energy reports that 142 solar-powered charging stations have been established across rural India, with plans to reach 500 by the end of 2025. These renewable charging solutions are particularly valuable in areas with inconsistent grid electricity.

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

- **Expected Budget 2025 Support:** The auto industry anticipates that Budget 2025 will include increased government support for EV supply chain development, charging infrastructure, and rural demand stimulation. These potential initiatives could further accelerate rural EV adoption through direct incentives and schemes that strengthen the EV ecosystem.

➢ **Engineering for Rural Realities: Adaptation and Innovation**

The unique challenges of rural environments require specialized vehicle engineering:

- **Terrain-Adapted Vehicle Design:** Rural terrain presents distinctive challenges that urban-focused vehicle designs often overlook. Features like enhanced gradeability—a vehicle's ability to climb inclines—are critical when navigating the diverse topography of rural India. Companies are prioritizing these specifications, achieving metrics like 22% gradeability to ensure vehicles can handle varied rural landscapes.
- **Battery Technology Evolution:** Advanced Lithium Iron Phosphate (LFP) battery systems offering enhanced durability and performance in varying temperature conditions—like the 60V/210AH configurations appearing in rural-focused vehicles—provide the reliability necessary for rural operations. These technological adaptations are essential for addressing the specific demands of rural usage patterns.

8. **Future Outlook: 2025 and Beyond:** Looking toward 2030, we anticipate a rapid transformation in rural transportation that extends beyond technology to encompass new ownership models and integrated mobility systems. Several key trends will shape this evolution:

- **Declining EV Prices:** One of the most significant trends for 2025 is the projected drop in EV prices, making electric mobility more accessible to rural populations. As manufacturing scales up and battery costs decrease, more affordable EV models will enter the market, addressing a major adoption barrier.
- **Expanded Charging Networks:** The continued expansion of charging stations, including solar-powered options suitable for off-grid rural locations, will mitigate range anxiety concerns. TelioEV is committed to accelerating this development through our comprehensive infrastructure services.
- **Emergence of Mobility Ecosystems:** India is likely to witness the emergence of integrated mobility ecosystems rather than standalone vehicles in the coming years. These networks will create innovative transportation systems connecting villages to economic opportunities while prioritizing sustainability.
- **Specialized Rural Vehicle Designs:** Research suggests that vehicles with larger passenger capacities—like the emerging 7+1 seating configurations—will become central to rural mobility networks, creating efficient transportation systems tailored to rural communities' unique needs.

9. CONCLUSION

The adoption of electric vehicles (EVs) in rural India is both a challenge and an opportunity. While issues such as inadequate charging infrastructure, range anxiety, high upfront costs, and limited awareness persist, they are not insurmountable. Strategic initiatives, including government incentives, private investments, and community-driven solutions, can help overcome these barriers.

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

Renewable energy integration, such as solar-powered charging stations, offers promising alternatives to address electricity supply challenges in rural areas.

By addressing these structural and cultural barriers, rural India has the potential to play a pivotal role in the country's transition to sustainable mobility. This shift will not only support India's climate goals but also empower rural communities with cleaner, cost-effective transportation options, fostering economic growth and improving quality of life. Together, we can power the rural EV revolution, creating a greener, more economically vibrant India. Digitalization offers a range of opportunities to the Electric Vehicle industry, making them smarter and more efficient. With smart digital solutions, the EV industry will register exponential growth and efficiency in mass production and customer experience. EV companies can use technologies to gain better business insights and enhance decision-making. The IoT solutions, AI & ML, EV Telematics, and tech-driven infrastructure stands as strong elements in converting the EV industry into a smart EV industry and offer what customers are looking for in the digital era.

10. AUTHOR(S) CONTRIBUTION

The writers affirm that they have no connections to, or engagement with, any group or body that provides financial or non-financial assistance for the topics or resources covered in this manuscript.

11. CONFLICTS OF INTEREST

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

12. PLAGIARISM POLICY

All authors declare that any kind of violation of plagiarism, copyright and ethical matters will\take care by all authors. Journal and editors are not liable for aforesaid matters.

13. SOURCES OF FUNDING

The authors received no financial aid to support for the research.

REFERENCES

[1] Achtnicht, M., Buhler, G., & Harmeling, C. (2012). The impact of fuel availability on demand for Alternative-fuel vehicles. Transportation Research Part D: Transport and Environment.

[2] Araghi, Y., Krasen, M., Molin, E., & van Wee, B. (2014). Do social norms regarding carbon offsetting affect individual preferences towards this policy? Results from a stated choice experiment.

[3] Axsen, J., & Kurnai, K. S. (2011). Interpersonal influence in the early plug-in hybrid market: Observing social interactions with an exploratory multi-method approach. Transportation Research.

Vani D Y, Vilas M Kadrolkar (2026). *Driving Change: E-Vehicles as Digital Catalysts for Sustainable Rural Empowerment. International Journal of Multidisciplinary Research & Reviews, 5(si2), 219-230.*

[4] Bhattacharyya, D., & Pradhan, S. (2023). Barriers in Replacement of Conventional Vehicles by Electric Vehicles in India: A Decision-Making Approach. International Journal of Decision Support System Technology (IJDSST), 15(1), 1-20.
[5] Boxall, P. C., & Anamonics, W. L. (2002). Understanding heterogeneous preferences in
[6] Bunce, L., Harris, M., & Burgess, M. (2014). Charge up then charge out? Drivers'
[7] Caperello, N. D., & Kurnai, K. S. (2011). Households' stories of their encounters with a
[8] Chorus, C. G., & Kroesen, M. (2014). On the (im-)possibility of deriving transport policy
[9] e-AMRIT Portal, "Choose My Electric Vehicle," [Online]. Available: https://e-amrit.niti.gov.in/choose-my-electric-vehicle.
[10] e-AMRIT Portal, "Standards and Specifications," [Online]. Available: https://e-amrit.niti.gov.in/standards-and-specifications implications from hybrid choice models.
[11] Khurana, A., Kumar, V. V. R., & Sidhpuria, M. (2020). A Study on the Adoption of Electric Vehicles in India: The Mediating Role of Attitude. Vision, 24(1), 23–34. https://doi.org/10.1177/0972262919875548
new meta-analysis of psycho-social determinants of pro-environmental behavior.
[12] Pawar, S., & Pawar, A. (2022). 'Opportunities and Challenges of Electric Vehicles in India: A perceptions and experiences of electric vehicles in the UK.
[13] Rajper, S. Z., & Albrecht, J. (2020). Prospects of Electric Vehicles in the Developing. MDPI.
[14] Rapa, M., & Ruggieri, L. G. (2020). Environmental and Economic Sustainability of Energies, MDPI.
[15] S. Kumar, "Green Vehicle Rating for 2 and 3 wheelers in India," Alliance for an Energy Efficient Economy, New Delhi, 2018.
[16] S. Sripad, T. Mehta, A. Srivastava and V. Viswanathan, "The Future of Vehicle Electrification in India May Ride on Two Wheels," ASC Energy Letters, 2019.
[17] Satyendra Singh, N. S. (2021, July). Electric Vehicles in India.
[18] Role of Digitalization in Business Growth by Vaibhav Sharma 5 November 2024.
[19] Tata Nexon EV price, sales numbers, Tata EV sales, buying preferences | Autocar India.
[20] International Energy Agency (2023). World Energy Investment 2023.
[21] International Energy Agency (2023). World Energy Investment 2023.
[22] Government of India & Ministry of Finance (2023). Economic Survey of India.
[23] NITI Aayog (2022). India's Electric Mobility Transformation.
[24] TERI (2021). Policy Brief on Rural Electrification and Mobility.
[25] World Bank (2020). Mobility and Digital Inclusion in South Asia.
[26] CEEW (2022). Charging Ahead: EV Readiness in Indian States.
[27] Interviews and Surveys conducted (2024).
[28] Tata Nexon EV price, sales numbers, Tata EV sales, buying preferences | Autocar India