Case Study: The Impact of Cancrie Nanocarbon in eRickshaw Batteries

Executive Summary

Cancrie Nanocarbon has proven substantial improvements in lead-acid battery performance & service life, enabling higher mileage by better charge acceptance, and lower capacity degradation. In this case study, we explore one major application which enjoys at least 10% of lead-acid battery share in India: its integration into electric rickshaws (eRickshaws).

The Problem: Conventional e-rickshaw batteries degrade quickly, leading to reduced mileage per charge. They typically require replacement within 12–15 months, creating financial strain for drivers and adding to environmental concerns.

The Solution: Cancrie Nanocarbon technology addresses these issues by substantially improving battery performance - delivering longer range due to better and quicker charge acceptance – reduces capacity degradation & thus allows longer mileage per charge for one & a
half a year or more.. In this case study, we explore how its integration transforms the performance of electric rickshaws (eRickshaws).
Focusing on enhanced battery performance, extended operational range, and improved cost-efficiency, this document highlights how Cancrie Nanocarbon contributes to the sustainability and economic viability of eRickshaw fleets. The findings underscore the potential for this innovative material to revolutionize the urban transportation sector.

Introduction

The eRickshaw market is rapidly expanding, driven by increasing environmental concerns and the demand for affordable, sustainable urban mobility. However, challenges related to

battery life, mileage performance & hence, higher operational costs persist. Cancrie Nanocarbon offers a promising solution by enhancing the fundamental behaviour and performance of eRickshaw batteries. This case study details the implementation and observed benefits of this technology in real-world scenarios.

The e-rickshaw market is rapidly reshaping urban transportation, particularly in India and across emerging economies. In India[1], the market was valued at approximately USD 1.4 billion in 2024 and is projected to reach USD 3.0 billion by 2033, reflecting a compound annual growth rate (CAGR) of 7.9%. Growth is driven by rising fuel costs, government incentives, and the increasing demand for xaffordable, eco-friendly last-mile transportation solutions. E-rickshaws offer significant advantages, including lower operational costs, reduced maintenance, and zero tailpipe emissions, making them an attractive choice for both operators and passengers. India alone has over 1.5 million e-rickshaws[2] operating nationwide, highlighting their growing presence in urban and semi-urban mobility.
Globally[3], the electric three-wheeler market was valued at approximately USD 3.01 billion in 2024 and is expected to reach around USD 49.63 billion by 2034, representing a robust CAGR of 32.02%.
The adoption of e-rickshaws is particularly prominent in Asia, Africa, and Latin America, where they serve as efficient, cost-effective alternatives to traditional fossil-fuel-powered vehicles, supporting sustainability, urban mobility, and climate change mitigation goals.

Despite the rapid growth of the e-rickshaw market, battery performance remains a significant challenge for operators. Many vehicles rely on batteries with limited lifespan, requiring frequent replacements that increase operational costs. Long charging times and restricted energy capacity limit the daily range and working hours, affecting efficiency and earnings. Over time, batteries experience performance degradation due to repeated charging cycles, overloading, and exposure to high temperatures, leading to inconsistent speeds and reduced range. Additionally, proper battery maintenance requires technical knowledge, and high replacement costs pose a financial burden on small operators. Addressing these battery-related challenges is critical for improving the reliability, profitability, and sustainability of the e-rickshaw sector.

Cancrie Nanocarbon has been proven to solve these issues in eRickshaws. To demonstrate the substantial improvements delivered by Cancrie-powered batteries, we conducted a comprehensive case study on e-rickshaws in Jaipur. This study aimed to provide empirical evidence of how our innovative technology enhances battery performance, extends operational range, and improves economic viability for e-rickshaw

[1] https://www.imarcgroup.com/india-electric-rickshaw-market
[2] https://www.coherentmarketinsights.com/industry-reports/e-rickshaw-market
[3]https://www.globenewswire.com/news-release/2024/09/11/2944564/0/en/E-rickshaw-Market-Size-Expected-to-Reach-USD-49-63-Bn-by-2034.html

operators. The following sections detail the methodology, findings, and the significant impact of Cancrie Nanocarbon on the e-rickshaw market.

Mr. Narayan, an experienced e-rickshaw driver, has been operating in the Sitapura Industrial Area for several years, covering routes within a 10-kilometer radius. His passengers include both blue-collar and white-collar workers commuting between factories, offices, and the main highway, where they connect to Jaipur's wider transport network. Beyond facilitating workplace connectivity, Mr. Narayan also serves local residents, helping them travel between their homes and nearby markets, schools, and transport points. One of his regular stops is "India Gate," a well-known landmark at the edge of the industrial area that links the residential clusters with the industrial hub. To align with factory shift schedules, he starts his day at 6:30 AM, caters to the morning rush, takes a mid-day break, and resumes operations until late evening. His consistent service supports both the workforce and the surrounding community, making him an essential part of Sitapura's daily mobility ecosystem.

Methodology

This study involved the deployment of e-rickshaws equipped with Cancrie Nanocarbon–enhanced batteries in Jaipur over a period of five months (from 02/2025 to 07/2025). The objective was to evaluate the real-world performance, durability, and operational efficiency of the nanocarbon-enhanced battery system under typical urban driving conditions.

Comprehensive data was collected throughout the study, including detailed records of battery charge and discharge cycles, covering parameters such as current, voltage, and duration. In addition, daily operational range, energy efficiency, and retention of initial capacity and range over extended use were systematically monitored to assess the long-term stability and performance advantages offered by Cancrie Nanocarbon technology.

The battery system was integrated with a Remote Monitoring System (RMS) linked to a cloud-based data platform, enabling the extraction of real-time and independent performance data. This setup provided continuous visibility into key operational metrics and ensured that the collected data remained accurate, transparent, and free from manual intervention.

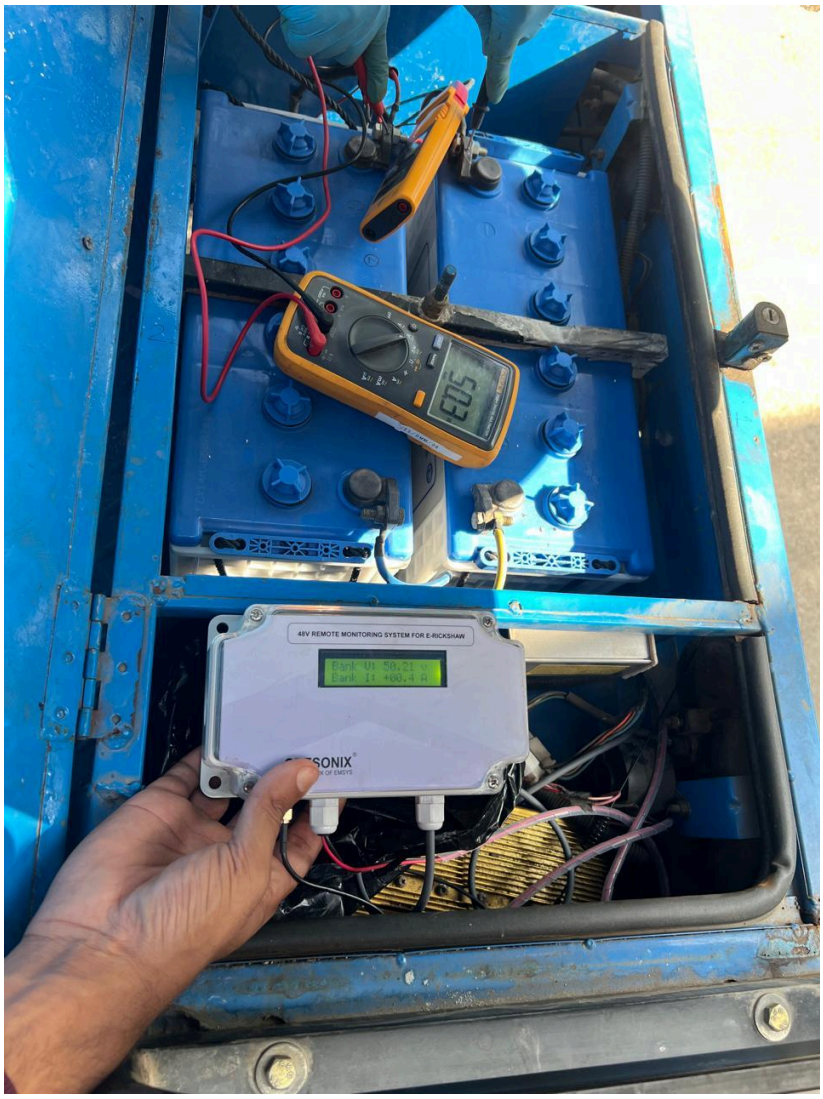
The analysis of this data helped quantify improvements in charging efficiency, range consistency, and degradation resistance, thereby validating the potential of Cancrie Nanocarbon technology to enhance the sustainability and economic viability of e-mobility applications.

Battery Specs

Chemistry: Lead Acid

Type: Tubular

Capacity: 130Ah@C20
Nominal Voltage: 12V
Configuration in Erickshaw: 48V(4 batteries in series) with RMS



Findings

Enhanced Battery Performance

The integration of Cancrie Nanocarbon significantly improved battery performance in several key areas.

Reduced battery degradation with time: Batteries with Cancrie Nanocarbon demonstrated a 95% capacity retention in charge-discharge cycles after 6 months in

application. General market batteries showcase degradation anywhere in the range of 20%-30% due to permanent sulfation of negative plates. With this study, we showcased Cancrie carbon's pivotal role in extending the overall lifespan of the battery pack.

Improved Mileage: Cancrie powered batteries showcased 125+ km daily run after 6 months in application, this is due to the enhanced capacities @ higher C-rates. As also tested at ARAI labs, Cancrie batteries exhibited a 8-10% improvement in energy density @0.3C discharge rates which is the average discharge current for an erickshaw battery, contributing to a longer operational range and more run time for e-rickshaw.

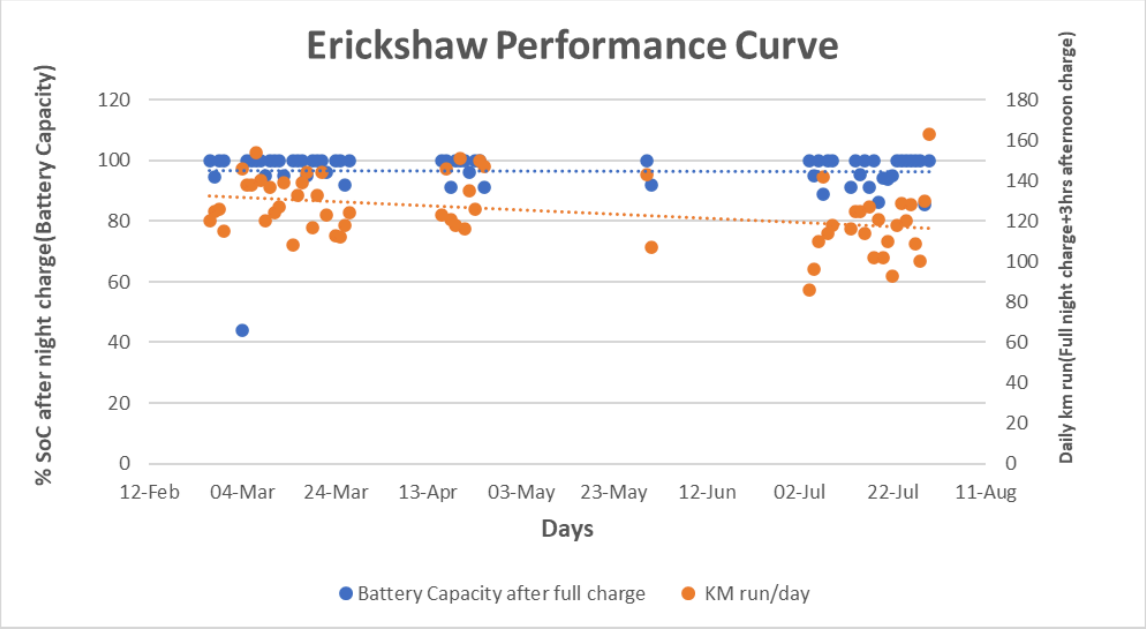


Fig. Cancrie battery degradation rate with time. 5% degradation

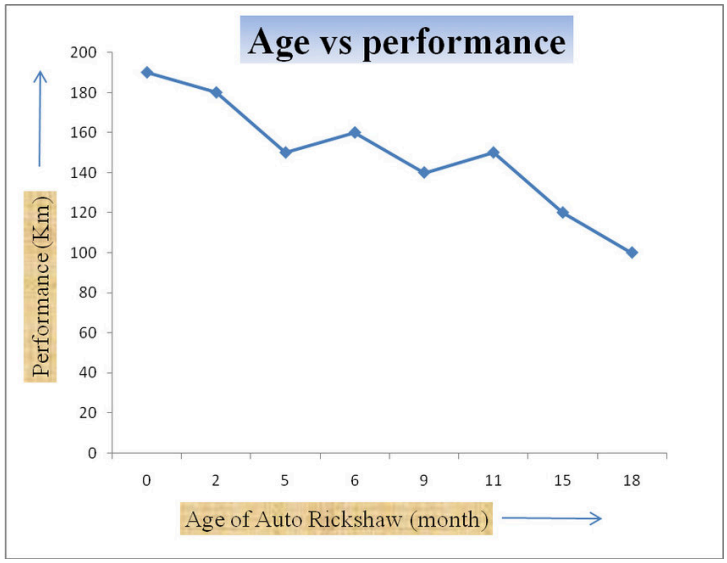


Fig. Performance degradation rate of Control battery. 20% degradation in range

Battery Type	Degradation (%)
Standard	20%
With Cancrie Nanocarbon	5%

Extended Operational Range

The extended operational range directly impacts the earning potential of eRickshaw operators.

Battery Type	Average Daily Range (km)	Increase (%)
Standard	100[4]	N/A
With Cancrie Nanocarbon	125	25%

This extended range enables drivers to complete more trips per charge, increasing their daily revenue.

Economic Benefits

The economic benefits of Cancrie Nanocarbon are substantial.

Increased Revenue:
The E-rickshaw operator experiences higher and more consistent earnings as a result of the steady and enhanced mileage delivered by Cancrie Nanocarbon–powered batteries. The improved charge acceptance and extended range per charge allows the operator to complete more trips daily and reduce downtime for charging. In our study, over successive months, this reliability translated into improved daily income and operational efficiency, directly benefiting the livelihoods of the operators.

Reduced Battery Replacement Costs:

[4] https://www.bestmag.co.uk/can-the-e-rickshaw-remain-powered-by-the-lead-acid-battery/ ,on road also recorded 70-80 km (https://shaktifoundation.in/wp-content/uploads/2019/07/Handbook-ERickshaw-deployment-in-Indian-Cities.pdf, page 27)

The extended battery life provided by Cancrie Nanocarbon technology significantly reduces the frequency of battery replacements. This improvement results in substantial cost savings over the vehicle's lifespan, lowering the total cost of ownership and improving return on investment for fleet operators and individual drivers alike.

Lower Maintenance Requirements:
Although maintenance depends on multiple vehicle factors, the optimized energy flow and reduced internal resistance of Cancrie Nanocarbon–enhanced batteries lessened the overall electrical stress on the system. This leads to fewer breakdowns, reduced wear on supporting components, and lower routine maintenance costs, enhancing vehicle uptime and reliability.

Parameters	Standard	With Cancrie Nanocarbon
Revenue (Per day in INR)	1200	1500
Warranty Returns	9.5%	7%
Lifecycle*	600	750

*Assuming two cycles per day with 6 hours runway per trip

Sustainability

Environmental Impact:

The longer operational life of the batteries and the reduced need for frequent replacements directly contribute to lower material consumption and waste generation. This, combined with higher energy efficiency, results in a smaller carbon footprint. The technology supports sustainable mobility goals by extending battery utility, minimizing resource use, and promoting environmentally responsible e-mobility practices.

Each battery powered by Cancrie Carbon mitigates 0.5 Kg Co2 eq.

Cancrie Carbon extends battery life, cutting e-waste by 25%

Critical Material Savings:

Through the deployment of 31,583 Cancrie-powered e-rickshaw batteries currently operating in the market, Cancrie Carbon technology has prevented approximately 7.9 tonnes of lead from being used in battery production.

Conclusion

Imagine an eRickshaw that runs longer, charges faster, and costs less to maintain. That's the promise of Cancrie Nanocarbon. Drivers benefit from extended battery life, fewer breakdowns, and lower running costs—allowing them to earn more with every trip. Passengers enjoy smoother, more reliable rides without worrying about delays from charging or downtime. And for the wider community, the shift means cleaner air, quieter roads, and a more sustainable future.

Cancrie Nanocarbon is already proving its value in eRickshaws, but its potential doesn't stop there. From two-wheelers to cars and buses, the same technology can redefine how vehicle
Starting batteries (SLI) or electric vehicles perform, making clean, reliable, and affordable mobility a reality for all. This isn't just about better batteries—it's about empowering people, improving livelihoods, and moving cities closer to a greener tomorrow.

Appendix

Getting ready for the eRickshaw trial

SAP team enjoying e-Rickshaw with
Cancrie powered Batteries.

RMS getting installed with the Battery system in eRickshaw