JOURNAL OF ELECTRONIC VOLTAGE AND APPLICATION
e-ISSN: 2716-6074

JEVA

Vol. 6 No. 2 (2025) 53-60
https://publisher.uthm.edu.my/ojs/index.php/jeva

Economic Viability Analysis of Electric Bikes over Conventional Bikes

Praveen Kumar[1]*

[1] *Department of Electrical Engineering, UIT RGPV, Bhopal, 462033, INDIA*

*Corresponding Author: sahupraveen@rgpv.ac.in
DOI: https://doi.org/10.30880/jeva.2025.06.02.005

Article Info

Received: 10 March 2025
Accepted: 18 September 2025
Available online: 9 December 2025

Keywords:

Electric two-wheelers, total cost of ownership, internal combustion engine, battery replacement cost, EV calculator pro, sustainable transport, India

Abstract

In India, two-wheelers have taken over the transportation industry, with a large portion of the vehicles sold in the country and being used as a major means of transportation. The trend of sustainable transport in the world has made electric vehicles (EVs) an attractive alternative to internal combustion engine (ICE) vehicles, which can potentially save energy and minimize greenhouse gas emissions. Nevertheless, the lack of clarity in the total cost of ownership (TCO) is a barrier to EV adoption in India. The paper is a comparison of TCO of electric two-wheelers (E2Ws) and ICE bikes based on real-world models such as the Revolt RV400 and Honda CB Shine 125cc. The initial costs, running costs (electricity/fuel), and the cost of replacing the battery are calculated using a methodological cost framework, which is supported with the EV Calculator Pro application. The findings indicate that EV running costs (0.25-0.98/km) are 31-67 percent less than ICE costs (1.42-2.00/km), and the Revolt RV400 saves 67 percent compared to the Honda CB Shine. The costs of battery replacement (0.40-0.48/km) are also a major consideration. The paper finds that EVs can be cost-effective and is environmentally friendly and suggests that the policy measures, such as subsidies and charging networks, should be implemented to increase adoption.

1. Introduction

The transportation industry of India is dominated by two-wheelers with a massive proportion of the population using two-wheelers as their main mode of transport. share in the sale of vehicles, which indicates their significance in the mobility scenario in the country. The trend of green transportation has placed electric vehicles (EVs) in the role of a potential alternative to the internal combustion engine (ICE) vehicles, and the potential energy savings in the primary energy consumption and greenhouse gas emissions. To a significant extent, however, Indian consumers face a lot of uncertainty in making a choice between EVs and ICE two-wheelers due to the lack of clarity in the cost comparison, particularly the total cost of ownership (TCO). The cost effectiveness of EVs depends on several factors including the purchase prices, operating costs of EVs (cost of electricity), and long term costs (cost of replacing batteries) EVs have lower running costs (due to the low cost of electricity and minimal maintenance as compared to ICE vehicles), but high purchase prices and cost of replacing the batteries can offset these savings In India, where affordability is a major factor when customers purchase vehicles, it is important to calculate the TCO comprehensively to address consumer concerns and to encourage the adoption of EVs . Moreover, the prices of batteries, which constitute a large portion of EV TCO, are also influenced by market forces and technological advancement, and they need to be examined now. The transportation in India is being powered by two-wheelers with the highest vehicle sales and a primary mode of mobility to millions of individuals (SIAM, 2023). The shift to sustainable transport is transforming the world, and electric vehicles (EVs) may become an alternative to ICE

vehicles, which can save energy and emissions (Wang & DeLuchi, 1992) European Environment Agency, 2018). However, Indian consumers are occasionally hesitant to buy E2Ws due to the lack of certainty in the total cost of ownership (TCO) calculations and the long-term cost of buying and replacing the battery (Rezvani et al., 2015; Dumortier et al., 2015). Consumer decisions and energy policy making should be based on whole-regional TCO assessments (Li et al., 2019). This gap is what the current paper seeks to fill by providing a clear, unbiased, data-driven method of comparing the TCO of E2Ws and ICE bikes in the Indian context, using real-world models and app-calculation to reach relevance to practice.

2. Research Methodology

This paper is a comparison of the total cost of ownership (TCO) of electric two-wheelers (E2Ws) and ICE bikes based on a structured cost model and software. Prices are calculated using 2023 prices, and it is noted that the prices of electricity, petrol, and batteries need to be checked in 2025.

2.1 Cost Calculation Framework

- TCO (Total cost of ownership) is calculated as in Equation (1)

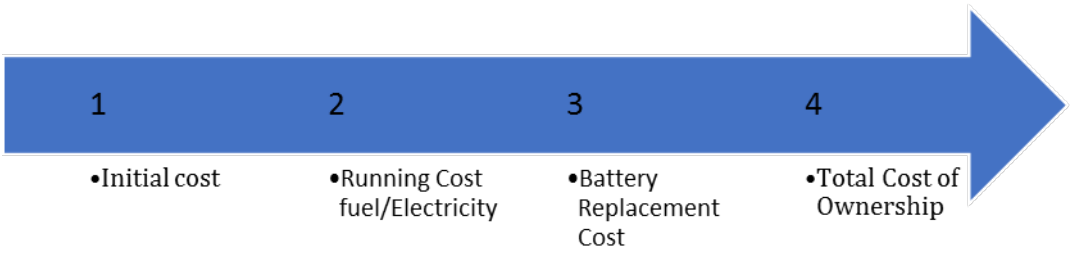


Fig. 1 *Cost calculation framework for TCO analysis*

$$\text{TCO} = \text{Initial Cost} + \text{Running Cost (Electricity/Fuel)} + \text{Battery Replacement cost} \quad (1)$$

To arrive at the conclusion that the operational cost of electric two-wheelers is less than that of petrol bikes, the paper uses a few techniques to compare the two. The following are the main techniques:
Running cost per km combines electricity cost in Equation (2) and (3):

$$\text{electricity cost} = \frac{\text{Battery Capacity (kWh)} \times \text{Electricity Rate (/kWh)}}{\text{Range (km)}} \quad (2)$$

and

$$\text{battery replacement cost} = \frac{\text{Battery Cost}}{\text{Lifecycle (cycles)} \times \text{Range (km)}} \quad (3)$$

This strategy aligns with the literature-based approaches (Palmer et al., 2018; Liu et al., 2021).

2.2 Data Sources and Justifications

- Battery Price: Li-ion: at 20,000 / kwh (1500 cycles), lead-acid: at 10,000 / kWh (400 cycles), in 2023 market averages (Ding et al., 2019).
- Electricity Rate: 6-7.5/ unit (kwh), resourcing to 2023 residential prices in India; the rates are state-centralized.
- Price of Petrol: 100/liter, in 2023 Indian market.
- Bike Data: Manufacturers provide such specifications of EV (e.g., Revolt RV400); ICE data determined based on industry report (Honda CB Shine 125cc) (SIAM, 2023; Revolt RV400, 2023).

J. of Electronic Voltage and Application Vol. 6 No. 2 (2025) p. 53-60

2.3 Software Tool: EV Calculator Pro

Cost calculations were done using the EV Calculator Pro application (Android v2.3). The users enter battery voltage (V), capacity (Ah), range (km), electricity rate (₹/unit), and battery cost (₹, cycles). The outputs are the cost of electricity per charge, running cost per kilometer, and the cost of battery replacement per kilometer. The results were compared with the manufacturer data and manually calculated.

2.4 Comparative Analysis

The E2W costs were compared to the ICE bike costs, where Honda CB Shine 125cc (fuel efficiency: 55 km/liter, petrol price: 100/liter) was used as the baseline.

3. Result and Discussion

In this section, TCO of a generic EV, Revolt RV400, and Honda CB Shine 125cc are compared based on initial and running costs. Table 1 tabulated cost comparison and Table 2 running cost comparison.

Table 1 *Initial cost comparison (EV vs. ICE)*

Bike Model	Total Price (₹)	Battery Price (₹)	Price Without Battery (₹)
Generic EV	160,000	50,000	110,000
Revolt RV400	122,000	60,000	62,000
Honda CB Shine	90,000	N/A	90,000

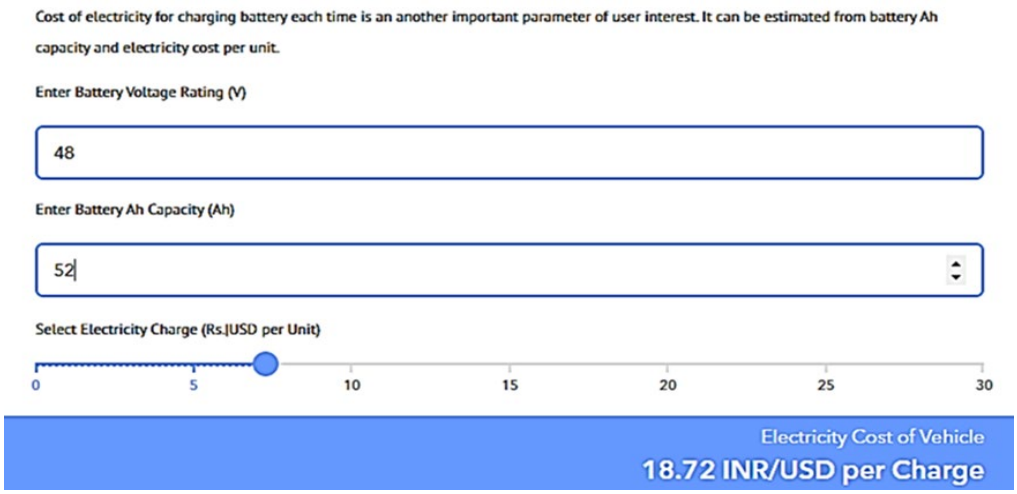
Table 2 *Running cost comparison (EV vs. ICE)*

Bike Model	Battery Capacity (kWh)	Range (km)	Motor Power	Electricity Cost (/km)	Battery Replacement Cost (/km)	Total Cost (/km)	Initial Cost (₹)
Generic EV	2.5	70	3.3 kW	0.27	0.48	0.75	110,000
Revolt RV400	3.24	100	4.1 KW	0.20	0.40	0.60	62,000
Honda CB Shine	N/A	55	125 cc	N/A	N/A	1.82	90,000

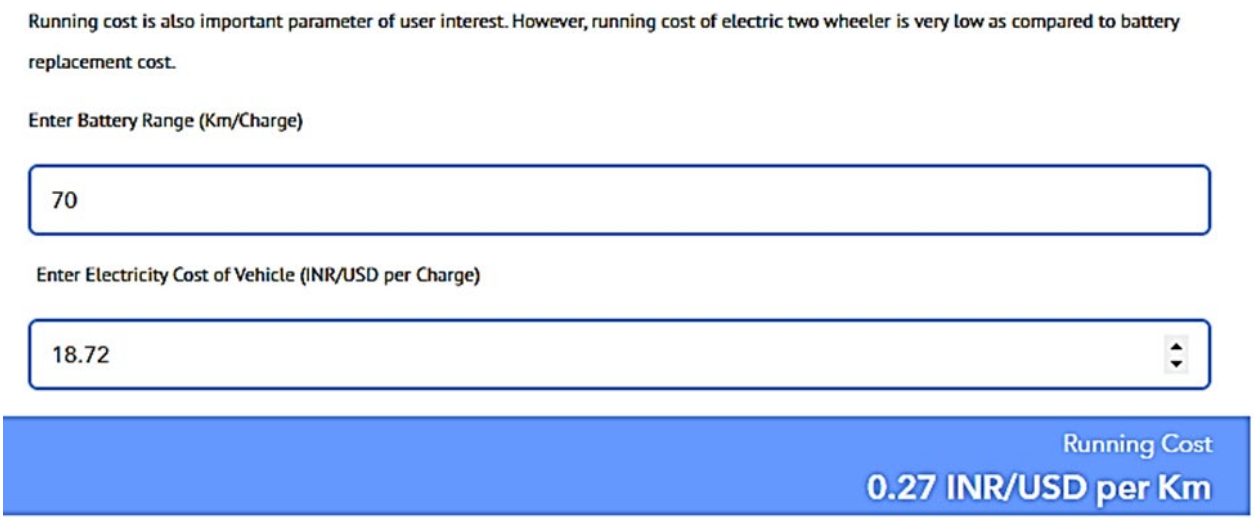
Notes: Generic EV uses Electricity rate: ₹7.5 per unit (kWh), Battery cost: ₹20,000 per kWh. Revolt RV400 uses Electricity rate: ₹6.0 per unit (kWh), Battery cost: ₹18,519 per kWh. Honda CB Shine Fuel efficiency: 55 km per liter Petrol price: ₹100 per liter.

3.2 Generic EV vs Honda CB Shine 125cc

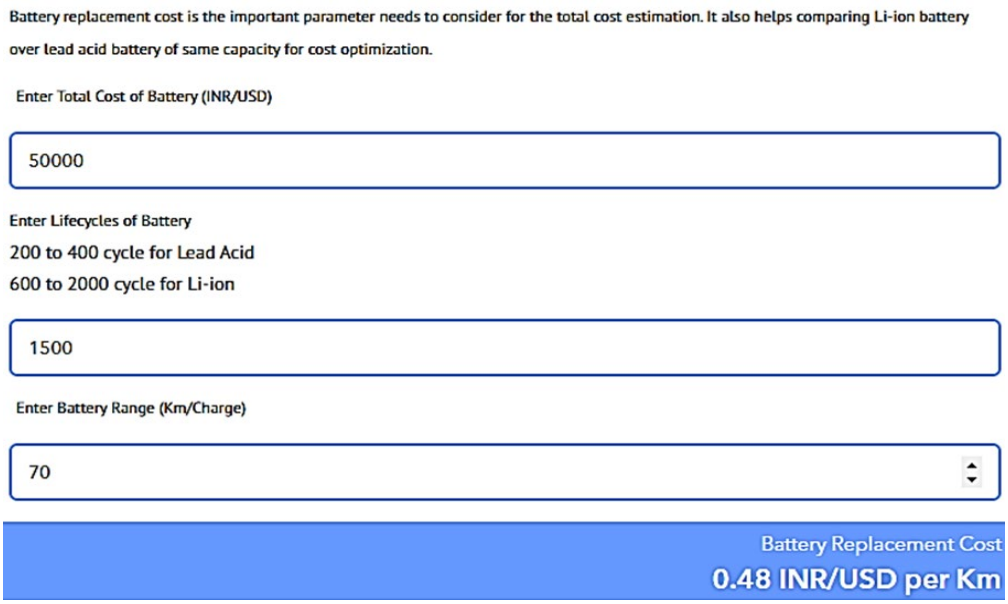
a. *Calculate the Electricity Cost of Vehicle*



b. Calculator Running Cost of Vehicle



c. *Calculate Battery Replacement Cost of Vehicle*



3.2.1 Result of the Generic EV

- Electricity Cost: 0.27/km (EV Calculator Pro, 7.5/unit) .
- Battery Replacement Cost: 0.48/km (1500 cycles, 50,000) .
- Total Cost: 0.75/km (59% lower than ICE).

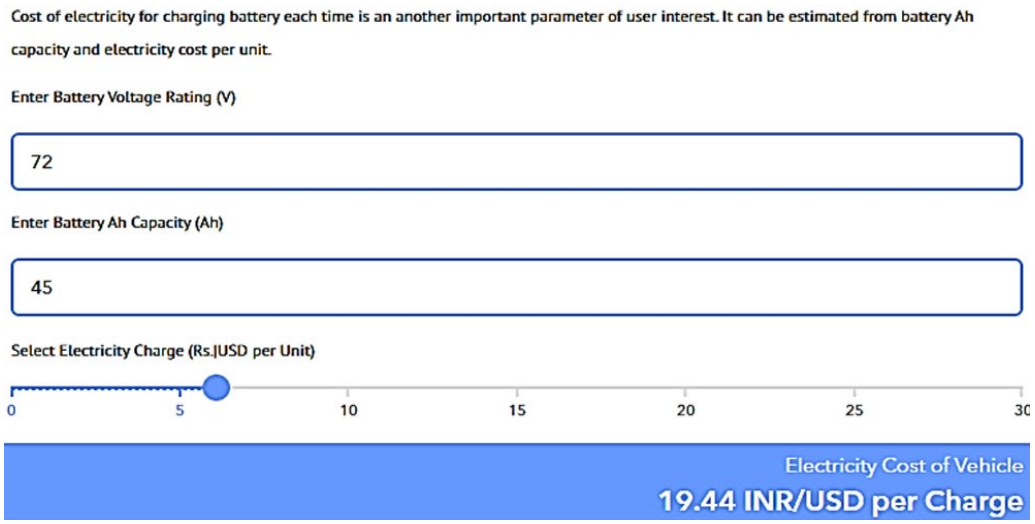
3.2.2 Result of Honda CB Shine

- Specifications: 124 cc, 55 km/litre, 90,000.
- Running Cost: 100/litre ÷ 55 km/litre = 1.82/km

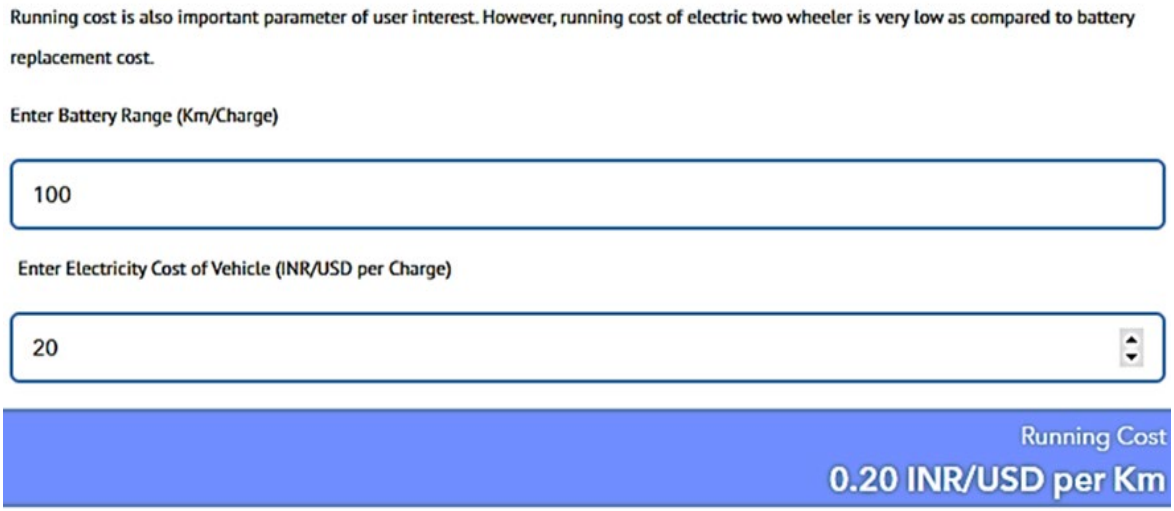
3.3 Revolt RV400

a. *Calculate the Electricity Cost of Vehicle*

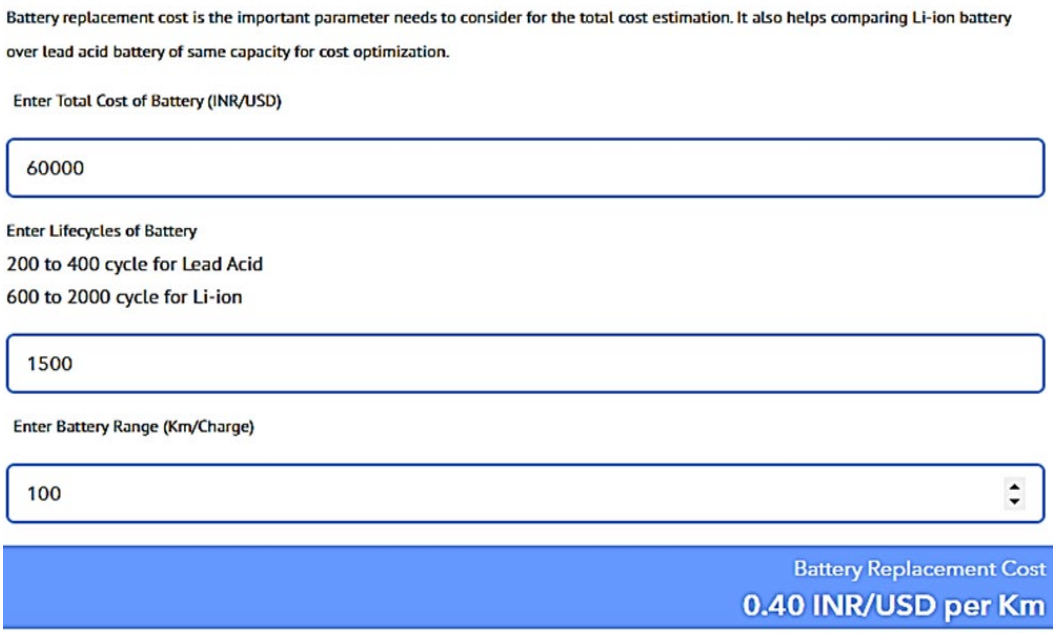
J. of Electronic Voltage and Application Vol. 6 No. 2 (2025) p. 53-60



b. *Calculate the Running Cost of Vehicle*



c. Battery Replacement Cost of Vehicle



3.3.1 Result of the Revolt RV400

- Electricity Cost: 0.20/km (6/unit).
- Battery Replacement Cost: 0.40/km (1500 cycles, 60,000).
- Total Cost: 0.60/km (67% lower than ICE).

3.4 Running Cost Comparison of EVs vs. ICE Bike Graph

Fig 2 shown in running cost comparison and Fig 3 shown percentage cost reduction of EVs vs ICE bike.

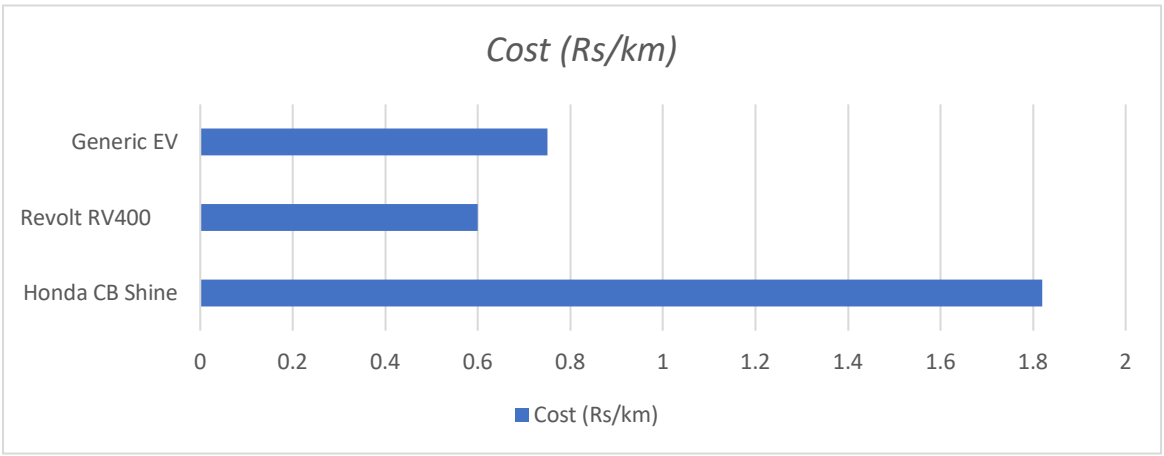


Fig. 2 *Running cost comparison of EVs vs. ICE bike*

3.5 Percentage Cost Reduction of EVs vs. ICE Bike Graph

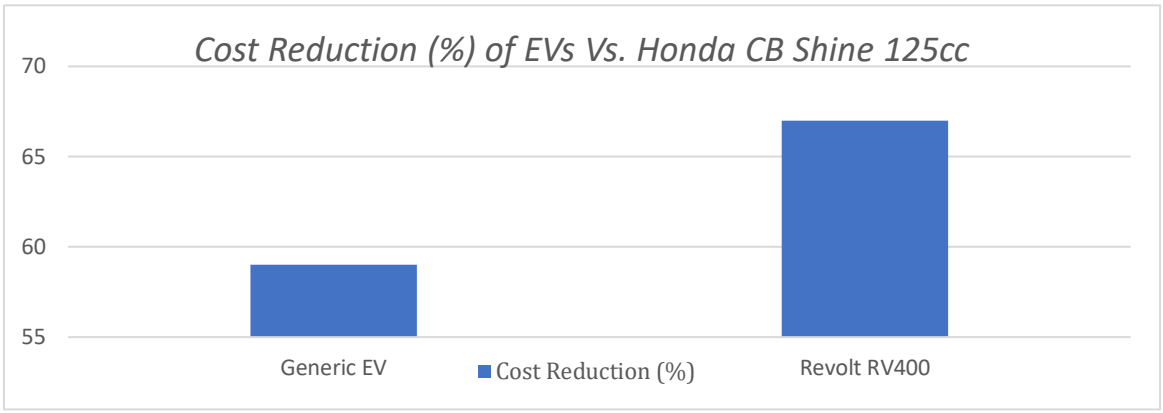


Fig. 3 *Percentage cost reduction of EVs vs. ICE bike*

4. Conclusion

In India, where the two-wheeler market dominates vehicle sales (75 percent), EVs can help riders save a significant amount of money over internal combustion engine (ICE) bikes. This paper estimates using the EV Calculator Pro app, the EV running cost (0.25-0.98/km) is 31.67 percent cheaper than ICE running cost (1.42-2.00/km) with Generic EV having 59 percent (0.75/km) and Revolt RV400 having 67 percent (0.60/km) less running cost than Honda CB Shine 125cc (1.82/km). The cost of replacing batteries (0.40-0.48/km) is a significant contributor to TCO, but the price of EVs without batteries e.g., 62,000 Revolt RV400 is lower than that of ICE 90,000. Rising fuel prices are an advantage to EVs and low emissions can support climate goals. The costs of batteries and infrastructure limitations are leading to consumer confusion that can be mitigated through open TCO calculations. The policymakers should expand charging infrastructure and subsidies. Future price reductions in batteries will also be beneficial to EVs.

Acknowledgement

Communication of this research is made possible through guidance by Electrical and Electronics Department UIT RGPV Bhopal.

Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors are responsible for the study conception, research design, data collection, data analysis, result interpretation and manuscript drafting.

Appendix

A. Generic EV

- Battery Capacity: 2.5 kWh Li-ion or 48V, 52Ah Li-ion
- Range: 70km
- Motor Power: 3.3kw

B. Revolt RV400

- Battery Voltage: 3.24 kWh Li-ion or 72V 45 Ah Li-ion
- Battery Ah Capacity: 45 Ah (i.e., 3.24 kWh Stored Energy)
- Range: 100Kms (Normal Mode)
- Motor Power: 4.1kw

C. Honda CB Shine

- 125cc
- 55 km/liter

References

[1] SIAM. (2023). Automobile domestic sales trends. Society of Indian Automobile Manufacturers. [Online]. Available: http://www.siam.in

[2] Wang, Q., & DeLuchi, M. A. (1992). Impacts of electric vehicles on primary energy consumption and petroleum displacement. *Energy*, *17*(4), 351-366. https://doi.org/10.1016/0360-5442(92)90110-L

[3] European Environment Agency. (2018). Greenhouse gas emissions from transport," 2018. [Online]. Available: https://www.eea.europa.eu

[4] Rezvani, Z., Jansson, J., & Bodin, J. (2015). Advances in consumer electric vehicle adoption research: A review and research agenda. *Transportation research part D: transport and environment*, *34*, 122-136. https://doi.org/10.1016/j.trd.2014.10.010

[5] Dumortier, J., Siddiki, S., Carley, S., Cisney, J., Krause, R. M., Lane, B. W., ... & Graham, J. D. (2015). Effects of providing total cost of ownership information on consumers' intent to purchase a hybrid or plug-in electric vehicle. *Transportation Research Part A: Policy and Practice*, *72*, 71-86. https://doi.org/10.1016/j.tra.2014.12.005

[6] Li, J., Jiao, J., & Tang, Y. (2019). An evolutionary analysis on the effect of government policies on electric vehicle diffusion in complex networks. *Energy policy*, *129*, 1-12. https://doi.org/10.1016/j.enpol.2019.01.070

[7] Palmer, K., Tate, J. E., Wadud, Z., & Nellthorp, J. (2018). Total cost of ownership and market share for hybrid and electric vehicles in the UK, US and Japan. Applied energy, 209, 108-119. https://doi.org/10.1016/j.apenergy.2017.10.089

[8] Liu, Z., Song, J., Kubal, J., Susarla, N., Knehr, K. W., Islam, E., ... & Ahmed, S. (2021). Comparing total cost of ownership of battery electric vehicles and internal combustion engine vehicles. *Energy Policy*, *158*, 112564. https://doi.org/10.1016/j.enpol.2021.112564

[9] Ding, Y., Cano, Z. P., Yu, A., Lu, J., & Chen, Z. (2019). Automotive Li-ion batteries: current status and future perspectives. *Electrochemical Energy Reviews*, *2*(1), 1-28. https://doi.org/10.1016/j.apenergy.2017.10.089

[10] Revolt RV400 (2023). Specifications and pricing. [Online]. Available: https://www.bikedekho.com

[11] Dash, P., & Behera, P. (2019, December). The way forward for e-mobility in India. In 2019 IEEE Transportation Electrification Conference (ITEC-India) (pp. 1-6). IEEE. https://doi.org/10.1109/ITEC-India48457. 2019.ITECINDIA, 2019-130