

## Emissions challenges in rapidly urbanizing India: A road map to Sustainable Transportation



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Air pollution is a major issue in rapidly urbanizing countries like India, where a substantial portion of the population is exposed to poor air quality. The rise in motor vehicles, primarily due to urbanization, has become a major source of air pollutants. The Indian government has implemented various measures, including technological advancements and legislation, to mitigate emissions. However, these efforts are not occurring at a sufficient rate to mitigate the growth in the number of vehicles and their usage, which has a detrimental effect on Indian cities. A significant measure is the Bharat Stage (BS) emissions standards, which aim to reduce vehicular emissions. However, emissions observed from real-world driving conditions significantly differed from the emissions observed in laboratory test.

Furthermore, a potential alternative solution to reduce tail-pipe emissions is to implement electric vehicles. However, the environmental impact of electric and hybrid electric vehicles can differ considerably from conventional vehicles, requiring appropriate driving cycles to assess their full potential. The main focus of this study is electric rickshaw (e-rickshaw) and conventional vehicles like auto rickshaws and petrol/diesel cars. The key objectives include developing a driving cycle for e-rickshaws and quantifying the real-world emissions for conventional vehicles in actual driving conditions using a portable emission measurement system (PEMS). **Figure-1** shows the overall research framework and its related outcomes.

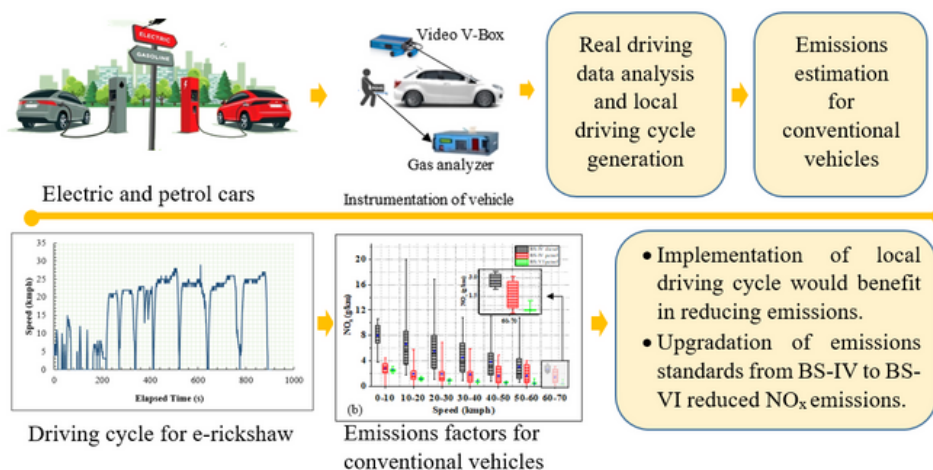


Figure-1: A comprehensive research framework and its related outcomes

The research contribution from this study can be summarized as follows, (1) The study provides insights on the transition to electric mobility, introducing the concept of the driving cycle, (2) The study highlights the necessity of including diesel auto-rickshaws in real-world driving test protocols for future emission regulations, (3) This research provides insights into the environmental impact of transitioning from BS-IV petrol to BS-VI petrol cars. It highlights the effectiveness of the upgrade in reducing NO<sub>x</sub> emissions, which are harmful to air quality and public health. Furthermore, the study quantified the CO<sub>2</sub> emissions vehicles from conventional vehicles highlighting the importance of addressing these emissions issues related to climate change. In summary, this study provides essential insights into the complex issue of vehicular emissions in rapidly urbanizing countries and their impact on air quality and public health.

By promoting electric mobility, addressing emissions from conventional vehicles, and examining the outcomes of upgraded fuel standards, we contribute vital information that can assist future emissions regulation and pave the path for cleaner and more sustainable transportation systems.

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