Abstract of the Problem

India is undergoing a rapid transition toward electric mobility to reduce carbon emissions, lower fossil fuel dependency, and support sustainable urban transport. While electric two-wheelers have emerged as a promising solution due to their affordability and suitability for Indian roads, large-scale adoption remains constrained by critical systemic challenges.

One of the primary barriers is high upfront cost, largely driven by battery pricing, which accounts for a significant portion of the vehicle cost. This makes electric two-wheelers less accessible for middle-income users and commercial delivery operators who are highly price-sensitive.

Another major limitation is charging downtime. Conventional fixed-battery EVs require several hours
to recharge, reducing vehicle availability for commercial users such as delivery partners and fleet operators. Since their income is directly linked to daily vehicle utilization, long charging times negatively impact productivity and earnings.

Additionally, the lack of standardized and scalable battery swapping infrastructure restricts operational flexibility. Existing solutions are fragmented and not interoperable across platforms, creating ecosystem inefficiencies.

Battery asset management is another unresolved challenge. Lithium battery systems require intelligent
monitoring for performance, safety, and lifecycle optimization. Without real-time tracking and standardized Battery Management Systems (BMS), issues such as battery misuse, thermal risks, asset loss,
and unmonitored degradation arise.

From an industry perspective, startups face high R&D; costs in developing modular vehicle platforms,
advanced battery architectures, and integrated digital ecosystems. Many early-stage EV companies struggle to validate their technology at scale due to limited access to structured testing environments.

From an academic perspective, universities often possess advanced research capabilities in battery chemistry, power electronics, IoT systems, and energy management. However, limited structured collaboration prevents real-world validation and commercialization of research outputs.

India’s urban mobility ecosystem demands a scalable, modular, and intelligent EV solution that integrates
vehicle design, smart battery systems, swapping infrastructure, and digital monitoring under one unified
architecture.

The core problem is not merely the development of an electric vehicle, but the creation of a scalable,
intelligent, and commercially viable EV energy ecosystem that enables faster adoption, improves operational
efficiency, reduces lifecycle cost, and supports sustainable mobility growth in India.