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Sustainable Mobility Transition: The Role Of Green Startups In Ev Charging Infrastructure Development.

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ABSTRACT
Green business and eco-innovation are important for sustainable development, especially when it comes to low-carbon urban mobility. This study illustrates how green entrepreneurship fosters electric scooters and battery charging infrastructure in Mysore, Karnataka, India, to enhance the EV ecosystem. A qualitative case-based methodology, secondary data, policy research, and industry insights are employed to examine the collaborative efforts of local entrepreneurs, electric vehicle manufacturers, energy utilities, and governmental agencies in developing sustainable mobility solutions. The article suggests a sustainable electric vehicle (EV) scooter idea that uses renewable energy, has advanced charging systems, digital monitoring, and follows the principles of a circular economy by reusing and recycling batteries. Most of the electric vehicles (EVs) in Mysore are two-wheelers. Because they cost less, are better for short trips in the city, and don't need as much infrastructure as four-wheelers. Branded experience centers and more public charging stations have made customers more confident, but gaps in infrastructure—like not having enough charging stations and not being able to swap batteries—are keeping people from using them widely. This article also talks about how IoT-enabled monitoring and data analytics can help with energy management, predictive maintenance, and making operations more efficient...
Keywords: sustainable, Eco System, Electric Vehicles, Green Transportation, Startup

INTRODUCTION:

The rise of green startups has transformed the role of entrepreneurship by integrating sustainability into business models, fostering economic growth while addressing urgent ecological concerns [1]. This shift towards sustainable entrepreneurship is particularly evident in India, which has emerged as a global hub for startups with over 90,000 recognized enterprises and 107 unicorns, driven largely by the contributions of its youth [2]. Green entrepreneurship serves a crucial role in overcoming social challenges and environmental damage by promoting the economy's steady expansion over the long term [3]. Within this context, the electric vehicle sector has become a focal point for innovation, with companies in Karnataka such as Ather Energy and Ola Electric driving adoption through advanced business models and the establishment of dedicated charging infrastructure [4]. However, the expansion of this ecosystem relies heavily on strategic investments and partnerships, as evidenced by initiatives like Fortum India's plan to install 720 charging facilities across seven cities and the joint venture involving EV motors, DLF, and ABB India aiming to establish 6,500 stations [5]. Despite these advancements, the widespread adoption of electric vehicles faces significant hurdles, including consumer perception gaps and the need for robust charging networks to support sustainable mobility solutions [4], [6]. To address these barriers, supportive mechanisms such as green incubators, accelerators, and eco-innovation hubs are essential for providing the mentorship, seed funding, and collaborative infrastructure that sustainable ventures require to scale effectively [7]. This study specifically examines the ecosystem in Mysore, Karnataka, to understand how local green startups are navigating the complexities of battery charging infrastructure and eco-innovation within the broader national framework [8], [9]. The literature review synthesizes theoretical perspectives on green entrepreneurship, business model innovation, and the critical role of charging infrastructure in the electric vehicle ecosystem. Green entrepreneurship is defined as the development of business ventures that consciously seek to balance profitability with environmental

responsibility, thereby embedding sustainability as an intrinsic component of the value proposition [10]. These ventures are not confined to specific industries but span across various sectors of the economy, with a significant concentration of projects observed in renewable energy and waste management [11]. Recent studies have expanded this scope to include the electric vehicle sector, where innovative business models and infrastructure development are critical for overcoming adoption barriers and achieving sustainable development goals [12], [13]. The transition from internal combustion engine vehicles to electric vehicles is a central global strategy to mitigate climate change, yet consumer adoption remains a major challenge despite technological progress and regulatory incentives [14]. One of the primary challenges hindering widespread adoption is the inadequate charging infrastructure, which creates range anxiety and limits the practicality of electric mobility for consumers [12], [15]. To overcome these challenges and encourage wider adoption, it is crucial for stakeholders, including governments, manufacturers, and energy providers, to work together towards building a robust ecosystem that supports sustainable mobility solutions [16]. This ecosystem requires a multifaceted approach that integrates policy support, access to green finance, and specialized infrastructure development to foster a conducive environment for innovation [7], [17]. Specifically, the deployment of electric vehicles and e-mobility services necessitates collaboration across diverse industries, including electricity supply, transport, and smart city development, to effectively address national-level concerns regarding sustainable mobility [8]. The holistic development of this ecosystem extends beyond vehicle manufacturing to encompass diverse stakeholders such as charging infrastructure providers, battery suppliers, regulatory bodies, and eco-conscious consumers [18]. Consequently, the successful integration of electric mobility depends on the synergistic alignment of these actors to overcome systemic barriers related to interoperability, grid capacity, and the economic viability of charging networks [19], [20]. Furthermore, the absence of a sufficient mass of EVs often results in low incentives for private actors to invest in infrastructure, creating a "chicken-and-egg" dilemma that stalls market progress [21]. Scholars suggest that resolving this impasse requires the discovery of innovative business models that allow companies to achieve successful commercialization and profitability from new technologies [22]. In the context of battery charging infrastructure, business model innovation is particularly critical for addressing the "chicken-and-egg" dilemma by ensuring that investments in charging stations remain economically viable even before EV adoption reaches mass-market levels [23]. This necessitates the development of collaborative frameworks where infrastructure operators, mobility service providers, and energy companies align their interests to create a functional business ecosystem that can sustain operations during the early stages of market diffusion [21], [24]. Government policies play a pivotal role in mitigating this deadlock by providing subsidies and support for innovative value propositions, though companies must ultimately demonstrate financial sustainability beyond the phase of public funding [22]. A business model articulates the logic and provides data and other evidence that demonstrates how a business creates and delivers value to customers, while also outlining the architecture of revenues, costs, and profits associated with the business enterprise delivering that value [25]. In the electric vehicle sector, this logic must address the complex interdependencies between infrastructure availability and vehicle adoption, often referred to as the "chicken-and-egg" dilemma, where the lack of charging points discourages EV purchases while the low number of EVs makes infrastructure investment unattractive [22], [26]. The concept of a business model is frequently analyzed through a multidimensional lens, where scholars distinguish between the value proposition, the value network, and the revenue or cost model as distinct yet interconnected components.

LITERATURE REVIEW

The concept of a business model is frequently analysed through a multidimensional lens, where scholars distinguish between the value proposition, the value network, and the revenue or cost model as distinct yet interconnected components [22]. For instance, business models for battery second use could provide improved lifetime management solutions for EV batteries, thereby addressing environmental concerns associated with disposal while offering economic benefits to the customer [20]. Research indicates that successful business models in this sector cannot be achieved through isolated, actor-focused considerations, but rather require systemic coordination that spans various actors within the mobility ecosystem [22]. This ecosystemic perspective highlights that incumbent firms and entrepreneurial ventures often exhibit path-dependent behaviours that influence the evolution of business models for electric vehicles, necessitating distinct strategies to overcome barriers to market penetration [27]. Recent studies have suggested new business models as a vehicle to overcome the barriers to EV adoption and to help move commercial fleets towards a more sustainable system [20]. To operationalize these models, scholars emphasize that a business model must be understood as a holistic description of how a firm creates and captures value within a value network, with the central element being the value proposition that differentiates the offering from competitors [28].

Background of using EV Scooters in India:

The adoption of electric scooters in India is gaining momentum as a critical component of the nation's strategy to reduce urban pollution and dependence on fossil fuels, supported by government incentives and the emergence of innovative business models that address infrastructural gaps [29]. Despite the Indian government's commitment to the Paris Climate Agreement and the provision of subsidies to promote electric vehicles as a means of reducing CO2 emissions, the actual pace of adoption remains slow due to persistent barriers [30]. These barriers primarily include high upfront costs, limited charging infrastructure, and consumer concerns regarding battery range and safety, which necessitate the development of robust business models that can effectively mitigate these risks for potential users [8],

[31]. To better obtain insights on the potential diffusion of a product and the development of necessary infrastructure and services, different parameters such as governmental policy, regulations, the current level of required infrastructure, and the availability of related services must be understood [8]. Governmental policies and regulations play a pivotal role in shaping the market environment, as evidenced by India's relaxation of foreign direct investment rules and the provision of purchasing incentives to encourage output and reduce pollution levels [12]. However, consumer response to these subsidies has been limited, as studies indicate that Indian consumers are more concerned with the future policy roadmap and the availability of post-purchase maintenance support than with immediate financial incentives [32]. Consequently, the successful diffusion of electric mobility in India requires a collaborative ecosystem approach where stakeholders, including manufacturers, energy providers, and policymakers, work together to build robust infrastructure and establish standards for battery swapping and charging services [16], [30]. The deployment of electric charging infrastructure is regarded as one of the key elements for the diffusion of EVs and e-mobility services, making it critical to examine electricity supply infrastructures themselves in Indian cities since the discontinuity of electricity supply is an important aspect of the local context [8]. Furthermore, the adequacy of this infrastructure is currently insufficient, as evidenced by the fact that India possesses only 12,146 public charging stations to serve approximately 3.4 million electric vehicles [33]. This significant disparity between the number of vehicles and available charging points highlights the infrastructural bottlenecks that hinder widespread adoption, particularly when considering the additional challenges of high upfront costs and range anxiety that consumers face in price-sensitive markets [32], [34]. To address these infrastructural deficits, the Indian government has projected a requirement of 63,000 charging units necessitating a cumulative investment of Rs. 26,900 crores over the next 5 years, emphasizing the need for public-private partnerships to scale infrastructure development [33]. Private sector participation is further evidenced by the involvement of Charge Point Operators such as Tata Power EZ Charge, Charge Zone, and Magenta Charge Grid, which play pivotal roles in establishing and managing the necessary charging networks [35]. Despite these efforts, the logistical efficiency of current charging stations remains a significant constraint, as petrol stations can serve around 20 vehicles in 30 minutes whereas EV stations currently serve only one vehicle in the same time frame [35].

Problems facing due to EV Sectors- A case of Ola Electric exemplifies the infrastructural and operational challenges inherent in the Indian EV sector, particularly regarding the inadequacy of charging networks and the high total cost of ownership that impedes widespread adoption [36]. The operational difficulties faced by shared mobility firms are further illustrated by Ola's pilot project in Nagpur, where high recharging costs and long wait times despite a ratio of approximately one charging station for every 17 cars led to drivers abandoning the EV program in favor of diesel vehicles [12]. This case highlights the critical "chicken-or-egg" dilemma where investors hesitate to build infrastructure without sufficient vehicle numbers, while consumers are reluctant to adopt EVs due to the lack of refuelling stations [37], [38]. This infrastructural deficit is exacerbated by the substantial spatial requirements needed to establish charging stations compared to traditional petrol stations, alongside the significant load demands of approximately 100 kW per public station [35]. These substantial power requirements necessitate significant upgrades to the existing electrical grid capacity to prevent instability and ensure reliable service delivery [39], [40]. Furthermore, the lack of clarity on land ownership and the high cost of urban land present additional regulatory and financial hurdles that complicate the planning and maintenance of parking facilities necessary for charging infrastructure [41]. Additionally, the psychological barrier of range anxiety significantly impacts consumer disposition, as diminished battery capacity over time forces owners to constantly monitor dashboard indicators and adjust travel plans to accommodate unexpected route deviations [40]. To mitigate these operational inefficiencies and consumer concerns, the implementation of smart and intelligent charging systems has been proposed as a viable solution to optimize energy consumption and enhance the user experience [42]. Smart charging systems utilize advanced algorithms and communication technologies to dynamically manage power loads based on grid capacity and user requirements, thereby preventing network overloading while ensuring reliable vehicle charging [35]. These systems facilitate the integration of renewable energy sources and enable vehicle-to-grid (V2G) capabilities, which allow EVs to return stored energy to the grid during peak demand periods, thereby enhancing overall grid stability and reducing the need for expensive infrastructure upgrades [43]. Scholars suggest that optimizing power resource allocation through smart grids and energy management systems can effectively mitigate this issue [44]. Specifically, intelligent charging management systems are capable of optimizing EV charging schedules, smoothing out demand peaks, and ensuring grid reliability amidst the accelerating transition to electrified transportation [45]. The integration of renewable energy sources into charging infrastructure aligns with global sustainability goals, as stations powered by solar or wind contribute significantly to reducing the overall carbon footprint of electric mobility [46]. However, the widespread implementation of EVs also presents significant challenges related to the availability and accessibility of charging stations, which are pivotal to facilitating convenient and efficient charging for EV owners [47].

Sustainable EV Scooter Model

The idea behind the sustainable EV scooter is to use a closed loop system that starts by making clean, renewable energy, mostly from solar and wind sources. After that, the energy goes to the grid and charging stations. This clean energy is used to make electric scooters in a way that is good for the environment. They use modular design ideas, eco-friendly production methods, and machines that use less energy to lower carbon emissions, waste, and damage to the environment. The scooters have new battery management systems, lightweight parts, and

electric drivetrains that make them better at what they do and use less energy. Once they are made, the EV scooters can use a well-known charging network that includes home charging units, public charging stations, and, when possible, places where you can change the batteries. Smart charging systems manage the flow of energy, stop batteries from being overcharged, and keep them in good shape.

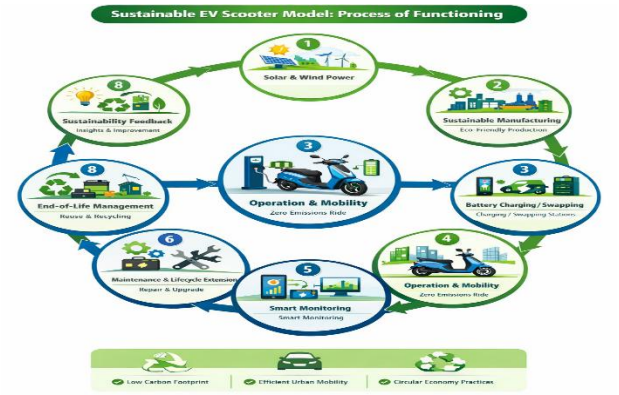

Image 1: Sustainable EV scooter Model

Regenerative braking systems, on the other hand, get kinetic energy back as the car slows down, which makes them even more efficient. Because they don't have tailpipe emissions, are quiet, and are cheap to use in cities, EV scooters are great for short trips, shared transportation services, and last-mile delivery. During the use phase, digital tools such as IoT sensors, mobile apps, and data analytics platforms keep an eye on things like how well the vehicle is running, how much energy it uses, how healthy the battery is, and how people ride it. With this real-time data, you can do predictive maintenance, find the best routes, and use energy more efficiently. This makes the scooter last longer and reduces the number of times it breaks down unexpectedly. Taking care of the product regularly and replacing modular parts will make it last longer and use fewer resources, which will also make it cheaper to fix. The method puts a lot of emphasis on circular economy ideas by using systematic end-of-life management at the end of the product's useful life. Batteries can be reused for things like storing energy in a stationary way, or they can be sent to be recycled in a way that is good for the environment. Parts that can be used again are taken out of the production cycle and put back in. We use data on how much people use, maintain, and recycle things to make products better, make rules, and build infrastructure. This makes a feedback loop for sustainability that never ends. This closed-loop method makes sure that urban transportation systems that use electric scooters have less of an effect on the environment, use resources more efficiently, and last for a long time.

Case of Electric Scooter / EV Two-Wheeler Production & Sales in Mysore:

EV Adoption & Registrations: There has been a big rise in the number of electric vehicles (EVs) registered in Mysuru, especially electric scooters. This means that a lot of people want them in the area. In Mysuru East RTO, 1,424 electric cars had been registered for the 2025–26 fiscal year by the middle of January 2026. This is about 16% more than last year. A lot of them are scooters that run on electricity. In the last few years, thousands of electric two-wheelers and four-wheelers have also been registered in other parts of the city besides Mysuru. This shows that two-wheeled electric vehicles are the most popular in the area.
Brand Presence and Sales Channels: Ather Energy, one of India's most well-known electric scooter makers, has opened Ather Space, a retail experience center, in Mysore on Hunsur Road, Hinkal. This center sells popular models like the Ather 450X and Ather 450 Plus. You can also test ride them there. There are experience centers like this in the city because there is a need for EV scooters. These centers give customers a place to buy them and get help. There isn't any specific information about EV scooter factories in Mysore city itself; they are in Mysuru. There are big plans in Karnataka to make electric vehicles (EVs). For example, Honda Motorcycle & Scooter India wants to make a lot of EVs at its Narsapura facility. Over the next ten years, these plans will probably have a big effect on the area's EV ecosystem. Mysore has charging stations and battery infrastructure for electric vehicles: Charging stations for electric vehicles in public: As the number of cars in Mysuru has grown, so has the city's EV charging network: The city has several places where people can charge their phones and get quick charges. For instance, Ather Energy has its own fast chargers called Ather Grid stations. These stations can be found in important places like Hinkal, Nazarbad Mohalla, Gokulam Road, and Vijaya Nagar. These make it simple to charge Ather scooters while you're on the go. There is a charging station at Dyuthi Automobiles on Hunsur Road that can charge quickly, like Bharat DC chargers that have 15–50 kW of power. Mysuru's overall AV charging ecosystem includes many more licensed charging sites run by the Chamundeshwari Electricity Supply Corporation (CESC) in addition to brand-specific networks. These sites add to the area's charging points. CESC recently built a 30 kV fast charging station for electric cars at its office and is thinking about letting the public use it. Battery Changing / Swapping Stations: Right now, there aren't many places in Mysore where riders can trade in a dead battery for a charged one. Major OEMs like Honda have national and state EV plans that talk about building battery-swapping infrastructure in important places like gas stations and public transportation areas. However, these are more general plans for Karnataka and India as a whole, and they are not yet fully operational in Mysore. Most of the equipment that is already in Mysore is for permanent public charging stations, not full battery-swap hubs.

Findings:

The research indicates that green enterprises and eco-innovation initiatives significantly influence the electric transportation ecosystem in Mysore, Karnataka. Electric two-wheelers, especially EV scooters, are the most popular type of electric vehicle in the area right now. This is because they are cheap, great for short trips in cities, and don't need as much infrastructure as electric four-wheelers. The fact that more people are registering EVs in Mysore shows that they are becoming more popular. Ather Energy and other well-known companies are in the

area, and there are experience centers where people can learn more about EVs and feel more confident in them. The results also show that more people are buying electric scooters, but the charging infrastructure is still not growing at the same rate everywhere. There are more public charging stations now, including fast-charging stations run by businesses and utility companies like CESC. But they are still only available in some cities. Mysore doesn't have a lot of battery-swapping infrastructure, which could help a lot with range anxiety and charging downtime. This shows that the current ecosystem has a big problem. The study also shows that business models based on the ideas of a circular economy, like battery second-life applications, modular scooter design, and smart energy management, could make the economy and the environment much better. Digital technologies, such as IoT-enabled monitoring and data analytics, are seen as important tools for making EV scooter systems more efficient, allowing for predictive maintenance, and optimizing energy use. To solve the "chicken-and-egg" problem of getting people to buy EVs and building the infrastructure to support them, government agencies, entrepreneurs, charging infrastructure providers, and energy utilities need to work together.

Conclusion:

The research shows that green businesses and eco-innovation projects are important for the long-term growth of Mysore's electric vehicle ecosystem. Electric scooters are a good way to get around cities that can be used by a lot of people. The proposed sustainable EV scooter model shows how using clean energy, smart manufacturing, digital monitoring, and circular economy practices together may lower environmental impact while making the economy more stable and the user experience better. The Mysore case shows that even though government support and private sector involvement have sped up the rollout of electric vehicles (EVs), infrastructure issues—especially with charging density and battery swapping facilities—are still stopping widespread use. The results show that we need a complete ecosystem strategy that includes regulatory frameworks, technical innovation, and business model development to make sure that things last over time. Increasing public-private partnerships, expanding decentralized and renewable-powered charging infrastructure, and encouraging new business models like battery-as-a-service can all help people use electric vehicles more. The paper adds to the research on green entrepreneurship and sustainable mobility by using examples from a tier-II Indian city. It demonstrates how localized innovation ecosystems can contribute to the attainment of national and global sustainability objectives. Future research may focus on comparative analyses among cities, examination of consumer behaviour, and the economic feasibility of extensive battery swapping networks to advance sustainable electric mobility in India.

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