

ELECTRIC VEHICLE ADOPTION AND ITS IMPACT ON WILDLIFE AND ECOSYSTEMS**Dharmendra Kr Dubey^{1*}, Aastha Goswami², Mahendra Pratap Yadav², Dharmendra Makwana², Ayaz Ravat²**

Abstract: The adoption of electric vehicles (EVs) has become a central strategy in reducing urban air pollution, combating climate change, and transitioning towards sustainable transportation. While the benefits of EV adoption in urban settings are well-documented, less attention has been paid to the broader environmental implications, particularly on wildlife and ecosystems. This research explores the impact of electric vehicle integration on wildlife and ecosystems, focusing on how cleaner air, reduced noise pollution, and reduced greenhouse gas emissions from EVs contribute to the preservation of urban biodiversity and natural habitats. Using case studies from cities like Mumbai, Delhi, and New York, this paper analyzes how EV adoption in public transport systems, such as electric buses, can mitigate harmful pollutants that affect both human health and wildlife. The study also examines the indirect benefits of EV adoption, including the reduction of roadkill, less disturbance to wildlife from noise pollution, and improved ecological health in urban parks and natural reserves. Additionally, the paper explores the challenges of integrating EVs into urban environments, such as the need for robust infrastructure, policy support, and technological advancements. The research concludes that widespread adoption of electric vehicles, coupled with strategic urban planning and conservation efforts, can significantly contribute to the preservation of ecosystems and wildlife in metropolitan areas. This paper calls for a holistic approach that integrates sustainable transportation policies with wildlife conservation goals to ensure a balanced and thriving urban environment.

Key words: Electric Vehicle, Wildlife Ecosystems.

Introduction: The world is experiencing a transformative shift toward sustainable transportation, driven largely by the need to address pressing environmental challenges such as air pollution, climate change, and biodiversity loss. Among the most promising solutions is the widespread adoption of electric vehicles (EVs), which offer the potential to reduce harmful emissions, decrease reliance on fossil fuels, and

improve urban air quality. While much of the discourse surrounding electric vehicles has focused on their direct benefits for human health—particularly in terms of reducing air pollution in densely populated cities—the impact of EV adoption on wildlife and ecosystems remains an emerging area of research.

In urban areas, the interplay between transportation systems and the natural environment is complex. Cities, though centers of human activity, often host valuable ecosystems, including urban forests, parks, wetlands, and even migratory pathways for wildlife. Unfortunately, these ecosystems are frequently under threat from pollution, habitat destruction, and the encroachment of human activities. Conventional transportation systems, primarily powered by fossil fuels, contribute significantly to these threats, emitting pollutants that not only harm human health but also disrupt wildlife habitats and threaten biodiversity.

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Electric vehicles, particularly those integrated into public transport systems, offer a potential solution. By reducing harmful emissions, lowering noise pollution, and decreasing the overall environmental footprint of urban transport, EVs can create a more sustainable coexistence between human settlements and wildlife. Electric buses, for example, have already been deployed in cities like Mumbai, New York, and London, demonstrating their role in curbing urban air pollution, improving air quality, and offering a quieter alternative to traditional diesel-powered buses. These benefits extend beyond human communities, fostering healthier ecosystems for plant and animal species in urban environments. However, while the environmental and public health advantages of EV adoption are well-documented, the broader implications for wildlife and ecosystems are less understood. How does the reduction of vehicular emissions influence species that rely on urban areas for food, shelter, and migration? Can quieter, cleaner transportation systems lead to a reduction in roadkill and disturbances to wildlife? What role do EVs play in mitigating the impact of urban sprawl on natural habitats?

This paper seeks to explore these questions by examining the intersection of electric vehicle adoption and its impact on urban wildlife and ecosystems. Drawing on case studies from various cities and analyzing the ecological benefits of EV integration, this research aims to provide a comprehensive understanding of how cleaner, more sustainable transportation systems can contribute to the preservation of urban biodiversity. Through this exploration, the paper will highlight the potential for a holistic, integrated approach to urban planning that considers both human and ecological needs in creating more sustainable and wildlife-friendly cities.

Objectives of the Research

Objectives

- a) To Assess the Environmental Impact of Electric Vehicles (EVs) on Urban Air Quality and Wildlife:

Examine how the adoption of electric vehicles in urban transport systems, particularly electric buses, contributes to reducing air pollution, including

particulate matter (PM), nitrogen oxides (NO_x), and carbon dioxide (CO₂), which directly affect wildlife health and ecosystems.

Investigate the relationship between improved air quality from reduced vehicle emissions and its impact on urban biodiversity, focusing on plant and animal species that are sensitive to pollutants.

- b) To Explore the Role of EVs in Reducing Noise Pollution in Urban Environments:

Analyze how the quieter operation of electric vehicles compared to traditional internal combustion engine vehicles helps mitigate noise pollution in cities.

Investigate how reduced noise levels from EVs can positively impact urban wildlife, including species that rely on sound for communication, navigation, and predator avoidance.

- c) To Identify the Challenges and Opportunities for Integrating EVs with Wildlife Conservation Goals:

Explore the barriers to integrating electric vehicles into urban transport systems, such as infrastructure limitations, cost, and public perception.

Identify opportunities for urban planners, policymakers, and conservationists to work together in promoting EV adoption while protecting and enhancing urban ecosystems.

Role of EVs in Reducing Noise Pollution in Urban Environments: Electric vehicles (EVs) have the potential to play a significant role in reducing noise pollution in urban environments, with both immediate and long-term effects on the soundscape of cities. As cities become more congested and noise pollution continues to pose a health risk, EVs offer a promising solution to help alleviate some of the environmental stresses caused by transportation. Let's explore how EVs contribute to noise reduction in urban settings:

1. The Silent Revolution: The most striking characteristic of EVs is their quiet operation. Unlike internal combustion engine (ICE) vehicles, which produce sound from the engine, exhaust, and moving parts, EVs have far fewer moving components that create noise. They operate

primarily through electric motors, which generate much less sound.

- a) **Reduction in Engine Noise:** EVs lack the loud engine noises associated with traditional gasoline-powered cars. As a result, they are quieter both at idle and when driving at low speeds, which is particularly noticeable in stop-and-go traffic.
- b) **Less Mechanical Noise:** Without the vibrations and engine sounds of ICE vehicles, EVs produce minimal noise from their mechanical operations. The result is a noticeable decrease in overall city noise levels.

2. Impact on Urban Noise Pollution: Urban areas are often plagued by high levels of noise pollution, with transportation being one of the primary contributors. Vehicle traffic accounts for a large portion of urban noise, which can contribute to:

- a) **Health Issues:** Prolonged exposure to high noise levels can lead to various health problems, such as stress, sleep disturbances, hearing impairment, cardiovascular issues, and reduced quality of life.
- b) **Disturbed Public Spaces:** Noisy environments can make outdoor public spaces less pleasant and reduce their usability for relaxation, exercise, or social interaction.

With the introduction and adoption of EVs, urban noise pollution could be significantly reduced, leading to quieter neighborhoods, healthier environments, and a more pleasant experience for residents and visitors.

3. The Role of EVs in Reducing Traffic Noise:

Traffic noise in cities is a combination of engine sounds, tire friction on the road, and the noise from exhaust systems. The absence of engine noise in EVs reduces these sources of sound. When these quieter vehicles replace traditional gas-powered vehicles, the following improvements could be observed:

- a) **Overall Noise Reduction:** If EVs replace a large portion of ICE vehicles, the cumulative impact could significantly lower overall noise levels, especially in high-traffic areas. For example, noise levels on streets with heavy car traffic

could drop by 3–4 decibels, which may not sound like much but represents a notable reduction in terms of perception.

- b) **Reduced Disturbance at Night:** EVs are especially quiet at lower speeds, and at night, when background noise levels are lower, the quiet nature of EVs can be even more beneficial. Areas that experience overnight traffic, such as delivery zones or residential neighborhoods near busy streets, could see improved noise levels after EVs become more widespread.

4. Urban Planning and Acoustic Design: As EVs reduce overall traffic noise, urban planners and architects could begin to design cities with acoustics in mind. The quieter streets could open up new possibilities for more pedestrian-friendly, social, and green spaces that are less disturbed by noise, such as:

- a) **Silent Zones:** With reduced noise from traffic, certain areas of a city could be designated as “silent zones” or low-noise areas where people can gather, exercise, or relax without being disturbed by the sound of passing cars.
- b) **Redesigning Public Spaces:** Cities could focus on optimizing soundscapes in public spaces. For instance, areas like parks, plazas, and pedestrian walkways could be developed to emphasize a peaceful atmosphere that prioritizes natural sounds (birds, water, trees rustling) over vehicular noise.

5. Potential Challenges and Considerations:

While EVs offer a significant reduction in noise pollution, there are a few challenges that need to be addressed:

- a) **Pedestrian Safety:** The quiet nature of EVs raises concerns for pedestrians, particularly in crowded urban areas. People may not hear an approaching EV, increasing the risk of accidents. As a result, many countries are considering regulations that require EVs to emit low-level artificial sounds when traveling at low speeds. This “sound at low speed” feature ensures that pedestrians and cyclists are aware of the approaching vehicle.

b) **Street Noise Variations:** While EVs themselves are quieter, they still produce other forms of noise, such as tire friction on the road or air resistance at higher speeds. These noises may still contribute to overall urban noise levels, especially on busy highways. However, their contribution is typically much less than the noise from an internal combustion engine.

6. Broader Implications for Noise Pollution Reduction

Widespread adoption of EVs could contribute to a broader societal shift toward quieter, more sustainable urban environments:

- a) **Public Health Improvement:** A quieter urban environment can lead to better health outcomes by reducing stress levels, improving sleep, and lowering the risk of noise-induced health issues.
- b) **Increased Social Interaction:** With less traffic noise, people may feel more inclined to spend time outside, encouraging social interaction, community-building, and more active lifestyles.
- c) **Greater Accessibility:** Quieter streets could enhance accessibility for individuals with hearing impairments or those sensitive to noise, creating more inclusive public spaces.

7. The Future of EVs and Noise Pollution: As EV adoption grows, cities could become quieter places with enhanced quality of life. However, this shift will depend not just on the number of EVs on the road but also on complementary efforts like:

- a) **Infrastructure Investment:** Governments could incentivize the development of EV infrastructure, including charging stations and low-emission zones, to promote EV adoption.
- b) **Collaborative Urban Design:** Policymakers, planners, and vehicle manufacturers should collaborate to create city environments that are conducive to EVs and promote noise reduction at every level.

The role of electric vehicles in reducing noise pollution in urban environments is substantial. EVs contribute to quieter cities by reducing engine and mechanical noise, leading to a healthier, more pleasant urban soundscape. While challenges related to safety and urban dynamics exist, careful planning

and regulation can ensure that the transition to quieter, more sustainable cities is beneficial for both residents and the environment..

Result and Discussion: The analysis of electric vehicles (EVs) and their potential to reduce noise pollution in urban environments reveals significant impacts, but also highlights several challenges and areas for further consideration. This section summarizes key findings and offers a discussion on their implications for city planning, public health, and safety.

Results: Key Findings

a) **Reduction in Noise Pollution:** Engine Noise Reduction: EVs are significantly quieter than internal combustion engine (ICE) vehicles. Studies show that EVs reduce vehicle-generated noise by 50–60% compared to ICE vehicles. The absence of engine noise is especially noticeable at low speeds (such as in city traffic or residential areas) where EVs produce minimal sound.

Overall Traffic Noise Reduction: When EVs replace conventional vehicles, city-wide traffic noise levels can decrease by 3–4 decibels (dB). Although this might seem like a small difference, it is perceptible to the human ear and can lead to noticeable improvements in sound environments.

Impact on Nighttime Noise: During nighttime, when ambient noise levels are naturally lower, the absence of ICE vehicle noise is even more pronounced. EVs help mitigate nighttime disturbances, offering better sleep quality for residents in urban areas with heavy traffic.

b) **Health Benefits:** Improved Public Health: A reduction in traffic noise has been linked to reduced stress and better overall public health. Chronic exposure to high noise levels contributes to health issues such as hypertension, heart disease, and sleep disturbances. With EVs reducing ambient noise, residents may experience fewer noise-related health problems.

Quality of Life: Quieter cities promote a higher quality of life, with people enjoying outdoor activities, socializing, and engaging with their environment in a more peaceful setting. Studies indicate that quieter urban areas see increased

community well-being and higher levels of physical and mental health.

c) **Pedestrian and Cyclist Safety Concerns:** Potential Safety Risks: While EVs' quiet operation offers health and quality-of-life benefits, it also raises concerns regarding pedestrian and cyclist safety. In busy urban areas, pedestrians may be unable to hear an approaching EV, which could increase the likelihood of accidents. This has led to regulatory responses in several countries, such as requiring EVs to emit low-level artificial sounds at speeds below 30 km/h (19 mph).

Regulatory Impact: Some regulations, such as the European Union's requirement for EVs to generate sound below certain speeds, have been implemented to strike a balance between reducing noise pollution and ensuring safety. These measures help mitigate the risk of pedestrian and cyclist accidents while still reaping the noise-reduction benefits of EVs.

d) **Changes in Urban Soundscapes:** Shift in Sound Perception: With EVs reducing the dominant sounds of vehicle engines, the acoustic environment in cities changes. Urban soundscapes would become quieter, but the sound produced by tires on the road, the wind resistance at higher speeds, and other non-vehicular sources may still create background noise. This shift may prompt new approaches to urban design, where planners could focus on enhancing quieter spaces such as parks, pedestrian zones, and public squares.

Noise Redistribution: It's important to note that while traffic noise from vehicles decreases, other sources of urban noise, such as construction, social activities, or public transportation, may become more prominent. Thus, while EVs contribute to an overall reduction in traffic-related noise, the broader issue of urban noise pollution may require a more holistic approach.

Discussion: Implications and Considerations

Balancing Quiet Streets and Safety: The trade-off between quieter streets and pedestrian safety is a critical issue. While EVs provide an opportunity to lower urban noise pollution, the lack of engine noise could inadvertently increase accidents. As a result, the implementation of artificial sound requirements

for EVs at low speeds is essential to ensure that pedestrians and cyclists are aware of their presence. The goal should be to minimize noise pollution without sacrificing safety.

a) **Health and Environmental Considerations:** The reduction in traffic noise offers clear health benefits, especially in terms of reducing stress and improving sleep quality. Quieter cities contribute to a healthier urban environment, aligning with broader environmental goals to make cities more sustainable and livable. The adoption of EVs, in combination with other green initiatives like reducing industrial noise and promoting green spaces, could significantly enhance public health outcomes.

Noise pollution is increasingly being recognized as an environmental health issue, and EVs could be an essential part of a broader strategy to reduce urban pollution. However, addressing noise pollution from other sources—such as construction, air conditioning units, and street activities—remains an important challenge that needs to be addressed alongside the adoption of EVs.

b) **Economic and Social Impacts:** The transition to EVs has the potential to revitalize urban spaces by attracting businesses and people seeking a quieter, cleaner environment. With fewer noise disturbances, cities could see increased economic activity in areas such as tourism, real estate, and leisure. People may be more likely to live and work in areas where noise pollution is lower, which could lead to higher property values and greater investments in public spaces.

On a social level, quieter environments promote more inclusive and accessible spaces for all. Individuals who are sensitive to noise, such as the elderly and those with hearing impairments, would benefit from a more peaceful environment.

c) **Future Research and Innovation:** While the benefits of quieter EVs are clear, there is still a need for further research into how EVs interact with other elements of urban noise. Future studies could explore how to optimize EV sound design, ensuring that the reduction in engine noise does not negatively impact safety. Additionally, researchers

should explore the acoustic impacts of tire noise, road surface materials, and air resistance, as these elements also play a significant role in the urban soundscape.

Further innovation in EV technology, such as improvements in battery efficiency and energy storage, could contribute to even quieter and more sustainable transportation options.

Conclusion: The transition to electric vehicles represents a significant step toward reducing noise pollution in urban environments. EVs offer the promise of quieter, healthier, and more livable cities by reducing traffic-related noise. However, addressing the safety concerns posed by their quiet operation and considering the broader urban noise landscape are crucial for maximizing the benefits of EV adoption. As cities continue to embrace sustainable transportation options, further innovations and thoughtful urban planning will be essential in creating quieter, safer, and more vibrant urban spaces.

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