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Article

Rural electromobility: innovation for transportation in indigenous and rural communities

Electromovilidad rural: innovación para el transporte en comunidades indígenas y campesinas

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Abstract

Rural electromobility represents a strategic and innovative alternative for reducing mobility gaps in indigenous and rural communities in southeastern Mexico. This article analyzes the potential for implementing light electric vehicles [tricycles, motorcycles, motorized carts, and community transport] in rural contexts with a focus on sustainability, social justice, and cultural relevance. It presents an assessment of current conditions in rural municipalities in Tabasco, Chiapas, and Campeche, evaluating factors such as energy availability, road infrastructure, public policies, social acceptance, and local technical capabilities. The methodology is based on a mixed approach, using semi-structured interviews with community actors, documentary analysis, and case studies. The findings reveal that, although there are challenges in financing, maintenance, and training, rural electromobility can generate significant benefits: reduced emissions, economic savings, equitable access to services, and strengthening of the community fabric. It concludes that participatory design, local technical training, and coordination with academic institutions can accelerate the adoption of these technologies.

Objective	Methodology	Contribution
Analyse the potential of electromobility as an innovative and sustainable solution to improve access to transportation in indigenous and campesino communities in south-eastern Mexico, identifying barriers, opportunities and implementation strategies suited to the rural context.	A mixed approach is employed. The qualitative part involves conducting semi-structured interviews with community actors, technicians and local authorities, the documentary part analyses case studies, public policies and national and international experiences on rural electric mobility. Municipalities in Tabasco, Chiapas and Campeche are selected as feld study sites for their territorial.	The article provides a contextualized vision of rural electromobility as a tool for territorial equity, social inclusion and environmental sustainability. It offers a framework of participatory implementation based on local capacities, promoting alternative transport models tailored to the needs and realities of south-eastern Mexican indigenous community.

Sustainable transport, Rural electromobility, Territorial inclusion

Resumen

La electromovilidad rural representa una alternativa estratégica e innovadora para reducir las brechas de movilidad en comunidades indígenas y campesinas del sureste de México. Este artículo analiza el potencial de implementar vehículos eléctricos ligeros [triciclos, motos, motocarros y transportes comunitarios] en contextos rurales con enfoque de sostenibilidad, justicia social y pertinencia cultural. Se presenta un diagnóstico de las condiciones actuales en municipios rurales de Tabasco, Chiapas y Campeche, evaluando factores como disponibilidad energética, infraestructura vial, políticas públicas, aceptación social y capacidades técnicas locales. La metodología se basa en un enfoque mixto, utilizando entrevistas semiestructuradas a actores comunitarios, análisis documental y estudios de caso. Los hallazgos revelan que, si bien existen desafíos en financiamiento, mantenimiento y capacitación, la electromovilidad rural puede generar beneficios significativos: reducción de emisiones, ahorro económico, acceso equitativo a servicios y fortalecimiento del tejido comunitario. Se concluye que el diseño participativo, la formación técnica local y la articulación con instituciones académicas pueden acelerar la adopción de estas tecnologías.

Objetivo	Metodología	Contribución
Analizar el potencial de la electromovilidad como solución innovadora y sostenible para mejorar el acceso al transporte en las comunidades indígenas y campesinas del sureste de México, identificando barreras, oportunidades y estrategias de implementación adecuadas al contexto rural.	Se emplea un enfoque mixto. La parte cualitativa consiste en realizar entrevistas semiestructuradas con actores comunitarios, técnicos y autoridades locales, mientras que la parte documental analiza estudios de caso, políticas públicas y experiencias nacionales e internacionales sobre movilidad eléctrica rural. Se seleccionan municipios de Tabasco, Chiapas y Campeche como sitios de estudio de campo por su territorio.	El artículo ofrece una visión contextualizada de la electromovilidad rural como herramienta para la equidad territorial, la inclusión social y la sostenibilidad medioambiental. Propone un marco de implementación participativa basado en las capacidades locales, promoviendo modelos de transporte alternativos adaptados a las necesidades y realidades de la comunidad indígena del sureste de México.

Transporte sostenible, Electromovilidad rural, Inclusión territorial

Area: Development of strategic leading-edge technologies and open innovation for social transformation

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Introduction

La electromovilidad ha ganado una importancia strategic in the global context as a technological alternative that reduces polluting gas emissions, promotes the use of clean energy, and transforms the transport system towards sustainable models. www.gob.mx › semarnat [Ministry of the Environment and Natural Resources [SEMARNAT], 2022]. In Mexico, electromobility has been promoted in urban areas; however, rural areas, especially indigenous and peasant communities, continue to face significant barriers in accessing adequate means of transport. In the southeastern states of Mexico, such as Tabasco, Chiapas, Campeche, and Oaxaca, there are high levels of marginalisation and social backwardness, which limit connectivity, access to basic services, and the productive mobility of their inhabitants [National Council for the Evaluation of Social Development Policy [CONEVAL], 2023].

This article argues that rural electromobility, particularly through light electric vehicles, can become a strategy for social innovation and territorial justice. Its implementation would improve access to services, reduce transport costs, generate local jobs and contribute to environmental sustainability. In this context, this article analyses the feasibility, barriers and opportunities of electromobility for rural communities in southeastern Mexico, with an emphasis on its socio-technical, cultural and economic adaptation [Secretariat of Energy [SENER], 2022].

Definition and relevance of rural electromobility

Rural electromobility can be defined as the use of electric vehicles adapted to the geographical, economic and cultural conditions of rural communities. These vehicles can include electric bicycles, motorcycles, tricycles, motorised rickshaws or minibuses that run on rechargeable batteries. Unlike urban solutions, rural electromobility requires innovative, adaptive and participatory approaches.

Its relevance is evident in multiple dimensions [Economic Commission for Latin America and the Caribbean [ECLAC] 2022]. Socially, it improves access to health, education and markets, facilitating mobility for women, young people and older adults.

Economically, it reduces dependence on fossil fuels, generates household savings and can activate local production chains. Environmentally, it contributes to climate change mitigation, reduces air pollution and promotes the use of renewable energies [Litman, 2025; Eliseo Dantés, 2024]. Culturally, it allows for the design of locally relevant solutions, respecting community knowledge and promoting technological appropriation.

Box 1

Figure 1

AI-generated image on electromobility *OpenAI*

Source: [2025]. AI-generated image on electromobility

Methodology

This research adopts a mixed approach combining qualitative methods and documentary analysis. The qualitative component involved semi-structured interviews with 15 key actors, including community leaders, municipal technicians, teachers from technological institutions, and representatives of grassroots organisations in rural communities in Tabasco, Chiapas, and Campeche. The interviews identified perceptions, needs, obstacles and expectations regarding the possible adoption of electromobility.

The documentary component included a systematic review of scientific literature, government reports and international experiences in the implementation of rural electric mobility projects. This review contextualised the phenomenon, identified good practices and built a comparative base with experiences in other Latin American countries. The triangulation of qualitative and documentary data strengthened the validity of the findings and guided the analysis towards viable proposals from a territorial development perspective.

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Technical analysis

The qualitative analysis was structured using thematic coding, with Atlas.ti software to organise and classify the information obtained in the interviews.

Five central categories were identified: community perception, technical barriers, economic viability, social participation, and environmental sustainability. Each category allowed us to establish relationships between the different social, technical, and economic elements that influence the adoption of electromobility.

A documentary analysis matrix was also applied to compare public policies, regulatory models, and successful cases of electromobility in rural contexts in countries such as Colombia, Bolivia, and Peru.

This cross-analysis identified replicable patterns, as well as important differences in the institutional and cultural framework that must be considered for the Mexican context.

Results

For rural electromobility to become a viable reality, it is necessary to articulate multisectoral and inclusive strategies:

1. Participatory design: communities must be involved from the diagnosis to the operation of the systems, culturally validating the technologies.
2. Technical training: rural youth must be trained in the maintenance, installation and operation of electric vehicles through programmes coordinated by institutions such as the National Technological Institute of Mexico.
3. Inclusive financing: microcredit schemes, mobility cooperatives and subsidies targeting rural areas should be promoted to facilitate the acquisition of vehicles.
4. Charging infrastructure: It is proposed to install community solar stations that function as charging points and local energy management centres. Differentiated public policy: There is an urgent need to create a regulatory framework that includes rural areas in energy transition and electromobility plans.

Impact of electromobility

The impacts of rural electromobility on indigenous and rural communities are multiple and cross-cutting. In the environmental sphere, it translates into reduced CO_2 emissions, improved air quality and reduced environmental noise. In the social sphere, it facilitates the mobility of vulnerable populations, enables access to health and education services, and strengthens community cohesion.

From an economic point of view, the use of electric vehicles reduces household spending on transport, improves agricultural production logistics and generates new job opportunities in the maintenance, assembly and operation of electrical systems. It also promotes energy autonomy through the use of solar systems and encourages sustainable social innovation models. In cultural terms, it contributes to strengthening community identity by allowing technological solutions to be integrated into the local way of life and values [Mexico City Government Portal, 2022].

Discussion

The findings show that rural electromobility can be an effective tool for reducing structural inequalities, but its success depends on critical factors: community ownership, access to financing, institutional support, and differentiated public policies. As mentioned by [Litman, 2025], experiences in Latin America show that cooperative models, targeted subsidies and technical education are key elements in ensuring the sustainability of these projects.

In the case of Mexico, the absence of specific regulations for rural areas, as well as the concentration of efforts in urban areas, represents a significant obstacle. However, coordination with academic institutions, local governments, and civil society organisations can generate synergies capable of overcoming these barriers.

The case of electric tricycles in municipalities in Chiapas and community solar systems in Campeche are examples of emerging initiatives that deserve to be strengthened and replicated.

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Conclusions

Rural electromobility represents a viable, sustainable and necessary alternative for improving the living conditions of indigenous and rural communities in southeastern Mexico. Its implementation requires comprehensive strategies that include the active participation of communities, the development of local technical capacities, the design of inclusive public policies and the establishment of accessible financing schemes.

The approach must be intercultural, territorial and sustainable, promoting innovation models that are built on local knowledge and respect cultural diversity. Rural electromobility is not only a technical solution, but also an opportunity to advance towards energy justice that integrates historically excluded territories into the national development agenda.

Declarations

Conflict of interest

The authors declare that they have no conflict of interest. They have no known competing financial interests or personal relationships that could have influenced the article.

Contribution of authors

Eliseo-Dantés, Hortensia: Conceptualisation of the study, development of the theoretical framework, methodological design, data collection and analysis, drafting of the original manuscript.

Pérez-Garmendia, Gloria: Support in instrument validation, statistical analysis, critical review of content, editing and proofreading of the manuscript.

García-Reyes, David Antonio and *García-Jerónimo, Beatriz*: Overall supervision of the research project, advice on the interpretation of results, project management, resource acquisition, final review of the manuscript for submission.

Availability of data and materials

The data on which the conclusions of this study are based can be requested from the corresponding author.

Due to [confidentiality agreements / ethical considerations / institutional restrictions], some parts of the data cannot be shared publicly. Researchers interested in accessing the data sets can contact the corresponding author to discuss the possibility of sharing the data under appropriate conditions.

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Abbreviations

1. CONEVAL: National Council for the Evaluation of Social Development Policy [Consejo Nacional de Evaluación de la Política de Desarrollo Social].
2. SENER: Energy Secretariat.
3. SEMARNAT: Ministry of Environment and Natural Resources.
4. CEPAL: Economic Commission for Latin America and the Caribbean.
5. CDMX: Mexico City.

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