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# Assessment of the integration of electric vehicles into the Colombian market by 2050 using system dynamics

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**ABSTRACT**

This article focuses on evaluating the prospects and potential that Colombia possesses for achieving a complete transition to electric vehicles (EV), with the goal of reaching a 100% penetration of such vehicles by the year 2050. To address this challenge, four potential scenarios are proposed, each based on different approaches and strategies. To achieve the objective described in the article, a simulation modeling approach was employed. Through this process, a definitive model was obtained that enables a visual representation of the progress of the different scenarios over the years. This graphical representation offers a clear insight into which scenarios align with the established parameters to achieve the target of nearly 100% electric vehicle adoption in Colombia by 2050. Additionally, there is a considerable reduction in $CO_2$ emissions produced by the transportation sector in Colombia, with a 27% decrease compared to 2023. This is noteworthy given that the number of vehicles in 2050 is expected to be significantly higher than in the initial period, thus beginning a phase of declining pollution in the country.



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## 1. INTRODUCTION

The integration of electric vehicles (EVs) into the Colombian market poses significant challenges due to the country's current infrastructure, policy framework, and the lack of a widespread charging network. As Colombia aims to transition toward a cleaner energy future by 2050, the successful adoption of EVs is crucial for reducing greenhouse gas emissions. However, high costs, limited consumer awareness, and insufficient governmental incentives have slowed EV adoption, necessitating an in-depth analysis to ensure the country's targets can be met.

Despite Colombia's commitment to sustainable development, several unsolved problems remain. These include the slow pace of infrastructure development, high upfront costs of electric vehicles, and inadequate policy support for consumers and industries. Additionally, there is a lack of data-driven research to predict the impact of EV adoption on the energy grid, economic stability, and social acceptance. The complexity of these interrelated factors calls for a systems approach to properly address the EV market integration.

The global charging infrastructure for electric vehicles (EVs) experienced significant growth in 2021, with the number of available public chargers increasing by nearly 40% compared to the previous year [1], [2]. Charging stations are critical for the widespread adoption of electric vehicles, as they ensure convenient access to power, reduce range anxiety, and support the transition to sustainable transportation [3]. The installation of low-power chargers grew by 33%, although this is a decline from the average annual growth rate of 60% observed between 2015 and 2020. In contrast, high-power fast chargers saw a 45% rise in installations during the same period [4]-[7]. While this expansion of charging stations contributes to reducing the carbon, footprint associated with EVs, there remains potential for further reductions by integrating hybrid or renewable energy sources. Studies suggest that using renewable energy for EV charging could reduce the carbon footprint by as much as 89.9%, while also lowering the cost of charging, thus further reducing vehicle operating costs [8]-[12].

The growth of EV adoption is highly uneven across countries. For instance, China added approximately 9.5 million new registrations in 2021, which accounted for 97% of the global market. In comparison, Vietnam saw 230,000 new EV registrations, while India had 89,000. In Asia, electric motorcycles and tricycles are gaining popularity due to their affordability, with 25% of these vehicles being electric in 2021 [13]. This stark difference in market penetration highlights the need for localized strategies that consider both the economic conditions and infrastructure capacity of different regions.

The market share of electric vehicles, including light commercial vehicles (LCVs), pickups, trucks, and vans, grew significantly in 2021, increasing by 50% compared to the previous year. China led this market, selling 86,000 electric LCVs, while Europe sold 60,000 [4]. At the same time, sales of conventional buses decreased by 7%, whereas electric buses saw a 40% increase, representing 4% of the global bus market. The increasing dominance of electric vehicles across various segments reinforces the importance of reliable data on EV stock and sales for industrial policy planning, particularly concerning the use of renewable energy in transportation [14]-[19].

The economic and environmental potential of shared electric vehicle models is being increasingly recognized. Several studies propose that shared EV models not only reduce greenhouse gas (GHG) emissions but also introduce new business opportunities, such as selling stored energy from vehicle batteries back to the grid [20]. This approach not only promotes sustainability but also offers an income stream for vehicle owners. Moreover, government policies that regulate these technologies as income-generating resources could accelerate EV adoption by framing them as both transportation solutions and energy assets [21], [22]. This model could also mitigate GHG emissions by repurposing the batteries of decommissioned electric vehicles for clean energy generation, further contributing to environmental sustainability [23]-[26].

Modeling the penetration of electric vehicles (EVs) into the market is crucial for understanding the dynamics that drive their adoption and anticipating future trends. It enables policymakers, businesses, and researchers to assess the impact of various factors such as technological advancements, economic incentives, charging infrastructure, and environmental policies on consumer behavior. By simulating different scenarios, stakeholders can identify potential barriers to EV adoption and develop strategies to overcome them, ensuring a smoother transition to sustainable transportation [27], [28]. On the other hand, photovoltaic energy plays a crucial role in the sustainability of electric vehicles (EVs) by providing a renewable source of power that reduces reliance on fossil fuels. By harnessing sunlight through solar panels, EVs can be charged using clean energy, significantly lowering their carbon footprint [29], [30].

This research presents a novel approach by applying system dynamics to forecast the long-term implications of EV adoption in Colombia. Unlike previous studies, which have primarily focused on isolated aspects such as policy or technology, this study provides a holistic analysis. It incorporates technical, economic, environmental, and social factors into a dynamic model to simulate various scenarios. The model also introduces previously unexplored variables, such as energy demand fluctuation and consumer behavior over time, offering new insights into how Colombia can achieve its 2050 EV goals.

The subsequent sections will detail the methodology used to build the system dynamics model, including data sources and assumptions. The model's results will be presented to highlight potential pathways for successful EV integration under different policy and infrastructure scenarios. Finally, the discussion will interpret these findings in the context of Colombia's broader energy transition goals, offering practical recommendations for policymakers and stakeholders. The relevance of this work lies in its ability to provide actionable insights into the country's transition to sustainable transportation, with broader implications for other emerging markets aiming for similar objectives.

## 2. METHODOLOGY

### 2.1. Survey data and variable selection

The assessment model integrates key decision-making variables identified through a comprehensive survey conducted as part of the electric vehicle massification study in Bogotá [31]. This survey revealed the main factors influencing consumers' choices when selecting electric vehicles, which are pivotal for the design of the massification model. The identified variables include vehicle cost, range, operating costs, availability of charging stations, charging time, maintenance costs, and the variety of electric vehicle models available in the market.

### 2.2. Weighting of decision-making factors

To quantify the relative importance of these variables in consumer decision-making, specific weights were assigned to each factor based on the survey responses. The assigned weights reflect the perceived importance of each variable in the consumer's overall vehicle selection process. The factors and their corresponding weights are as follows:

- Vehicle cost: 30%, indicating its predominant influence on decision-making.
- Range (autonomy): 21%, reflecting the critical role of travel distance between charges.
- Operating costs: 23%, capturing the long-term expenses associated with electric vehicle ownership.
- Charging stations: 7%, highlighting the growing importance of charging infrastructure availability.
- Charging time: 7%, representing the importance of fast recharging for convenience.
- Maintenance costs: 6%, addressing the concern over ongoing maintenance expenses.
- Variety of models (number of vehicles): 6%, showing the impact of available choices in influencing consumer decisions.

These weights ensure a balanced representation of factors, providing a holistic evaluation framework for the decision-making process. This weighting structure aims to provide a balanced and comprehensive evaluation, considering all relevant aspects in vehicle selection. For the logit model used to determine the probability of selecting an electric vehicle, specific values are assigned to the coefficients (Betas) associated with different decision factors. These betas are essential for calculating the logarithmic probability of choosing an electric vehicle based on certain attributes. Below are the specific beta values for each factor:

- Vehicle cost (CVE): -5.96e-05
- Autonomy (A): 0.002575
- Operating costs (CO): -1.17e-07
- Charging stations (EC): 0.00028
- Charging time (TC): -0.001117
- Maintenance costs (CM): -5.25e-08
- Number of vehicles (VE): 3.3e-07

For calculating the logarithmic probability of choosing an electric vehicle using (1).

$$\text{Prob} = \frac{1}{1+e^{\left(-\left(-5.96e-05*\text{CVE}+0.002575*\text{A}-1.17e-07*\text{CO}+0.00208*\text{EC}-5.96e-05*\text{CM}-0.001117*\text{TC}+3.3e-07*\text{VE}\right)\right)}} \quad (1)$$

The maintenance costs of electric vehicles mainly consist of the annual increase in the compulsory traffic accident insurance (SOAT), which represents a significant portion of the expenses, and is calculated with (2).

$$Maintenance\ costs = Road\ kit + Washing + Preventive\ inspection + SOAT + Mechanical\ inspection - (Preventive\ inspection * Benefits\ and\ incentives) - (SOAT * Benefits\ and\ incentives) - (Mechanical\ inspection * Benefits\ and\ incentives) \quad (2)$$

The (3) shows the way to calculate the EV cost.

$$\text{EV cost} = \text{EV initial cost} + \int -cost\ reduction \quad (3)$$

The function representing the learning in the autonomy of the electric vehicle as (4).

$$Autonomy\ 30.537 * (Electric\ vehicles)^\wedge(Learning\ factor) \quad (4)$$

The mathematical expression that represents the operating costs is defined by the following (5).

$$Operating\ Costs\ \left(Km\ driven\ per\ year * \frac{kWh}{Km} EV * kWh\ cost\right) + Battery\ Price\ COP + Taxes \quad (5)$$

Currently, with an average charger of 16 A, 230 VAC, 3.7 kW, the average time for a full charge is around 480 minutes (8 hours). This variable is modeled using an equation that follows a learning curve, expressed as (6).

$$Charging\ Time = 480 * (Electric\ Vehicles)^\wedge(-\ learning\ factor) \quad (6)$$

The proposed model considers the growth of charging stations in relation to the number of existing vehicles, introducing a learning curve. The equation representing the increase in charging stations as (7).

$$Charging\ stations = 60 * (Electric\ Vehicles)^{\wedge}(learning\ factor) \quad (7)$$

### 2.3. Model calibration and validation

The logit model was calibrated and validated using the survey data from the Bogotá electric vehicle massification study [31]. The coefficients were fine-tuned through regression analysis, ensuring that the model aligns closely with observed consumer preferences. The model was subsequently validated using additional data points, allowing for robust predictions of electric vehicle adoption probabilities under various scenarios projected for the year 2050.

The model is validated through a combination of calibration and comparison against real-world data. First, it is calibrated using historical data from the Colombian market and survey results on electric vehicle (EV) preferences and adoption trends, specifically from the electric vehicle massification study in Bogotá. This calibration ensures that the model accurately reflects current consumer behavior and market conditions.

Next, the model's projections are validated by comparing them with actual trends in EV adoption and infrastructure development both in Colombia and in similar markets that have experienced EV growth. Sensitivity analysis is also employed to test the model’s robustness by adjusting key variables such as vehicle costs, charging infrastructure, and policy incentives and observing how these changes impact the model's predictions. This helps ensure that the model responds realistically to shifts in external conditions and produces reliable results under a range of future scenarios. Additionally, validation is strengthened through the comparison of the model's outcomes with established benchmarks and findings from other studies on EV adoption. This process ensures that the model aligns with known patterns in the diffusion of new technologies and provides credible forecasts for Colombia’s EV market by 2050.

### 2.4. Scenarios development and parametrization

In addition to the core decision-making factors, several potential scenarios were considered to capture the broader economic and political perspectives that could influence the adoption of electric vehicles in Colombia by 2050. These scenarios were developed based on varying assumptions about future policy, technology, and market developments and are named: Green Democracy, Greta, Renewable Extractivism, and Burning House. Each scenario reflects distinct trajectories for electric vehicle adoption, influenced by the rate of learning (technology improvements), economic incentives, and CO2 emissions from electricity generation. Figure 1 shows the planned scenarios for the potential behavior of Colombia by 2050.

Table 1 shows the specific value of the parameters related with the model, in accordance with the economic and political perspective of potential scenarios. Each scenario introduces a unique combination of economic and technological parameters, which were incorporated into the model to capture their impact on electric vehicle adoption. For example, the Green Democracy scenario assumes high economic incentives and significant technological advancements, while the Burning House scenario predicts a less favorable economic and technological environment for electric vehicle adoption.

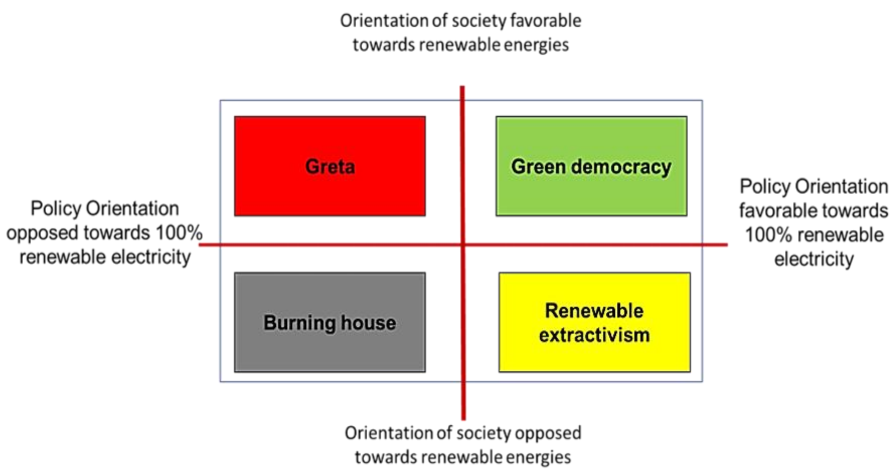



Figure 1. Planned scenarios for the potential behavior of Colombia by 2050

### 2.5. Model simulation

Once the scenarios were defined, the best simulation strategy was developed to analyze the potential market behaviors under each condition. The chosen simulation tool for this analysis is Vensim software, which offers an intuitive platform for modeling system dynamics. This software was selected due to its strong capabilities in handling complex systems, enabling the incorporation of various interconnected factors and feedback loops that affect electric vehicle adoption.

The system dynamics model (illustrated in Figure 2) captures the interactions between the decision-making factors and the broader economic and policy scenarios. The logit model was integrated into this system dynamics framework to analyze the behavior of electric vehicle selection, particularly how the likelihood of adoption evolves over time in response to changes in factors such as vehicle costs, charging infrastructure, and CO2 emissions. This approach allowed for the simulation of the electric vehicle market under different future scenarios, providing a comprehensive assessment of the potential pathways for electric vehicle integration into the Colombian market by 2050.

Table 1. Parameters values of each potential scenario proposed

| Parameter | Green Democracy | Greta | Renewable Extractivism | Burning House |
|---|---|---|---|---|
| Economic benefits and incentives (%) | 1 – 50 | 1 – 8.9 | 1 – 50 | 1 – 8.9 |
| Autonomy learning (%) | 20 | 15.5 | 14 | 14 |
| Charging stations learning (%) | 30 | 28 | 26 | 25 |
| Charging time learning (%) | -5 | -4 | -3 | -2 |
| Learning reduction per vehicle cost (%) | -33 | -42 | -43 | -45 |
| Cost per kWh (USD) | 0.21 – 0.13 | 0.21 – 0.17 | 0.21 – 0.22 | 0.21 – 0.23 |
| CO2 emissions in electricity generation (gCO2eq/kWh) | 166.2 – 0 | 166.2 – 10.6 | 166.2 – 43.2 | 166.2 – 23.5 |

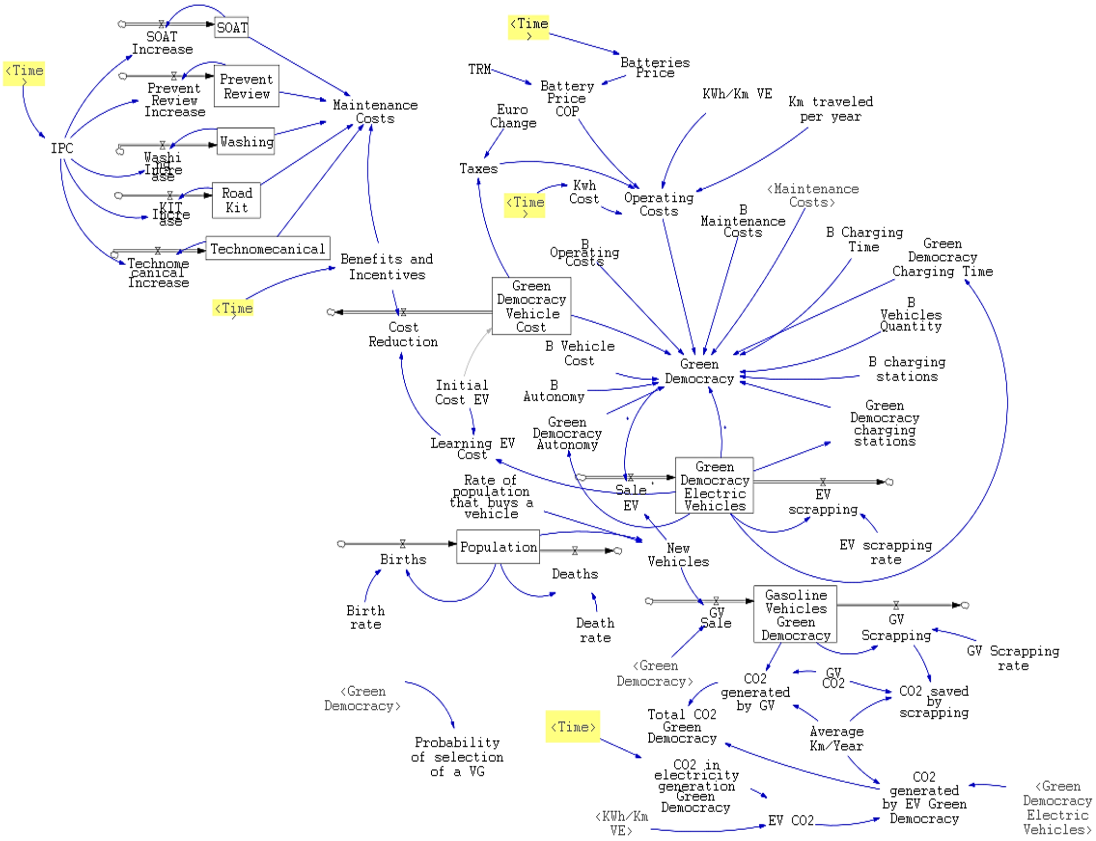



Figure 2. System dynamics model developed in Vensim

## 3. RESULTS AND DISCUSSION

Figure 3(a) presents the projections of charging stations by 2050 for the 4 scenarios. To increase the likelihood of people choosing electric vehicles, it is essential to have a high number of charging stations that accommodate the annual increase in vehicles. In the scenario called "Green Democracy," a learning pattern is observed showing a total of 7213 charging stations by the year 2050, significantly surpassing the values of other scenarios such as 4665 for "Greta," 2684 for "Burning House," and 3280 for "Renewable Extractivism."

Figure 3(b) shows the projection of charging time by 2050 for the 4 scenarios analyzed. The speed at which an electric vehicle charges plays a crucial role in its overall acceptance, being a determining factor in people's adaptation to this change. This aspect is particularly highlighted because it involves dedicating considerable time compared to traditional combustion vehicles. To address this challenge, a simulation of the model was conducted using an average charging of 16 amperes, 230 volts of alternating current, generating 3.7 kilowatts, with a total charging time of approximately 480 minutes to reach 100% capacity.

The most efficient results were obtained in the "Green Democracy" scenario, where the average charging time was reduced to about 330 minutes, equivalent to 5.5 hours. In contrast, the other scenarios presented values of 366 minutes for "Greta," 428 minutes for "Burning House," and 397 minutes for "Renewable Extractivism." These results suggest that the current charging methodology could evolve towards an approach where users charge their vehicles overnight or during idle times, such as in shopping centers, offices, or at home. This is because current charging times are too extensive to quickly replenish, as is currently done with combustion vehicles. This change in charging dynamics could be crucial in facilitating the transition to widespread adoption of electric vehicles. These data suggest that the most influential factor for efficient growth of charging stations lies in societal predisposition toward electric vehicles. A favorable attitude from society toward this technology is the determining element in driving the development and efficiency of charging infrastructure, thus providing a better environment for the widespread adoption of electric vehicles.

(a)

(b)

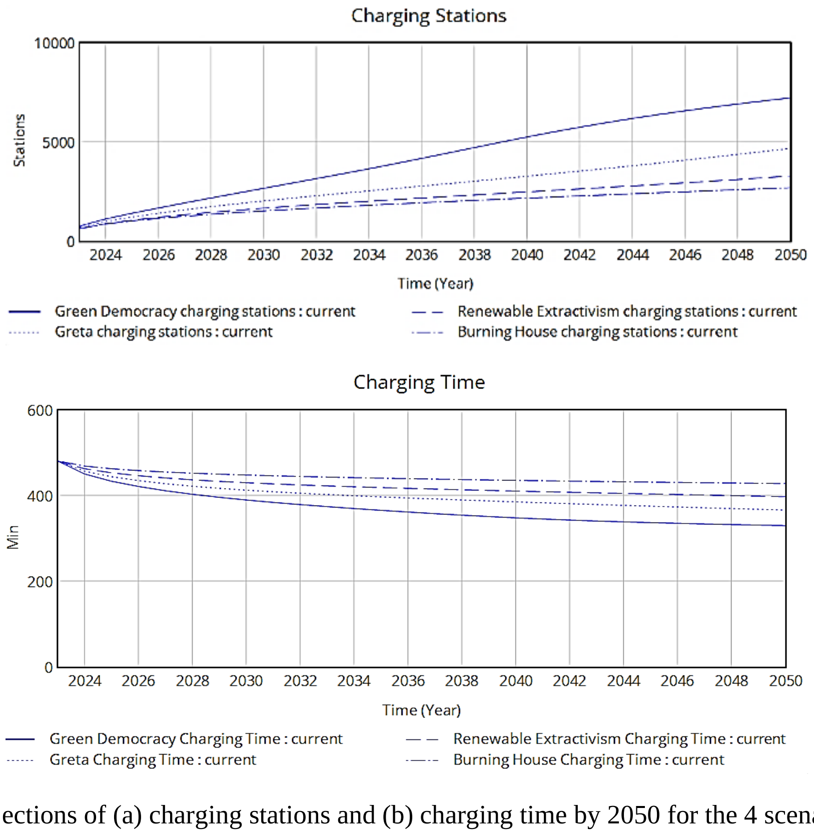



Figure 3. Projections of (a) charging stations and (b) charging time by 2050 for the 4 scenarios

Figure 4(a) shows the projection of EV’s autonomy by 2050 for the 4 scenarios analyzed. According to the values obtained from the model simulation in the different scenarios, it is projected to reach efficiency values close to that of a current combustion vehicle by the year 2050. For the “Green Democracy” scenario, the autonomy will increase to 840 km, 529 km for the “Greta” scenario, 417 km for “Burning House,” and 448 km for “Renewable Extractivism.” The autonomy achieved in the Green Democracy scenario demonstrates that with a significant increase in electric vehicles, it could be considered a competitive technology in terms of autonomy, competing with current combustion vehicles. However, the other scenarios do not show such favorable results, as currently, an autonomy close to 500 km would not provide consumers with the confidence needed for long trips or extended travel distances.

Figure 4(b) presents the projection of electric vehicles by 2050 for the 4 scenarios analyzed. The number of electric vehicles currently does not exceed 1.4% of the total, with approximately 8,299 vehicles, and growth is expected based on the fulfillment of the decision factors for each scenario. For the “Green Democracy” scenario, an estimated 15.7 million electric vehicles will be achieved by 2050. in the “Greta” scenario, around 7.7 million are expected, in “Burning House” a total of 2.9 million, and for “Renewable Extractivism,” a total of 4.8 million electric vehicles is anticipated. There is a significant difference between these values and the “Green Democracy” scenario, as this is one of the most important factors for the growth of this technology, creating a substantial gap between the results of the proposed scenarios.

Figure 5(a) shows the projection of the probability of selecting an EV by 2050 for the 4 scenarios analyzed. Given the enormous growth in the "Green Democracy" scenario, there is a considerable increase starting in 2028, where a separation from the simulation results for the other scenarios begins to become evident. For the "Green Democracy" scenario, 99.8% of the vehicles are expected to be electric. However, the other scenarios do not show similar or nearly 100% results. For the "Greta" scenario, an 81.4% adoption of this technology is expected, "Burning House" is estimated to have 19.8% of these vehicles, and "Renewable Extractivism" is expected to reach 50%. This gap between scenarios highlights that the social and political spheres must align to progress as expected in the future.

Figure 5(b) presents the projection of CO2 produced by electric vehicles in Colombia by 2050 for the 4 scenarios analyzed. Electric vehicles contribute only a minimal part of the total CO2 emissions, as this refers to the CO2 produced from the generation of energy used to recharge their batteries, making them indirect producers. The "Green Democracy" scenario expects CO2 generation from electric vehicles to reach a maximum value of 99,000 tons of CO2 by 2030, and then it will reduce to zero due to the increase in renewable energy for power generation. For the other scenarios, a prolonged increase is expected, as their energy grids are not 100% renewable, leading to values of 184,000 tons of CO2 for the "Greta" scenario, 283,000 tons of CO2 for "Burning House," and 252,000 tons of CO2 for "Renewable Extractivism."

The 27% reduction in CO2 emissions from the transportation sector in Colombia is significant, reflecting the positive impact of increased electric vehicle (EV) adoption and a shift towards cleaner energy sources. As EVs replace internal combustion engine vehicles, the reliance on fossil fuels decreases, directly lowering emissions from gasoline and diesel consumption. Moreover, the development of renewable energy infrastructure in Colombia further enhances this reduction, as a larger share of the electricity used to power EVs comes from low-carbon sources. This combination of cleaner vehicles and energy sources is pivotal in achieving substantial emissions reductions compared to 2023 levels.

(a)

(b)

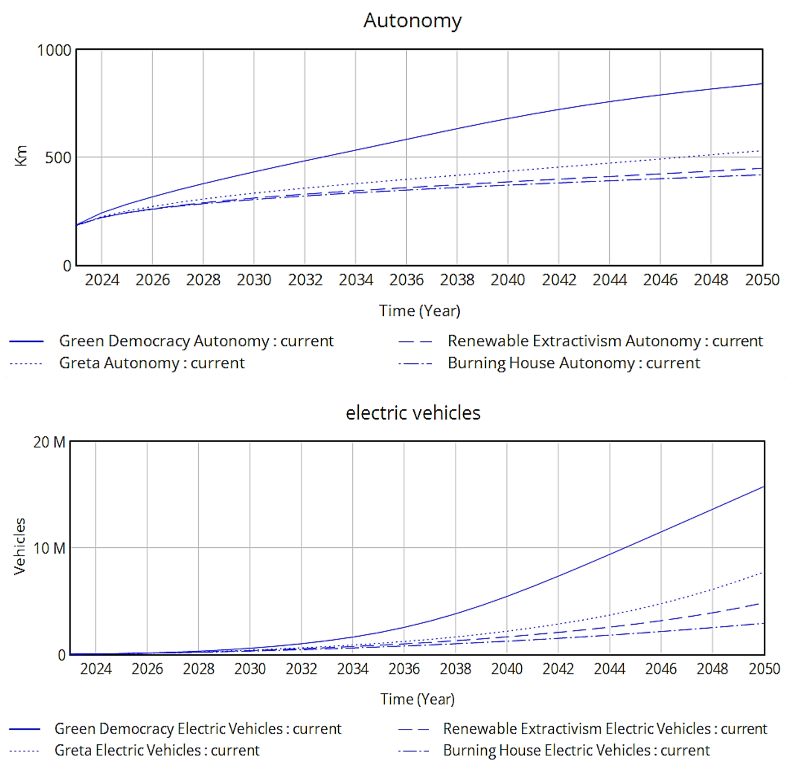
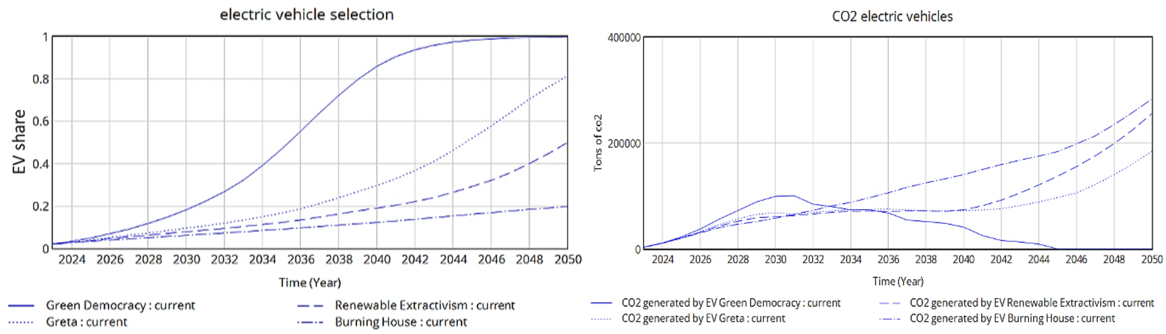



Figure 4. Projections of (a) EV´s autonomy and (b) electric vehicles by 2050 for the 4 scenarios



(a) (b)

Figure 5. Projections of (a) probability of selecting an EV and (b) CO2 produced by EV´s in Colombia by 2050 for the 4 scenarios

The study accounts for the current state of infrastructure and technology for electric vehicles (EVs) in Colombia by incorporating key factors such as the availability of charging stations, charging time, and vehicle autonomy. These elements are reflected in the weighting of decision-making variables and are critical to understanding the limitations and potential growth areas for EV adoption. The model also considers learning curves for both autonomy and charging infrastructure, assuming gradual improvements over time as technology evolves and infrastructure expands. Additionally, the different scenarios such as Green Democracy and Burning House reflect varying levels of policy support and technological advancement, allowing the model to simulate the impact of current and future developments in EV infrastructure and technology on market penetration.

This research shows that while the deployment of electric vehicles (EVs) in Colombia by 2050 is feasible, the integration requires significant infrastructural, regulatory, and societal shifts. The ramifications of these findings indicate that without proper incentives, grid modernization, and public-private partnerships, EV penetration could be slower than anticipated. Additionally, comparative analysis with other nations that have successfully implemented EV policies highlights the need for Colombia to adopt similar strategic approaches. Future applications of the model presented could provide vital decision-making tools to policymakers, assisting in refining energy strategies to accelerate EV adoption. Therefore, the research offers not only a framework for understanding EV integration but also valuable insights for potential policy interventions and market incentives, which will be crucial for the country’s energy transition.

We can draw parallels between Colombia’s progress in electric vehicle (EV) adoption and that of countries with more advanced EV markets, such as Norway and China:

- Policy and incentives: In Norway, aggressive government policies, including subsidies, tax exemptions, and free parking for EV users, have led to one of the highest EV adoption rates in the world, where over 80% of new car sales are electric. In contrast, Colombia’s EV market is still in its infancy, with significantly lower incentives. If Colombia were to adopt similar policies, such as reducing import taxes on EVs or providing subsidies, it could accelerate the adoption rate and transition to cleaner transport options.
- Charging infrastructure: China’s rapid deployment of charging infrastructure has been a critical factor in scaling its EV market, where over 2.2 million charging stations exist as of 2022. Comparatively, Colombia is still developing its charging network, and the absence of a widespread fast-charging infrastructure poses a bottleneck for large-scale EV adoption. To catch up, Colombia needs to prioritize the development of public and private charging stations, ensuring they are accessible in both urban and rural areas.
- Energy mix and environmental impact: Norway’s predominantly renewable energy mix (nearly 100% from hydropower) ensures that its EVs have an almost negligible carbon footprint. In contrast, Colombia’s energy grid is also relatively clean, with a strong reliance on hydropower, but its capacity to integrate additional EV load could be challenging without further investment in renewable energy sources like solar and wind. Comparative investments in renewables will be critical to ensuring that the EV transition does not inadvertently increase reliance on fossil fuels.
- Market penetration and vehicle type: In 2021, China led the global market with over 9.5 million new EV registrations, accounting for a significant portion of the global EV market share. Comparatively, Colombia lags far behind with only a few thousand new EV registrations annually. Colombia can learn from China’s success in incentivizing not only passenger EVs but also electric buses, trucks, and two-wheelers, making the EV market more diverse and accessible to all income levels.

## 4. CONCLUSION

The key points to consider for envisioning a future with 100% electric vehicle adoption in Colombia include achieving complete harmony between social and political orientation, as described in the "Green Democracy" scenario. Additionally, a thorough analysis of the future behavior of the purchase cost of electric vehicles, their autonomy, and operating costs is necessary, as these factors collectively account for 73.87% of the total decision factors when purchasing an electric vehicle. It is also important to understand that the number of charging stations, maintenance costs, charging time, and the quantity of electric vehicles are other key variables to consider in order to achieve a fully electric vehicle fleet.

According to the results obtained, the percentage of electric vehicle adoption in Colombia, based on the proposed scenarios, shows a significant autonomy. In the least optimistic scenario, "Burning House," the percentage is 19.8%, while in the most encouraging scenario, "Green Democracy," the adoption rate reaches 99.8% by the year 2050. These percentages provide a significant approximation suggesting that in a few more years, the entire vehicle fleet could be completely electric.

It is relevant to note that the highest percentage obtained for the year 2040 is 85.9% from the "Green Democracy" scenario and 29.7% for the "Greta" scenario, indicating that the final years considered in the scenarios are crucial for the massive growth of this technology. This suggests that the acceptance of electric vehicles tends to accelerate significantly in the final years of the analyzed period. The model relies on assumptions about future economic, political, and technological developments, which are inherently uncertain. Changes in policy, unexpected technological breakthroughs, or shifts in consumer behavior could lead to different outcomes than those projected by the model. This uncertainty may impact the accuracy of predictions for EV adoption by 2050.

The study assumes a steady improvement in charging infrastructure, but the actual pace of infrastructure development could be slower or faster, depending on government policies, private sector investments, and public acceptance. Inadequate infrastructure expansion could limit the mass adoption of EVs. The model assumes certain rates of improvement in EV technology, such as battery costs and vehicle autonomy. However, if technological advancements occur at a slower pace than predicted, this could affect the affordability and performance of EVs, thus impacting adoption rates.

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This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

## CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

## DATA AVAILABILITY

The data that support the findings of this study are available on request from the corresponding author, [AJA]. The data, which contain information that could compromise the privacy of research participants, are not publicly available due to certain restrictions.

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