



Public Sentiment Toward Electric Vehicle Adoption: A Case Study of Semarang, Indonesia

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ABSTRACT: The growth of Indonesia's population has led to a significant increase in vehicle volume, contributing substantially to CO₂ emissions and air pollution. Central Java Province ranks third nationally in vehicle numbers, with Semarang City recorded as having the highest air pollution level in Indonesia, reaching an air quality index (AQI) score of 107 in March 2024. One of the strategies to mitigate this pollution is the transition from conventional vehicles to electric vehicles (EVs). However, this transformation requires an understanding of public perception and readiness. This study aims to analyze public sentiment toward the transformation of electric vehicles in Semarang City using sentiment analysis based on the Indonesian RoBERTa model. Data was collected using an online questionnaire distributed to 1,025 respondents aged 17 years or above. Respondents answered questions covering three aspects: (Q1) perception of EV quality as a personal vehicle, (Q2) perception of the government's role in policy and infrastructure, and (Q3) perception of the EV transformation process in Semarang City. The results indicate that positive sentiment dominates only in Q1 (49.95%), reflecting public confidence in EV quality for personal use. Besides, Q2 and Q3 are dominated by neutral sentiment (41.5% and 52%, respectively), with Q2 even showing a higher percentage of negative sentiment (33.8%) than positive sentiment (24.7%), indicating dissatisfaction with current government policy and infrastructure support. These findings suggest that although Semarang City has strong potential for EV transformation, government policies and supporting infrastructure, such as public EV charging stations (SPKLU), need substantial improvement to accelerate public adoption and strengthen positive sentiment toward electric vehicles.

KEYWORDS: air pollution, air quality index, electric vehicle, RoBERTa, sentiment analysis.

INTRODUCTION

Indonesia's population growth is always increasing every year will certainly have an impact on increasing the volume of vehicles (Aryanti, 2024). The increase in vehicle volume contributes to exhaust gas emissions and air pollution (Kumar, et al, 2021). The effect of increased CO₂ gas due to the combustion of motor vehicles is high greenhouse gas emissions, which can cause the phenomenon of global warming (Odilov, et al. 2025). The World Health Organization (WHO) reports that exposure to air pollution in the outdoor environment contributes significantly to premature mortality rates (Liponhay, et al. 2024). Data from the National Police of the Republic of Indonesia Central Java Province ranks third with the highest number of vehicles in Indonesia. Because of the large number of motorized vehicles, Central Java is a considerable contributor to CO₂ emissions (Sugiarti et al., 2024). The area in Central Java that contributes the most to the rate of increase in motor vehicles is Semarang City. Data obtained through the DataIndonesia.id website showed that Semarang City was ranked first for the highest level of air pollution in Indonesia on March 19, 2024, at 10.20 WIB, with an air quality index (AQI) score of 107.

One alternative that can be implemented by the government and the public to reduce pollution from CO₂ gas emissions is to switch to using electric vehicles (Pan, et al. 2026). The use of electric vehicles certainly provides an opportunity to increase public awareness of the environment (Zola et al., 2023). The transition from motor vehicles that use combustion to electric vehicles is certainly not easy (Ananta et al., 2024). Because of that, it is necessary to know in advance the response and interest of the people of Semarang City regarding the transformation of the use of electric vehicles. The method used to find out public perception is sentiment analysis. Sentiment analysis will help identify and group people's perceptions into positive, neutral, or negative sentiments (Bucur et al., 2024). The research conducted by Aprillia, et al. (2024) used sentiment analysis to find out the perception of the Indonesian people regarding electric vehicles. Sentiment analysis research was also conducted by Karimah et al., (2024) to find out comments from the public regarding videos discussing electric cars on the YouTube platform. The model used in the study to conduct sentiment analysis was RoBERTa. The RoBERTa model is a development of the BERT model, which has better



performance for extracting text data (Nur, et al. 2025). Based on research from Abdal, et al. (2023), the RoBERTa model provides an accuracy rate of up to 96.78% when compared to Decision Tree (DT), Support Vector Machine (SVM), and Long Short-Term Memory (LSTM). The results of the sentiment analysis can serve as an initial reference for the Semarang City government to assess the feasibility of transitioning to electric vehicles in Semarang. In addition, the government can use the analysis results to develop strategies for future implementation.

LITERATURE REVIEW

1. Air Pollution

Population growth and increasing economic development in large cities, if not managed properly, can generate negative impacts, one of which is air pollution (Hixson et al., 2010). Air contaminated harmful pollutants can cause various health problems, making air quality an important factor that must be carefully maintained (Masdiyasa et al., 2024). Air pollution occurs when pollutants originating from vehicles and industrial activities are released into the atmosphere in excessive quantities over a prolonged period (Ismiyati et al., 2014).

2. Electric vehicles

The adoption of EVs has gained increasing attention because they produce lower exhaust emissions than conventional vehicles, thereby contributing to environmental sustainability. However, successful EV implementation also requires adequate supporting infrastructure and policies (Priscillia & Habibie, 2023). The adoption of electric vehicles can serve as one solution to help mitigate the impacts of climate change by reducing exhaust gas emissions produced by transportation equipment (Nur & Kurniawan, 2021)

3. Sentiment Analysis

The method that helps to understand an individual’s opinions, feelings, and emotions by analyzing data both qualitatively and quantitatively is called sentiment analysis (Jhosefhin & Dewi, 2025). The sentiment analysis process is carried out to help identify sentences or words in the form of positive, negative, or neutral phrases (Sejati et al., 2023). Such sentences or words typically represent an individual's opinion or review of a particular product or service (Najibulloh et al., 2025).

4. RoBERTa

RoBERTa (Robustly Optimized BERT Pretraining Approach) is an enhanced version of the Bidirectional Encoder Representations from Transformers (BERT) model. It has been optimized to better understand natural language by capturing contextual information more effectively (Pusung & Dewi, 2024). The model, which has an abbreviation (Robustly Optimized BERT Pretraining Approach) was chosen because it has superior performance for processing text (Claudia, 2026). The RoBERTa method has been shown to produce better performance, exhibit stronger generalization capabilities, and understand complex language structures more effectively, thereby yielding higher-quality analytical results (Yadalam et al., 2025).

METHODOLOGY

The subjects of this study consisted of residents of the City of Semarang aged above 17 years. The selection of 17 years as the subject category threshold was based on the legal eligibility to make purchasing decisions, including decisions regarding the purchase of high-value goods (Atthariq et al., 2024). The object of this study comprises electric vehicles, supporting infrastructure, and relevant government strategies in promoting the adoption of electric vehicles in the City of Semarang. Data collection in this study was carried out using a questionnaire distributed online. Questionnaire on perceptions of electric vehicle transformation was obtained from a study conducted by Amelia & Yustiana (2024). The following are three questions used to understand public perceptions regarding the transition to electric vehicles in Semarang.

Table 1. The Question of Sentiment

Code	Sentiment Question
Q1	"What is your perception of the quality of electric vehicles as a personal vehicle?"
Q2	"What is your perception of the government's role (policies and infrastructure) in supporting the use of electric vehicles?"
Q3	"What is your opinion regarding the transformation of electric vehicles in the City of Semarang?"

The following is the research flow to be conducted, as illustrated in the figure below

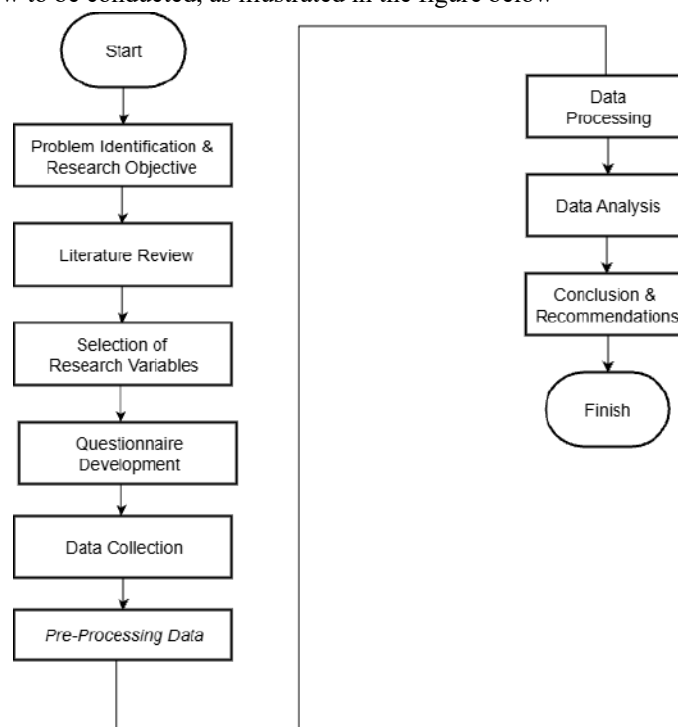


Figure 1. Research Flow

RESULTS

1. Data Selection

This study uses 1,025 data points, which will be processed and analyzed for sentiment analysis of qualitative data comprising respondents' answers to three questions (Q1, Q2, Q3). The following is the data that will be used in the sentiment analysis phase.

Table 2. Result of Questionnaire

ID	Q1	Q2	Q3
1	Economical, affordable, and easy to use.	Very good, especially if the VAT exemption is provided.	Developing.
2	Very interested.	Good.	I don't know.
.....			
1025	I believe I am still concerned about the battery's lifespan after years of use.	Based on my observation, the government still needs to increase the number of public EV charging stations (SPKLU) so that people will feel more confident about adopting electric vehicles.	In my opinion, the transition to electric vehicles will continue to progress slowly.

2. Pre-Processing data

The preprocessing stage aims to ensure that the text data is in the appropriate format so that it can be processed properly by the Indonesian RoBERTa model. The steps involved include checking for missing values, converting the data to a string type, removing unnecessary spaces (leading, trailing, or double spaces), and normalizing underscores (_) to spaces. This process is carried out to produce cleaner, more consistent data, in accordance with the input format required by the model

3. Sentiment Analysis Data Processing

a. Model Implementation

The RoBERTa model produces two outputs: sentiment labels and confidence scores. In this study, only the sentiment labels were used as the basis for further analysis. The RoBERTa model has three sentiment labels positive, neutral, and negative, which were derived from the comments provided by respondents in the questionnaire.

b. Classification & Sentiment Score

This classification process was applied to the three questionnaire items (Q1, Q2, Q3), resulting in a sentiment label for each response. For example, a respondent might receive a positive label for Q1 and Q2 but a negative label for Q3, while another might receive a mix of positive and neutral labels across the three questions.

Table 3. Classification Process

ID	Q1	Q2	Q3
1	Positive	Positive	Positive
2	Positive	Positive	Negative
3	Positive	Neutral	Positive
....			

Each sentiment label was then converted into a numerical value using a weighting scheme: positive = 1, neutral = 0, and negative = -1. This weighting allowed respondents' sentiment results to be represented numerically without altering the meaning of the original classification.

Table 4. Sentiment Score

ID	Q1_Score	Q2_Score	Q3 Score
1	1	1	1
2	1	1	-1
3	1	0	1
....			

c. Sentiment Result

The sentiment analysis results were determined based on the sentiment score calculated in the previous stage. The sentiment scores were then grouped into three categories: scores greater than zero (> 0) were categorized as positive sentiment, scores less than zero (< 0) were categorized as negative sentiment, and scores equal to zero ($= 0$) were categorized as neutral sentiment. Below the result of sentiment for Q1.

Table 5. Result of Sentiment Q1

Positive Label Percentage	Neutral Label Percentage	Negative Percentage	Label
49,95%	11,90%	38,15%	

Based on the Q1 sentiment results, which address public perception of electric vehicle quality for personal use, the positive label already dominates, reaching nearly 50%. The sentiment results for Q2, which address public perception in Semarang City regarding the government's role, particularly in terms of policy and infrastructure for supporting electric vehicle adoption, are presented in the table below

Table 6. Result of Sentiment Q2

Positive Label Percentage	Neutral Label Percentage	Negative Percentage	Label
24,7%	41,5%	33,8%	

The sentiment results for Q2 show a different pattern compared to Q1. Based on the table above, the percentage of the positive label is lower than both the neutral and negative labels. The sentiment results for Q3 are presented on the table below.

Table 7. Result of Sentiment Q3.

Positive Label Percentage	Neutral Label Percentage	Negative Percentage	Label
34,8%	52%	13,2%	

Q3 relates to public perception of the electric vehicle transformation in Semarang City. The analysis results show that public response is still dominated by neutral sentiment, with a percentage of 52%.

DISCUSSION

Based on the sentiment analysis results for the three questions posed, the positive sentiment percentage only dominates in Q1, which concerns public perception of electric vehicle quality as a personal vehicle. This indicates that the people of Semarang City generally had a positive view of electric vehicle quality for daily personal use. Meanwhile, for Q2 and Q3, sentiment remains dominated by the neutral label. In fact, for Q2, the percentage of the negative label is even higher than that of the positive label, and this condition indicates that the public still holds a perception that is not yet fully positive regarding the government's role in supporting the transition toward electric vehicles, both in terms of policy and infrastructure availability. The result for Q3 indicates that most of the public have not yet formed a firm, either supportive or opposed, toward the electric vehicle transformation process in Semarang City.

Thus, based on the sentiment label percentages across the three questions, Semarang City shows potential for transformation from conventional vehicles to electric vehicles. The public already considers the current quality of electric vehicles to be adequate for use as personal vehicles. However, the public still perceives that the government has not yet performed its role optimally in terms of the policies and infrastructure needed to support electric vehicle adoption. This suboptimal government role causes the public to remain hesitant about immediately undertaking the transition toward electric vehicles.

CONCLUSION

1. The government needs to conduct a review of the policies currently established regarding the electric vehicle transformation. It is possible that existing policies do not yet fully align with public expectations; therefore, if these policies were adjusted to better meet public needs, this would create an opportunity to increase positive sentiment. In addition to reviewing existing policies, the government also needs to evaluate the readiness of supporting infrastructure for electric vehicle users, such as Public Electric Vehicle Charging Stations (SPKLU). The limited number of currently available SPKLU units has the potential to become an obstacle in the electric vehicle transformation process. Therefore, a simulation is needed to determine the ideal number of SPKLU units required in Semarang City.
2. This research needs to be continued to the next stage, given that its scope should not be limited to identifying public sentiment toward electric vehicles but should also know the public profiling to facilitate the right treatments for each segment of society. A simulation is also required to determine the precise number of Public Electric Vehicle Charging Stations (SPKLU) needed to coverage across the city of Semarang. In addition, a simulation is needed to identify the most appropriate and efficient strategies and policies for increasing public interest in transitioning to electric vehicles.



3. Future researchers are advised to establish collaboration with the government, so that the parameters used in the research are aligned with the government's capabilities and needs, thereby allowing the research results to be directly reviewed and followed up on by the government.

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