



## How Does the Public React to the Electric Vehicle Tax Incentive Policy? A Sentiment Analysis

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### ABSTRACT

While there are arguments suggesting that tax incentives can expedite the adoption of electric vehicles (EVs), there are also counterarguments proposing that these incentives may exacerbate external costs. As a result, the government may need to incorporate public opinion as an input in formulating the most suitable approach to promote the adoption of electric vehicles within society. The purpose of this study is to investigate public sentiment on EV tax incentives in Indonesia through Twitter. This study utilizes text mining to examine public attitudes and sentiments toward EV using Twitter data. The sentiment analysis model employed is the Indonesian RoBERTa Base Sentiment Classifier. The data utilized in this study consists of Twitter posts spanning from May 2022 to May 2023. The final dataset for analysis comprises 99,856 tweets, each identified by a unique tweet ID. The results show that neutral sentiment dominating the tweet post from negative and positive sentiment. We also found that 56% are supporters and 44% are opposing groups. Tax incentive policies may not always be supported in terms of being considered unfair or inappropriate. Our finding shows three topics that are important for the public about EV: the price of electric vehicles, environmental issues, and EV infrastructure. This study demonstrates that tax incentives or price subsidies may not consistently receive positive perceptions or full support from society. Certain policies considered by specific stakeholders may diminish the effectiveness and expected outcomes of these measures. Our findings have several contributions for knowledge development and tax policy makers.

### KEYWORDS

public react, electric vehicle, tax incentive, sentiment analysis, tax policy

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## Как общественность реагирует на политику налоговых льгот для электромобилей: анализ настроений

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### АННОТАЦИЯ

Хотя существуют аргументы, предполагающие, что налоговые льготы могут ускорить внедрение электромобилей, есть также контраргументы, предполагающие, что эти стимулы могут увеличить внешние издержки. В результате правительству, возможно, придется учитывать общественное мнение в качестве вклада в формулирование наиболее подходящего подхода для содействия внедрению электромобилей в обществе. Целью данного исследования является изучение общественных настроений в отношении налоговых льгот

на электромобили в Индонезии через Twitter. В этом исследовании используется интеллектуальный анализ текста для изучения общественного отношения и настроений к электромобилям с использованием данных Twitter. В качестве модели анализа тональности используется индонезийский базовый классификатор тональности RoBERTa. Данные, использованные в этом исследовании, состоят из сообщений в Twitter, охватывающих период с мая 2022 г. по май 2023 г. Окончательный набор данных для анализа состоит из 99 856 твитов, каждый из которых идентифицируется уникальным идентификатором твита. Результаты показывают, что нейтральные настроения доминируют в твит-посте в диапазоне от негативных и до позитивных тональностей. Мы обнаружили, что 56% являются сторонниками, а 44% – оппозиционными группами. Политика налоговых льгот не всегда может быть поддержана с точки зрения того, что она считается несправедливой или неуместной. Наш вывод показывает три темы, которые важны для общественности в отношении электромобилей: цена электромобилей, экологические проблемы и инфраструктура для электромобилей. Это исследование демонстрирует, что налоговые льготы или ценовые субсидии могут не всегда получать позитивное восприятие или полную поддержку со стороны общества. Определенные меры политики, рассматриваемые конкретными заинтересованными сторонами, могут снизить эффективность и ожидаемые результаты этих мер. Наши выводы могут быть полезны для развития знаний и разработки налоговой политики.

#### КЛЮЧЕВЫЕ СЛОВА

общественная реакция, электромобиль, налоговое стимулирование, анализ настроений, налоговая политика

### 1. Introduction

The transportation sector is responsible for 24% of direct carbon dioxide (CO<sub>2</sub>) emissions from burning fuels worldwide [1]. These emissions cause various crises such as environmental pollution and greenhouse effects. This crisis has triggered a massive global movement in world countries to switch from fossil energy vehicles to electric energy.

Littlejohn & Proost [2] asserted that carbon emission standards achieve much lower emission reductions in EV. Therefore, governments in several countries have issued many policies, such as conducting research and development, improving infrastructure, and providing subsidies and tax incentives [3; 4]. Government policies play an important role in the adaptation of EV [5].

Wangsa et al. [6] stated that tax incentives and subsidies will increase the use of EV. However, the evaluation of this policy is still a limited topic discussed in the academic environment [7].

Indonesia has set up regulations with the issue of “Presidential Decree No. 55 of 2019” to encourage the switch to EV to promote the reduction of car-

bon dioxide emissions [6]. Among the programs within the regulation, the Indonesian government formulated tax incentives to stimulate people towards EV, such as 0% VAT and income tax, as well as 0% import duties on fully built EV imports.

Moreover, “battery electric vehicles” (BEVs) and “plug-in hybrid electric vehicles” (PHEVs) sales taxes are now fully excluded from the obligation of luxury tax (*Pajak Penjualan Barang Mewah – PPnBM*). Those tax incentives have just effectively applied for the April 2023 tax period until December 2023.

Although there is argument that the tax incentives might truly accelerate the rise of EV adoption [8], others may see that incentives for EV might raise the cost of other externalities like accidents, traffic, and increased government spending on infrastructure as well as the budget deficit will increase due to the subsidies and the decrease in tax collection [9].

But, Yuniza et al. [10] suggest that this policy has not yet become a trigger mechanism for the public to switch to electric vehicles because the incentive policy provided through Government

Regulation is still questionable. Therefore, the government may need to consider public opinion as input in formulating the most appropriate approach to push society towards the adoption of EV. Based on the provided background, the research question guiding this study is: What is the public sentiment on EV in Indonesia as expressed on Twitter.

Our study is important for several reasons.

*First*, Christidis & Focas [11] suggested the role of public sentiment and feelings in the adoption of EV. However, further research on these findings is still very limited, especially for the sentiment regarding EV tax incentive policy. Previous research has only investigated sentiments and emotions related to purchasing electric cars [12], pro-environmental behavior [13], consumer behavior towards innovation adoption [14], and consumer adoption of EV [15]. Jena [16] stated that the antecedents and critical factors of sentiment have not been thoroughly investigated, therefore, more studies are needed in the future. Our study extends this call for research by investigating public sentiments and emotions regarding EV tax incentive policies.

*Second*, previous studies related to public attitudes towards tax incentive policies and EV adoption only focused on one or a few cities [17; 18] and only a few articulated public attitudes and sentiments on a national scale [19]. Our study overcomes the limitations of previous research by investigating sentiments regarding EV tax incentives on a national scale. In contrast to previous research, we conducted an analysis in a developing country, namely Indonesia. We argue that the policy of EV tax incentives differs between developing and developed countries. Developing countries have many differences from developed countries, such as their limited infrastructure and low public trust. Therefore, this study comprehensively captures public sentiment on the electric vehicle tax incentive policy.

*Third*, most studies on attitudes towards public policies, such as tax incen-

tives, collect data through questionnaire surveys or interviews [20]. These studies tend to be subjective and have certain drawbacks [21].

Our study is more objective and large-scale, extending previous research to investigate public attitudes and sentiments through social media. Social media data can cover the entire country and provide effective and real-time content analysis [22]. Analysis technologies such as semantic text mining can extract insights from large amounts of data on social media and overcome some of the limitations of traditional methods such as time, space, and sample size [23].

We use text mining approaches to identify public perceptions and opinions about electric vehicle tax incentives on social media. We found that neutral sentiment dominating the tweet post (59.1%), followed by negative tweets account for 22.9% and finally the positive sentiment with 18%. We also found that 56% of group emotions is supporters ('happy', 'love') and 46% is opponents ('anger', 'fear', 'sadness'). Further, we determined the top three popular topic about tax incentive for EV by modeling LDA themes on Twitter posts, they are the price of electric vehicle, environmental issue and EV infrastructure.

*The purpose of this study* is to investigate public sentiment through Twitter regarding electric vehicle (EV) tax incentives in Indonesia.

*The research hypothesis* is the assumption that the tax incentives or price subsidies may not consistently receive positive perceptions or full support from society.

This study makes several contributions to the academic literature and the practical environment. First, we provide a comprehensive understanding of public sentiment regarding EV tax incentive policies. Knowledge of public attitude is very important for policymakers. Second, this study provides practical implications for policymakers regarding how public perceptions and attitudes respond to EV tax incentive policies.

## 2. Literature Review

### 2.1. Electric Vehicle Tax Incentive in Indonesia

Policy incentives have a favorable impact on electric car adoption [24]. Several countries such as Germany, Spain, Japan, Taiwan, Austria, Norway, France, United Kingdom, Italy, Hungary, Portugal, the Philippines suggest a tax incentive model to increase the acceleration of EV adoption [6].

Financial incentives will affect EV purchase and payment intentions [1; 6]. Further, EV consumers derive the most benefits from tax subsidies compared to producers or dealers [25]. This incentive model also adopted by Indonesia Government.

Indonesia issued Presidential Decree No. 55 of 2019 to encourage and speed the implementation of various EV programs. This regulation has five main guidelines for accelerating EV, one of them is incentive provision [6; 10]. The electric vehicle tax incentive in Indonesia is a policy aimed at fostering the development and widespread adoption of electric vehicles (EVs), specifically electric cars and buses [10].

This policy operates by reducing the value-added tax (VAT) applied to purchasing EVs [6]. The extent of VAT incentives is contingent on the domestic component level (TKDN) of the EVs. EVs featuring a TKDN exceeding 40 percent are eligible for a 10 percent VAT incentive, resulting in a mere one percent VAT payment. In contrast, EVs with a TKDN ranging from 20 to 40 percent qualified for a 5 percent VAT incentive. The determination of eligible EV models and types of incentives will be overseen by the Industry Ministry.

These incentives will remain in effect until the EV sector secures investments amounting to five trillion rupiah (\$347 million) or commences commercial production with a similar investment sum. The core objectives driving the implementation of VAT incentives include hastening national economic transformation, augmenting the appeal of investments in the domestic battery-based EV industry, facilitating the transition from fossil fuels

to electric energy, and cultivating public interest in the utilization of EVs.

Tax breaks and subsidies for the development of EV and charging stations are among the measures that the government of the Republic of Indonesia might provide the industry. This approach necessitates the government allocating additional funds in order to make pricing more reasonable. Other incentives include a 0% import duty on fully completed EV [6].

### 2.2. Attitudes and Sentiment towards tax incentive policies

Public attitudes and sentiments are important factors that drive EV development [11; 19].

Bai et al. [26] suggest that understanding cross-society experiences of tax policy can be investigated through sentiment analysis because the reasons behind different demands and requests for a tax policy can be described through sentiment.

Graham-Rowe et al. [27] states that positive feelings toward EVs have a positive correlation with public attitudes and intentions to switch to EVs. The various emotions expressed by the public are related to attitudes [15].

Higuera-Castillo et al. [12] also confirmed this, that positive public sentiment will lead to positive attitudes and vice versa, negative sentiment can trigger resistance. EV tax incentive policies can generate positive or negative public sentiment depending on the conditions under which the policy was issued. Thus, the public can react differently to the positive intention of the government or policymakers by providing tax incentives.

Several previous studies have improved public sentiment regarding EV policy.

Jena [16] finds that in the case of EV adoption policies in India, price and maintenance have a negative sentiment in the majority. Although the government has provided incentives for this type of EV, public interest in these vehicles remains low.

This is in contrast to the results of a study by Mpoi et al. [1] in Greece, which

found that incentives have positive sentiments. Mpoi et al. [1] finds that financial incentives help boost the EV market in Greece.

Another study by Wu et al. [19] found the interesting results that incentives do not matter to the Chinese public. Although the public has positive sentiments regarding EVs because of their impact on reducing carbon emissions, EV tax incentive policies are not very popular. In fact, the Chinese public is more interested in preferential policies, namely, driving without limits and brands in EV attributes. The inconsistency in some of these previous studies has triggered further investigation.

To that end, we argue that the country's environment plays a role in shaping public sentiment toward EV tax incentive policies, and we investigate this by comparing two economically and politically disparate countries.

### **2.3. Twitter as a data source of public opinion research**

Public sentiment can be observed through social media, such as Twitter.

Krishna [28] suggests that in the era of the rise of the Internet, public evaluation of a product or policy is highly dependent on social media platforms, and public opinion greatly influences decision-making behavior. Every individual can easily obtain information and public responses to certain issues through this platform in real-time. Moreover, social media can easily be used to guide public opinion in certain directions.

Wojtowicz & Wallace [29] suggested that social media can be a promising data source for researching public opinion. Especially Twitter, which is a social media platform that presents billions of public opinions or sentiments every day. The broad spatial, temporal, and social characteristics of the information on the Twitter platform allow for diverse environmental research [30]. In recent years, there has been a significant increase in the use of Twitter social media big data as a data source in public opinion literature studies [31].

Previous studies of the impact of tax incentive policies have generally used surveys or experimental methods. This method is good at detecting causality but still has some drawbacks. Therefore, our study attempts to compensate for this deficiency by analyzing public sentiment on social media. Social media offers an effective and real-time analysis of issues related to public sentiment [22].

This study complements the objectivity of the results of previous studies that began exploring sentiment on tax policy through surveys and experiments.

## **3. Methods**

### **3.1. Sentiment Analysis Approaches**

This study uses text mining approaches to identify public perceptions and opinions about electric vehicle tax incentives on social media. Public's social media data that will be analyzed in this study is obtained from Twitter within Australian and Indonesian twitter users. Text mining can be used to extract meaningful information from unstructured textual data by identifying, extracting, managing, integrating, and exploiting knowledge from texts efficiently and systematically [32].

Furthermore, text mining can maintain a high degree of consistency, therefore, this technique provides support for reliable qualitative research [33].

Text mining techniques can be used to conduct sentiment analysis in identifying public perceptions and opinions about electric vehicle tax incentives on Twitter within Australian and Indonesian twitter users. Sentiment analysis can provide insight about opinions, attitudes, and emotions of people about individuals, phenomenon, or topics [34].

As a classification technique, sentiment analysis can be conducted via machine learning approach and lexicon-based approach as Illustrated on the following Figure 1.

The use of multiple-layer networks with neural networks or deep learning in the sentiment analysis process has emerged in recent years as it provides advantage of far more of neural networks'

learning (representation) power than was previously possible with only a small amount of input [35].

Deep learning approach, therefore, facilitates broader aspects of textual analysis other than positive or negative sentiment polarity. One of the important features is that it can detect humans' subjective thoughts and sensations or emotions, such as "love", "joy", "surprise", "anger", "sadness", and "fear".

3.2. Data Collection and Pre-processing

Python programming language is used for scraping Twitter data as well as data cleansing, pre-processing and further analyses. The data retrieved include details of each tweet post such as: tweet details ('id', 'date', 'rawContent', 'lang', 'hashtags', 'url'), user details ('user', 'mentionedUsers'), and engagement: ('replyCount', 'retweetCount', 'likeCount', 'quoteCount', 'viewCount'). The keywords for the search are 'mobil listrik' (electric car), 'motor listrik' (electric motorcycle), and 'kendaraan listrik' (electric vehicle).

The pre-processing stage includes the standardization of lowercase and removal of meaningless words or sentences that do not affect the meaning of a tweet, for example: links to an external website,

html references, mentions tags, hashtags, special characters, and numbers.

Data used in this study is twitter post from the past year from May 2022 until May 2023. Total twitter post retrieved is 100,024 posts about EV, and after cleaning for missing value and duplicate post retrieved, the final data for analysis is 99,856 tweets as identified by unique tweet id.

4. Results

4.1. Sentiment Analysis

This study employs deep-learning approach in assigning the sentiment classification of every tweet. The model used for sentiment analysis is Indonesian RoBERTa Base Sentiment Classifier built with transformers library by Nabiilah et al. [36] that achieve 94.36% of accuracy.

The model is deep-learning models based on the "Bidirectional Encoder Representations from Transformers" (BERT)<sup>1</sup> model by Devlin et al. [37] which is modified and re-trained with Indonesian dataset. Using this model, every tweet is given label whether it is "positive", "negative", and "neutral".

<sup>1</sup> <https://ai-research.id/nlp-resources/indonesian/text-classification/>

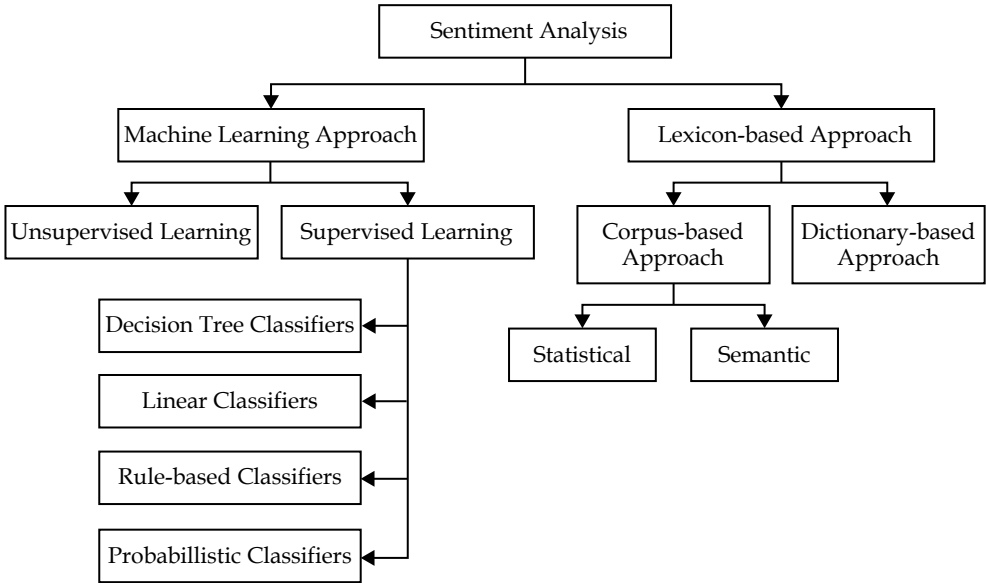


Figure 1. Sentiment Analysis Approaches [34]



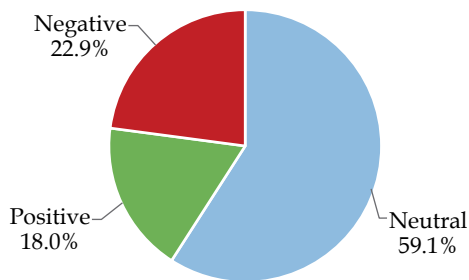


Figure 2. Sentiment Analysis

The overall data in Figure 2 shows that neutral sentiment dominates the tweet post with 59.1% (59,003), followed by negative tweets accounting for 22.9% (22,867) and finally positive sentiment with 18% (17,986).

However, when considering the rate of likes and retweets from a post, the proportion of the overall data changes with neutral sentiment get less engagement of likes and retweets compared to negative and positive twitter post. The result is shown in Figure 3.

*Positive Sentiment.* Figure 4 shows that the top ten words in tweets with positive sentiment about electric vehicles in Indonesia are: ‘hemat’ (economical) mentioned 1,838 times, ‘lingkungan’ (environment) mentioned 1,702 times, ‘ramah’ (friendly) mentioned 1,562 times, ‘dunia’ (world) mentioned 1,529 times, ‘keren’ (impressive) mentioned 1,468 times, ‘pln’ (State Electricity Company) mentioned 1,400 times, ‘baterai’ (battery) mentioned 1,071 times, ‘beli’ (buy) mentioned 1,059 times, ‘polusi’ (pollution) mentioned 1,000 times, and ‘beralih’ (move to) mentioned 991 times.

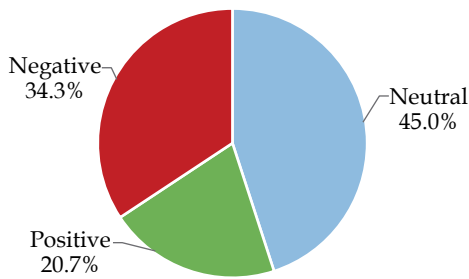


Figure 3. Sentiment Analysis from Rate of Likes and Retweets from A Post

These words suggest that the public recognizes the value of electric vehicles and their impact on the environment and world. The word ‘hemat’ (economical) being the most frequently tweeted word also indicates that people may consider the economic value that electric vehicles can bring when deciding to switch to them. Price and economic reasoning may be the top priorities for people when buying an electric vehicle.

In addition to the economic value, the presence of words such as ‘lingkungan’ (environment), ‘ramah’ (friendly), and ‘polusi’ (pollution) in the top ten words in tweets with positive sentiment about electric vehicles in Indonesia suggests that people are also concerned about the environmental impact of their transportation choices.

The fact that these words appear frequently in tweets with positive sentiments indicates that people see electric vehicles as a more environmentally friendly option compared to traditional fossil fuel-powered vehicles. This could be another factor that influences people’s decision to switch to electric vehicles, in addition to economic benefits.

*Neutral Sentiment.* Figure 5 shows that the top ten words in tweets with neutral sentiment about electric vehicles in Indonesia are: ‘pln’ (State Electricity Company - SOC) mentioned 5,435 times, ‘subsidi’ (subsidy) mentioned 4,883 times, ‘baterai’ (battery) mentioned 4,824 times, ‘pemerintah’ (government) mentioned 3,903 times, ‘ekosistem’ (ecosystem) mentioned 3,252 times, ‘G20’ mentioned 3,240 times, ‘KTT’ (G20 conference) mentioned 2,933 times, ‘juta’

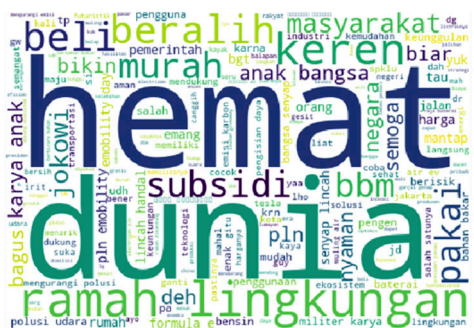


Figure 4. Positive Sentiment

(million) mentioned 2,510 times, 'ev' mentioned 2,350 times, and 'harga' (price) mentioned 2,316 times. These keywords highlight the role of the government in providing an ecosystem and subsidies to support the adoption of electric vehicles. People also recognize the vital role of the State Electricity Company in supporting the infrastructure needed for electric vehicles, such as battery charging stations.

The presence of words such as 'subsidi' (subsidy), 'pemerintah' (government), and 'ekosistem' (ecosystem) in the top ten words in tweets with neutral sentiment about electric vehicles in Indonesia suggests that people are aware of the government's efforts to support the adoption of electric vehicles. The fact that these words appear frequently in tweets with neutral sentiments indicates that people may have mixed feelings about the effectiveness of these efforts. Further analysis of the specific issues and concerns raised by the public could provide valuable insights into improving government policies and initiatives to increase public support for electric vehicles.

**Negative Sentiment.** Figure 6 shows that the top ten keywords dominating the tweets with negative sentiment are: 'subsidi' (subsidy) mentioned 4,895 times, 'beli' (buy) mentioned 2,853 times, 'orang' (people) mentioned 2,105 times, 'bbm' (fossil fuel energy) mentioned 1,506 times, 'kaya' (rich) mentioned 1,279 times. It is interesting that subsidy has become the most frequently mentioned word for negative sentiment. The word 'rich' also appears in the top five most frequently mentioned words. These findings raise concerns that

the public may not support the government's subsidy regulations.

The presence of words such as 'subsidi' (subsidy), 'kaya' (rich), and 'pemerintah' (government) in the top ten keywords dominating the tweets with negative sentiment suggests that people may have concerns about the fairness and effectiveness of the government's subsidy regulations. The fact that the word 'rich' appears in the top five most frequently mentioned words could indicate that people perceive subsidies as disproportionately benefiting the wealthy. Further analysis of the specific issues and concerns raised by the public could provide valuable insights into how to improve government policies and initiatives to increase public support for electric vehicles.

## 4.2. Emotion Analysis

The results of the emotion analysis can be seen in Figure 7. The emotions shown in the tweets posted by users may indicate public preferences. People expressing their emotions can also be captured using natural language processing, similar to sentiment analysis. The model used in this study for emotion analysis is the Indo RoBERTa Emotion Classifier<sup>2</sup>, which achieves an accuracy of 71.81%. The emotion labels output from the model's processing of the data are: 'anger' (27%), 'fear' (5%), 'sadness' (14%), 'happy' (54%), and 'love'. Further, we have grouped these emotions into a supporters group ('happy', 'love') and an opponents group ('anger', 'fear', 'sadness').

<sup>2</sup> <https://huggingface.co/StevenLimcorn/indonesian-roberta-base-emotion-classifier>

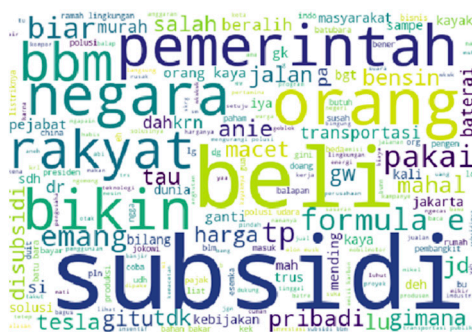


Figure 5. Neutral Sentiment



Figure 6. Negative Sentiment



Based on the results of the emotion analysis, it can be seen that the majority of the emotions expressed in the tweets were positive, with 54% of the tweets expressing happiness and an additional percentage expressing love. This indicates that the public may generally have a positive view of the topic being discussed. However, it is important to note that a significant percentage of tweets also expressed negative emotions such as anger and sadness. These emotions were grouped into an opposing group, indicating that there may be a portion of the public that opposes the topic being discussed. Further analysis could be conducted to explore the reasons behind these emotions and better understand public opinion on this topic.

Among the most mentioned words (translated) in the supporting group are SOC (6,020 mentions), battery (4,577 mentions), ecosystem (3,609 mentions), environment (2,862), and world (2828 mentions) as shown in Figure 8. Most people supporting the effort of SOC in establishing the infrastructure and ecosystem of EV. The majority also perceived that moving toward EV will bring benefits to environment and the world.

Moving to the opposing group, the top mentioned words are subsidy (8,843 mentions), buy (4,025 mentions), government (2,772 mentions), people (2,475 mentions), and fossil-fuel (2,371 mentions) that shown in Figure 9.

In line with the statistics of negative sentiment in the previous analysis, the

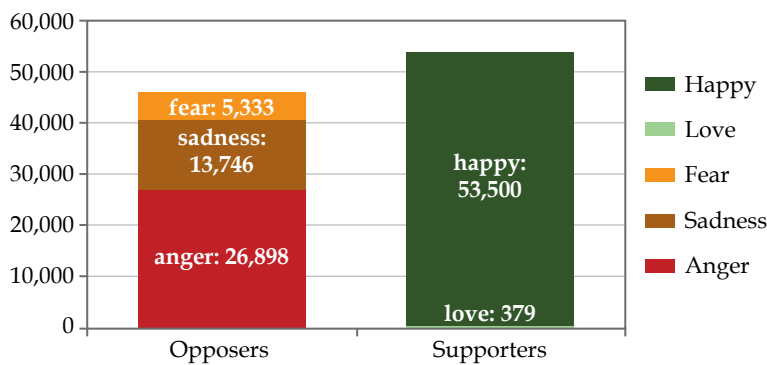


Figure 7. Emotion Analysis Result

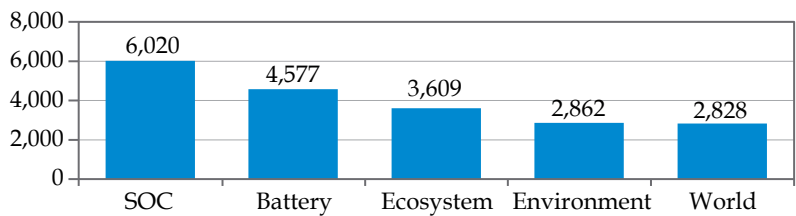


Figure 8. Top Words in Supporting Group

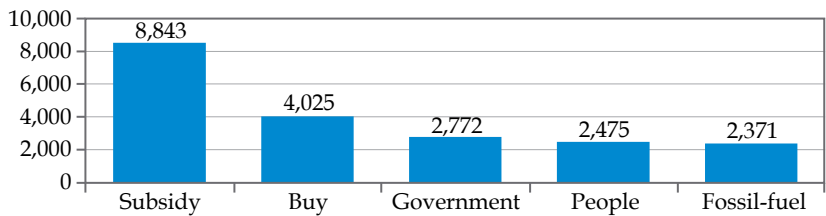


Figure 9. Top Words in Opposing Group

word ‘subsidy’, become the most mentioned, indicating that the voice against EV mostly related to the subsidy policy by the government. Other concern also raise issue that people disagree with the government that seems focusing on ‘buy’ side in the strategy of moving toward EV from fossil-fuelled vehicles.

4.3. Public Attention Topics

The topic of public attention in the tweet data can be generated from the process of natural language processing analyzing the attributes of textual data. Before process to the further analysis, it is possible that there are words that may distort the analysis of the topics, therefore, we conduct initial review of the textual data by overiewing the word occurrence in the data as shown in the following Figure 10.

The top five keywords (translated) from the overall data are: electric with 115,466 mentions, cars with 54,001 mentions, vehicle with 40,313 mentions, motorcycle with 31,161 mentions, and subsidy with 10,575 mentions. Tweet posts about cars significantly outnumber those about motorcycles, this indicates that concern about electric vehicle is more pronounce in higher economic ability people as in the context of Indonesia, people who own cars are considered more economically capable than people who own motorcycles. Subsidy also become one of the highlights of public opinion concern as the rising issue of government of Indonesia plan for tax subsidy for the purchase of EV in the timeframe.

As for the deeper understanding about how people perceived electric vehicles and its tax subsidy, we conduct topic analysis by modeling LDA themes on tex-

tual data of Twitter posts. In ranking and filtering terms, we use saliency measures that allows for quicker assessment and comparison of topics.

Based on the output of the approach, we determined three concerns about tax incentive for EV which are economical concern, environmental concern, and infrastructure of EV in Indonesia.

4.3.1. Economical Concern

Topic 1 focused on the economical concern of EV. This can be shown by LDA Topic 1 results in Figure 11. The most discussed themes in this topic are “subsidi” (subsidies) , “beli” (purchases) and “harga” (prices). The price paid to switch to EV is an important factor in this regard. The public will compare the costs that must be spent on EV with those of fossil fuel vehicles. Therefore, the themes of bonuses, prices, and incentives became the main public discussion. This topic also discusses how the government pays attention to prices.

Our study confirms previous findings by Ma & Mayburov [38], Rietmann & Lieven [39], Hardman et al. [40], Bienias et al. [41] that the public gave a higher response to tax incentives in topic 1.

Figure 12 shows that combining the analysis with emotion and public preference to support or oppose about this topic, the proportion show that opposers group dominating for most of the timeline analysed.

4.3.2. Environmental Concern

Topic 2 is about environment concern as shown in Figure 13. The themes that are of significant concern in this topic include “baterai” (batteries), “pemerintah” government) and dan “lingkungan” (environment).

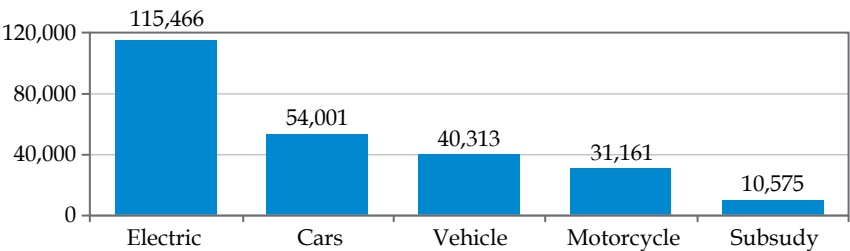


Figure 10. Overiewing The Word Occurence

The themes discussed the environmental effects of using EV, both positive and negative. The role of the government is also the focus of public discussion on this topic.

The public wants vehicles that are environmentally friendly but must be supported by green government policies. This is not surprising because the main motiva-

tion for the EV idea is to reduce pollution from the use of fossil-fuel vehicles that pollute the environment. However, it is also necessary to pay attention to whether migration to EV has reduced environmental pollution. or only for diverting pollution from cities to certain areas (power plant areas that still use fossil fuels).

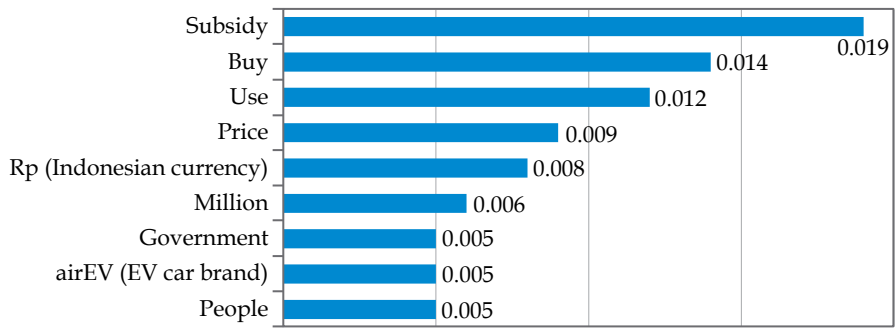


Figure 11. LDA Topic Model - Top Salient Words of Topic 1

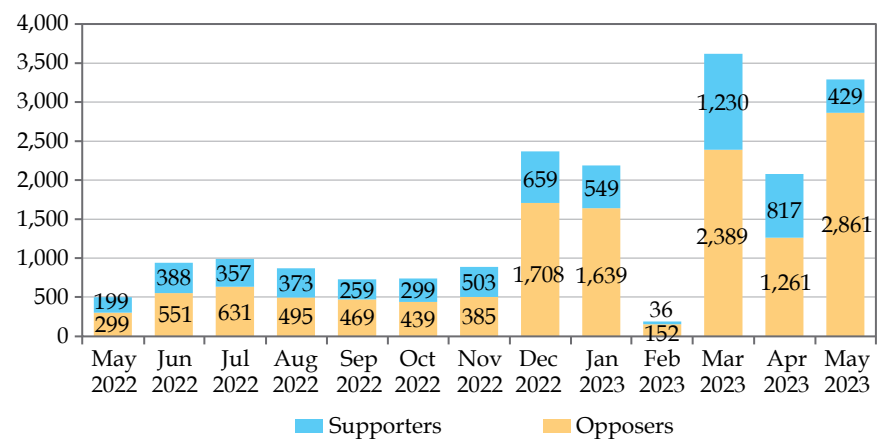


Figure 12. Number of Post - Topic 1

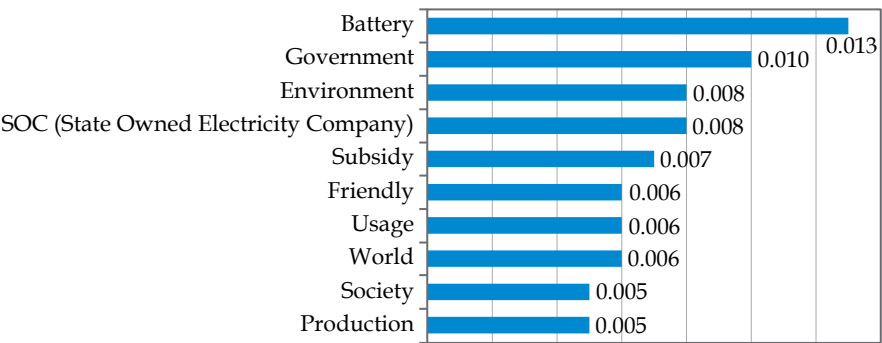


Figure 13. LDA Topic Model - Top Salient Words of Topic 2

According to Figure 14, in contrast with topic 1, the supporters group for topic 2 outnumber the opposers with significant margins.

4.3.3. Infrastructure of EV

Topic 3 reflects the public attention about electric vehicle infrastructure as shown in Figure 15. “PLN” (State Electricity Company), “KTT” (G20 Summit), BBM (fuel oil) is the most theme discussed in this topic. The public is worried about infrastructure, such as charging stations, the ability of the State Electricity Company, and the G20 countries’ attention (investment) to electric vehicle policies. Tax incentives may attract public interest to switch to EV, but there are concerns about the readiness of the existing infrastructure. The government paid close

attention to EV prices by providing subsidies and tax incentives. However, the availability of appropriate infrastructure is an important concern. Support for this argument is shown with the large number of supporters group twitter posts through out the year.

Figure 16 shows that the gap with opposers also considerably large, showing that this issue may play important aspect in electric vehicle adoption. It is interesting that in July 2022 the overall volume of posting increased significantly. This may due to the response of the use of electric vehicles in G20 summit in Indonesia. There are also spikes in march and april 2023 that might the increasing concern about the infrastructure readiness following the issuance of tax incentive regulation.

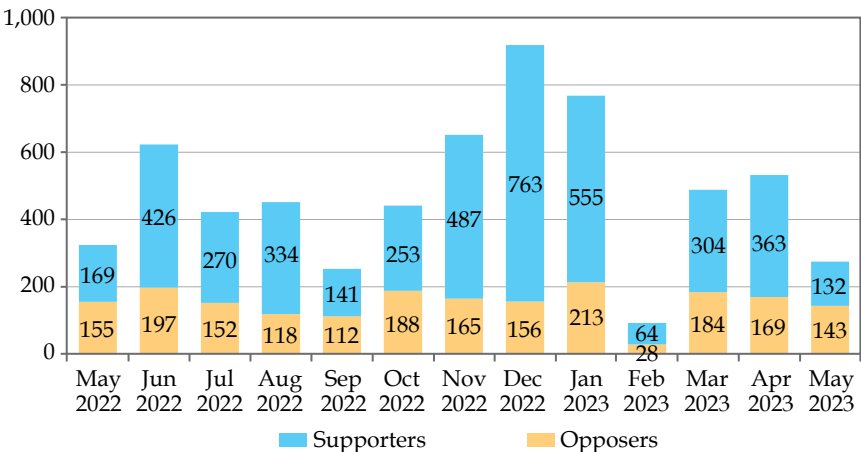


Figure 14. Number of Post – Topic 2

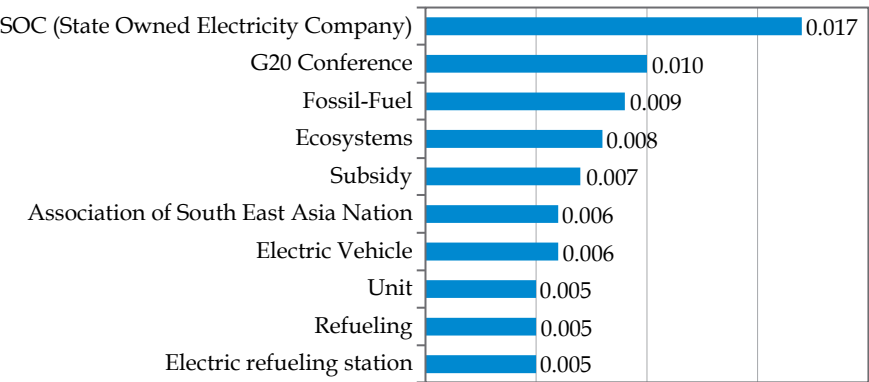


Figure 15. Lda Topic Model – Top Salient Words of Topic 3

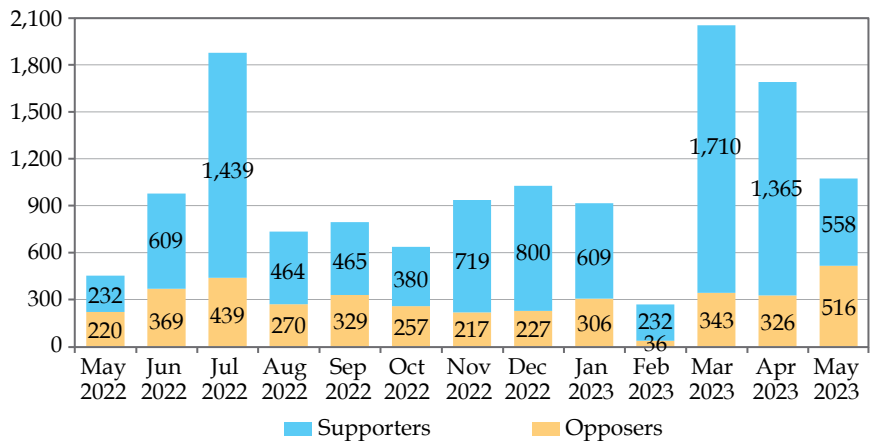


Figure 16. Number of Post – Topic 3

5. Discussion

Based on the three analyses that we have conducted the public voices are still mixed regarding the move towards EVs in Indonesia for the moment. For those who fully support the government step as reflected in the positive sentiment posts, they might recognize the benefits from the movement toward EV such as the environmental impacts, lowering transport cost, and opportunity for encouraging local products. Meanwhile, for the opposers of the government program, there are significant negative sentiments about the tax subsidy as they see that only rich people will get the most benefits of the program.

The public also show a variety of emotions as a respond of the EV movement program by the government. Although supportive emotions (love, happy) still dominate the overall number, the opposer emotions (anger, sadness, fear) is still high in value and cannot be easily ignored. The success of the program implementation itself might be difficult to achieve without the full support of the citizens as the main actors of the movement towards EV.

Previous literature suggest that a positive correlation between favorable emotions towards electric vehicles (EVs) and public attitudes and intentions to transition to Evs [27]. The emotional expressions of the public play a significant role in shaping these attitudes, as noted in [15]. A positive public sentiment can foster

positive attitudes, while conversely, negative sentiments may lead to resistance [12].

We can consider that the hypothesis of our study is fully confirmed. Our findings indicate that opposer emotions remains a significant concern that needs attention. It is evident that the public still does not favor the tax incentive policy. We contend that this lack of support may be attributed to the fact that the majority of Indonesian citizens continue to live below the average standard of living. Consequently, matters like this are highly sensitive and tend to evoke opposer emotions.

We also want to emphasize three key aspects of public opinion concerning electric vehicles (EVs) in Indonesia.

Firstly, the awareness of the economic benefits of EVs in Indonesia remains limited. Many Indonesians perceive these benefits as inaccessible because they believe only affluent individuals can afford the high upfront costs and take advantage of EV tax subsidies. The issue of purchase costs and monetary incentives holds significant importance as they have a positive impact on the market share of electric vehicles. Rather than solely relying on tax incentives, providing purchase incentives can potentially yield stronger results. This approach has demonstrated its effectiveness in increasing the market share of EVs, as highlighted by Hardman et al. [40]. It's essential to note that the public's willingness to adopt electric



vehicles is contingent upon price competitiveness with conventional vehicles, as emphasized by Bienias et al. [41].

Secondly, environmental issues become the most supported issue by the public. People recognized that the use of fossil-fuel is becoming more and more dangerous for the environment and switching to electric vehicles is the right solution. Although there are some people who still doubt the environmental benefits of the use of EV, the magnitude of this voices relatively minimal.

Previous literature has consistently affirmed the impact of environmental awareness and public concern on electric vehicle (EV) adoption, as stated in Mpoi et al. [1]. Both Axsen et al. [42] and Manutworakit & Choocharukul [43] highlight a significant and positive correlation between purchase intention and environmental concern. The ethos endorsed by electric vehicles, aimed at reducing pollution and environmental degradation, aligns with the global trend of “green earth” issues becoming an integral part of people’s lifestyles over recent decades.

Lastly, about the infrastructure readiness of EV in Indonesia, most people are still in doubt for the capability of the government and State Electricity Company as the main provider of EV infrastructure. This indicates that the government might need to focus first on the EV infrastructure before establishing such move toward EV programs. This study confirms the significance of infrastructure in the electric vehicle (EV) campaign, consistent with previous findings.

The establishment of a robust network of charging stations is a crucial factor in promoting EV adoption, as noted in Mpoi

et al. [1] and Giansoldati et al. [44]. Furthermore, Santos & Davies [45] emphasizes that a well-developed charging infrastructure will exert a substantial, if not partial, positive impact on adoption.

## 6. Conclusions

The purpose of this study is to investigate public voice and reaction through Twitter regarding EV policy in Indonesia. The use of social media as a tool to measure public response to government policies may not be common practices, especially in Indonesia.

However, with this study, it is shown that public voice through social media may have valuable value in seeing how people perceive and the usefulness of a policy for the public.

To be able to formulate more appropriate policies in encouraging the adoption of electric vehicles and provide policies that are pro-community, the government may need to review more interactions with the community or their representatives such as associations in the transportation sector.

We contribute to the literature that public voice provides valuable input for improving government policy formulation. As for practical implications, government can employ active monitoring of social media in capturing public voice and intensive communication when formulating new policies.

Our results limited to the Twitter data, so future study could extend this study using broader social media data.

The techniques used in this research can also be applied to other topics besides EVs, thus providing support for the importance of the public voice in interacting with government policy formulation.

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