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Barriers to Electric Car Acceptance: Analysis of Consumer Perceptions Regarding Safety and Security

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ABSTRACT

The Indonesian government has issued Presidential Regulation Number 55 of 2019 concerning the acceleration of the battery-based electric motorized vehicle program. In 2019 the sales data for PHEV were 25 units and HEV was 787 units, sales of new BEV battery-based cars were recorded in 2020 totaling 125 units, PHEV and HEV were sold 8 and 1,191 units. For 2021 sales of BEV were 687 units, PHEV 46 units and HEV 2,472 units and until March 2022, BEV sales were 64 units, PHEV 10 units and HEV 646 units. It can be seen from the above data that sales growth has occurred, but it is still quite low compared to fossil fuel cars (a percentage of no more than 0.5% each year). Seeing the number that is still minimal, it is necessary to look at the obstacles that occur in the community, why this can happen, even though the Indonesian government wants to build an integrated electric vehicle ecosystem to encourage energy security and domestic energy independence to reduce dependence on the use of fuel oil and reduce greenhouse gas emissions. One of these obstacles is the aspect of safety and security. The survey was conducted throughout the provinces of Indonesia with the results that the most perceived obstacles from the aspect of safety and security were batteries, very minimal sound noise, geographical and weather conditions in Indonesia and the risk of hacking, ransomware, and other forms of cyber-attacks due to sophisticated technology. attached to an electric car. Another result that is in the spotlight is that there are still many respondents who answered they did not know about electric cars,

Keyword: electric vehicles; electric cars; batteries, safety; security.

INTRODUCTION

The Indonesian government has issued Presidential Regulation Number 55 of 2019 concerning the acceleration of the battery-based electric motorized vehicle program. The development of battery-based electric motorized vehicles (KBLBB) in Indonesia until March 2022 there were 16,060 vehicles consisting of tricycles, passenger cars, motorbikes, buses, freight cars, bus platforms and goods platforms.

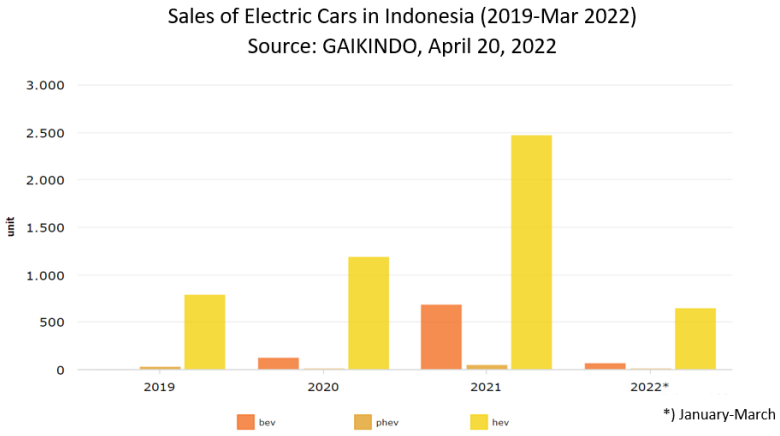

Figure 1. Electric Car Sales in Indonesia (2019-March 2020)

In 2019 the sales data for PHEV were 25 units and HEV was 787 units, sales of new BEV battery-based cars were recorded in 2020 totaling 125 units, PHEV and HEV were sold 8 and 1,191 units. For 2021 sales of BEV were 687 units, PHEV 46 units and HEV 2,472 units and until March 2022, BEV sales were 64 units, PHEV 10 units and HEV 646 units. It can be seen from the above data that sales growth has occurred, but it is still quite low compared to fossil fuel cars (a percentage of no more than 0.5% each year). Seeing the number that is still minimal, it is necessary to look at the obstacles that occur in the community, why this can happen, even though the Indonesian government wants to build an integrated electric vehicle ecosystem to encourage energy security and domestic energy independence so as to reduce dependence on the use of fuel oil and reduce greenhouse gas emissions. Milad Ghasri et. al (2019) conducted research on consumer perceptions of electric vehicles and their impact on consumer preferences in New South Wales Australia, the perceived benefits of consumers related to EVs are centered on three dimensions namely vehicle design/design, impact on the environment and safety, these dimensions interact on price and mileage, Mehar et. al (2015) presented several problems and challenges related to EV deployment and management, including: 1) costs, 2) standards, 3) power generation and smart grids, 4) incentive assistance, 5) communication security, 6) integration framework. An electric car consists of 2 (two) key components in its operation, namely the motor and the battery. The two components most at risk are the battery, one of the factors that can put the battery at risk is the presence of thermal abnormalities which can be divided into overheating and thermal runaway based on the degree of excess heat. Uncontrolled overheating will cause thermal runaway or even explosion. Therefore, accurately predicting overheating and thermal runaway can provide the basis for implementing appropriate thermal management, and effectively reduce the probability of thermal accidents. Although several thermal management methods and intrinsically safe designs are currently used to reduce thermal threats, battery fires/short circuits still occur from time to time (Liu.H.et.al 2017), in particular, burning of lithium-ion batteries is usually accompanied by with the release of toxic and flammable gases, which are an acute threat to human health and safety (Koch. S. et.al 2018 and Peng. Y. et.al 2020). During the combustion/short-circuiting process the battery releases a large amount of heat while maintaining a high temperature. Although flames can be extinguished quickly with gas extinguishing agents, the cooling time is long due to the material's poor cooling capacity. Besides that.

Table 1. Data on Electric Car Battery Fire Accidents in Several Last year

Event Time	Location	Accident Description	Reason
2019/04	shanghai. China	Tesla's EV caught fire in the parking lot without charging	Malfunction of the battery module
2018/09	Fujian, China	BYD EV caught fire	The battery spontaneously caught fire after hitting a guardrail
2018/06	Los Angeles, America	The Model S EV caught fire while driving	The battery spontaneously catches fire
2018/05	Florida, America	EV Model S catches fire after hitting a wall	The battery caught fire after hitting the wall
2016/05	Guangdong, China	Electric bus catches fire (ignition process)	Short circuit on battery with large scale

Source: Processed Data (2022)

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Accident data caused by batteries according to table 1 above shows that accidents are still prone to occur which can affect the safety and security of drivers and passengers. Apart from the price factor, infrastructure (SPKLU, charging system), waiting time, tax incentives, mileage, safety and security factors are still the main focus of the public to switch to electric vehicles, especially electric cars. Peter Cocron and Josef F. Krems (2013) examined driving perceptions about the safety implications of electric vehicles (associated with low noise factors). The results showed that affective risk assessment decreased with increasing experience driving electric cars. Based on individual experience, drivers adjust their evaluation of noise-related hazards, Road users' vulnerability to accidents as a result of low noise decreases with increasing driving experience.

RESEARCH METHODS

Surveys and Samples

In this study using an online survey and distributed to all provinces in Indonesia. The survey deployment timeframe is 2 (two) weeks with data according to table 3 below:

Table 2. Respondents' Personal Data and Initial Description of Respondents

Respondent's Personal Data	Preliminary Description of Respondents
Name	There is a desire to buy an electric car
Age	I know the differences and how electric cars work compared to fossil fuel/oil based cars
Gender	The main difference between electric cars and fossil fuel/oil cars lies in the three main components, namely the battery, electric motor and electronic control system
Education	Price, Mileage, Infrastructure (SPKLU/Charging), Safety and Security, and Tax Incentives are key factors in the development of electric cars in Indonesia
Profession	
Province of Residence	

The sample in this study is people with an age range starting from 20 (twenty) years and spread throughout Indonesia, after filling in their personal data, respondents are required to answer several questions related to EV, the aim is to get an initial picture of respondents regarding the desire to buy an electric car, differences and how oil-fueled cars work with electric cars, knowledge regarding the main components of EV, factors that influence the development of EV.

Characteristics of Respondents

In the survey questions a Likert scale of 1 to 5 was used (strongly disagree, disagree, do not know, agree and strongly agree). Age, gender, education, occupation and province of residence affect the characteristics of the respondents, this is important because each respondent has a different culture adapted to their respective places of residence.

RESULTS AND DISCUSSION

The questionnaire included was 61 (sixty-one) respondents, with the profiles of the respondents according to table 4 as follows:

Table 3. Profile of Respondents

Age	PERCENTAGE (%)
20 – 25 Years	45.9 %
25 – 30 Years	14.8 %
30 – 35 Years	18 %
35 – 40 Years	11.5 %

40 – 45 Years	6.6 %
45 – 50 Years	1.6 %
>50 Years	1.6 %
Gender	
Man	63.9 %
Woman	36.1 %
Education	
Senior high school	9.7 %
Diploma	40.3 %
S1	37.1 %
S2	12.9 %
S3	0 %
Profession	
ASN	49.9 %
BUMN	4.8 %
Lecturer	8.1 %
Freelancing	1.6 %
Teacher	1.6 %
Private	6.4 %
Student	8.1 %
Fisherman	1.6 %
Student	3.2 %
Motorized Vehicle Tester	4.8 %
VAT	1.6 %
Province of Residence	
Bali	24.2 %
East Java	9.7 %
West Java	8.1 %
Central Java	6.5 %
DKI Jakarta	6.5 %
In Yogyakarta	3.2 %
Lampung	1.6 %
South Sumatra	1.6 %
Riau islands	1.6 %
Riau	1.6 %
West Sumatra	3.2 %
North Sumatra	1.6 %
West Papua	4.8 %
North Maluku	1.6 %
North Sulawesi	3.2 %
Gorontalo	1.6 %
Southeast Sulawesi	4.8 %
South Sulawesi	6.5 %
East Kalimantan	1.6 %
South Borneo	1.6 %
Central Kalimantan	1.6 %
West Kalimantan	3.2 %

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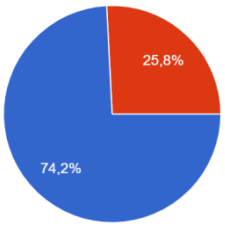
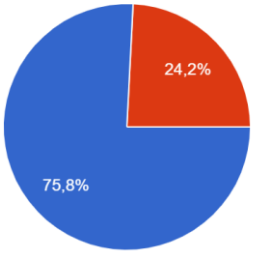
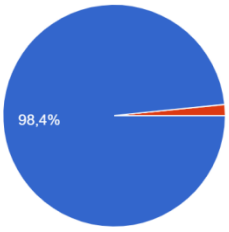
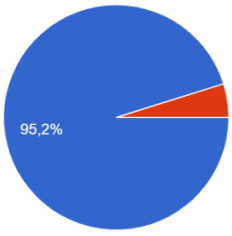
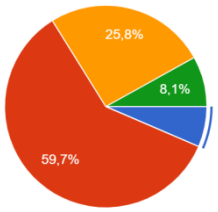
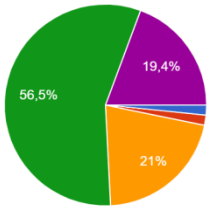
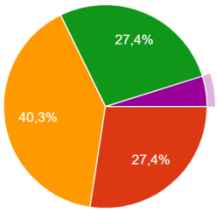
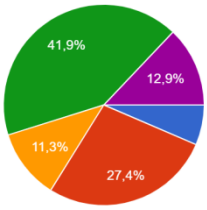
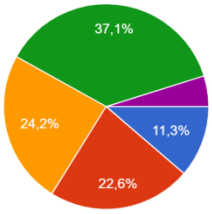
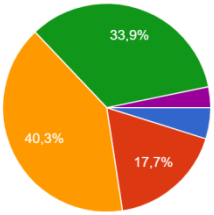
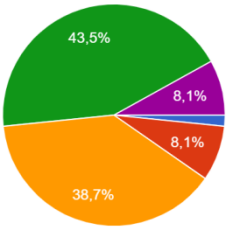
Based on age, a profile with the highest age range of 20 to 25 years was obtained at 45.9%, this proves that there is a strong desire for the younger generation to be curious about electric vehicles. Gender is dominated by men by 63.9%, Education is dominated by Diploma Education background by 40.3%, Work is dominated by ASN work by 49.9% and Province of Residence of the highest respondent, namely Bali Province by 24 .2%. From the data above, it was obtained that the distribution of questionnaires was almost evenly distributed throughout Indonesia.

Table 4. Questionnaire Results

No	Question Items	Results
1	There is a desire to buy an electric car?	
2	I know the differences and how electric cars work compared to fossil fuel/oil-based cars	
3	The main difference between electric cars and fossil/oil fueled cars lies in the three main components, namely the battery, electric motor and electronic control system (not 1.6%)	
4	Price, Mileage, Infrastructure (SPKLU/Charging), Safety and Security, and Tax Incentives are key factors for the development of electric cars in Indonesia (Not by 4.8%)	
5	If not, please provide these factors:	1. Regulation 2. Care 3. Parts 4. Vehicle age 5. Selling value (used price)
*	Yes No	

No	Safety Aspect	Results
1	Electric cars are more at risk for accidents. (Strongly Disagree of 6.5%)	
2	Electric cars on the market have passed tests, especially in terms of safety. (Disagree at 1.6% and Strongly Disagree at 1.6%)	
3	Batteries in electric cars are very risky for thermal runaway to occur. (Strongly Agree 4.8%)	
4	Minimal sound noise in electric cars affects the safety factor. (Strongly Disagree 6.5%)	
5	Electric cars match the geographical conditions of roads in Indonesia. (Strongly Agree 4.8%)	
6	With the seasonal conditions in Indonesia (dry and rainy) the safety of electric car users is guaranteed. (Strongly Agree 3.2% and Strongly Disagree 4.8%)	
7	The safety features inherent in today's electric cars are enough to ensure the safety of the driver and passengers. (Strongly Disagree 1.6%)	

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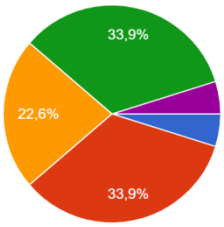
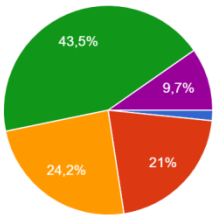
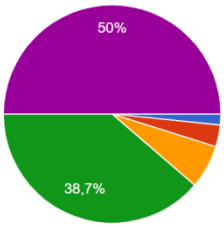
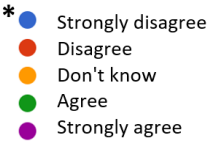
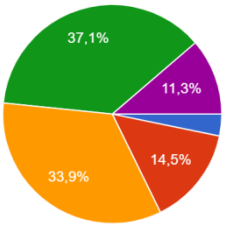
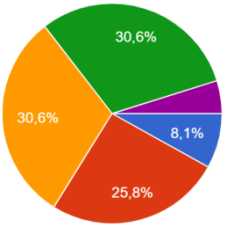
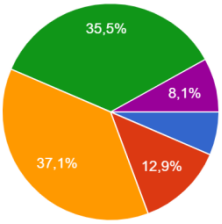
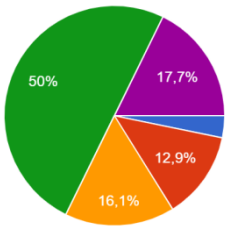
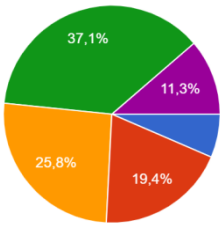
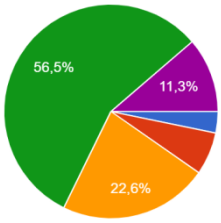
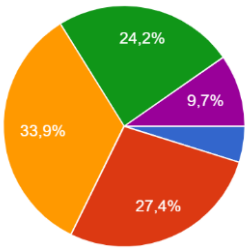
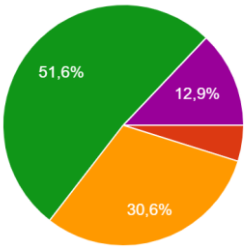
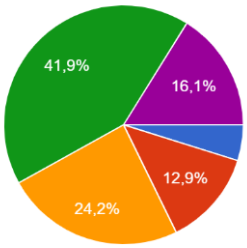
8	I believe more in the safety aspect of using a car based on fossil fuels/oil (internal combustion engine). (Strongly Agree 4.8% and Strongly Disagree 4.8%)	
9	One of the factors in the decision to buy an electric car is the safety aspect. (Strongly Disagree 1.6%)	
10	Risk management in the event of an incident/accident on an electric car is very important for drivers and passengers to know. (Don't Know 6.5%, Disagree 3.2%, and Strongly Disagree 1.6%)	
*		

No	Security Aspect	Results
1	Batteries in electric cars on the market today have a usage time of 8 to 10 years, do you think that with that time span the condition of the battery if used normally will not cause safety problems. (Strongly Disagree 3.2%)	
2	The more sophisticated security technology in electric cars, the more insecure, especially the threat of hacking, ransomware, and other forms of cyber-attacks. (Strongly Agree 4.8%)	
3	Electric car safety is guaranteed when it passes through puddles and is used during the rainy season. (Strongly Disagree 6.5%)	

No	Security Aspect	Results
4	The main factor related to safety issues in electric cars is the battery factor. (Strongly Disagree 3.2%)	
5	I feel safer using fossil fuel/oil-based vehicles (internal combustion engine)	
6	I believe the safety technology embedded in electric cars can reduce the occurrence of accidents. (Disagree 6.5% and Strongly Disagree 3.2%)	
7	I don't feel safe driving an electric car because the battery size is very large and there is a risk of fire. (Strongly Disagree 4.8%)	
8	The security of the charging system in public areas and at home for electric cars is very safe. (Disagree 4.8%)	
9	One of the factors in the decision to buy an electric car is the safety aspect. (Strongly Disagree 4.8%)	

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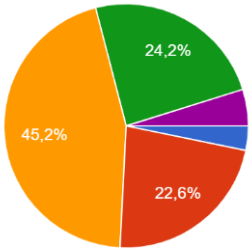
No	Security Aspect	Results
10	Electric cars are the safest mode of ground transportation. (Disagree 22.6% and Strongly Agree 4.8%)	

* Strongly disagree
Disagree
Don't know
Agree
Strongly agree

There is a relatively high desire from respondents to buy an electric car with a percentage of 74.2% and they do not want to buy with a percentage of 25.8%, this shows that there is a strong desire and interest from respondents to be able to own an electric car. In terms of how electric cars and fuel-based cars work, 75.8% of respondents said they knew and 24.2% did not know. It can be seen that there is a desire from respondents to know how electric cars work. In terms of the main difference between electric cars and oil-fueled cars lies in the three main components, namely batteries, electric motors and electronic control systems, 98.4% of respondents answered yes and 1.6% answered no, it can be seen that respondents really understand how does an electric car work Next,

Regarding the safety aspect, some important notes related to the respondents' responses are as follows: 59.7% of respondents disagree that electric cars are more at risk for accidents, 6.5% strongly disagree, 25.8% do not know and 8.1 % agree that electric cars are more at risk of accidents. There are positive things and beliefs from respondents regarding the safety aspects of electric cars. In terms of passing the safety test on electric cars 56.5% of respondents agreed that electric cars had passed the test, 19.4% strongly agreed, 21% did not know and disagreed and strongly disagreed each by 1.6%. The percentage of people who do not know gets a fairly high rating, this proves that there are still many respondents who do not get complete information about electric cars that have been circulating in the market. this requires a fairly massive dissemination of information from producers so that the public at least knows that electric cars are safe to drive. Regarding the safety of the battery in terms of the possibility of thermal runaway 40.3% of respondents answered they did not know, 27.4% agreed and disagreed, and 4.8% strongly agreed. It can be seen that the concern over the occurrence of thermal runaway is quite high so that it affects the desire to buy an electric car. The minimal/no sound noise factor affects the safety factor with the results 41.9% of respondents agree, 12.9% strongly agree, 27.4% disagree, 6.5% strongly disagree and 11.3% do not know This is one of the obstacles faced by drivers and road users because electric cars have no sound. There are quite interesting results from the aspects of respondents' trust regarding the safety of using fossil fuel/oil-based cars (internal combustion engines), 33.9% agree that they believe more in internal combustion engine vehicles and 33.9% agree on the safety aspects of electric cars and one the decision factor to buy an electric car is the safety aspect of the response of respondents 43.5% agreed to be an important consideration and those who answered disagreed by 21%. From the safety aspect, the battery is still a problem that is quite worrying for respondents, as many as 50% of respondents agree that the battery is the main factor related to safety issues in electric cars and 12.9% answered that they did not agree. Respondents' fear of a fire on the battery also got quite high results with 24.2% agreeing and 27. 4% disagree. Respondents' trust in the safety of internal combustion engine vehicles is still quite high, 37.1% of respondents answered that they agreed and 19.4% answered that they did not agree, but there was quite high confidence from respondents regarding the safety aspects embedded in electric cars being able to reduce accidents by the results of 56.5% of respondents answered agree and only 6.5% answered disagree. Regarding the security of the charging system at SPKLU and at home, respondents rated it positively, 51.6% of respondents agreed and 4.8% disagreed. There is an interesting thing regarding the question of electric cars being the safest mode of land transportation, 45.2% of respondents answered they did not know, 24.2% agreed and 22.6%

did not agree, it can be said that respondents believed they did not fully want to buy an electric car. The results above are in accordance with research conducted by Ebgue and Long (2012), Graham-Rowe et al. (2012), She et. al (2017), Noel et al. (2020), Zaunbrecher et al. (2014), Berkeley et al. (2018). Peter Cocron and Josef F. Krems (2013) where the results of the study contain barriers to acceptance of electric cars associated with aspects of safety and security.

CONCLUSION

This study attempts to explain and provide an overview of the barriers to acceptance of electric cars in terms of safety and security. The most felt obstacle from the aspect of safety and security is the battery, the sound value is very minimal, geographical and weather conditions in Indonesia and the risk of hacking threats, ransomware and other forms of cyber attacks because of the sophisticated technology attached to electric cars. Another result that is in the spotlight is that there are still many respondents who answered that they did not know about electric cars. The results of this study can provide recommendations to the government and manufacturers to be able to innovate regarding product socialization, regulations and other information media to further accelerate the achievement of the electric vehicle ecosystem in Indonesia. Respondent representatives in filling out the questionnaire are things that can be noted, because it was only carried out for two weeks, with a longer time, of course, you will get larger respondents and get more measurable results.

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