Barriers to the adoption, acceptance and public perceptions of Electric Vehicles (EV) in Indonesia: Case studies in the city of Surakarta

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Barriers to the adoption, acceptance and public perceptions of Electric Vehicles (EV) in Indonesia: Case studies in the city of Surakarta

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Abstract. Electric Vehicle (EV) is one of the technologies in the transportation industry that reduces the amount of toxic emissions. However, EV faces some technical difficulties in terms of the implementation as its application is still far from competing with Internal Combustion Engine (ICE) vehicles in numerous countries. The public acceptance of EV is considered an obstacle, hence, this study will further examine the public perceptions of price, performance, infrastructure and acceptance of this technology. Furthermore, an incentive policy was offered to the respondents as the survey was carried out using a quantitative approach in Indonesia with Surakarta City residents as the population. The results of this study contribute as a reference for policy makers to draft energy plans and transportation policies and as a discussion material for EV companies in their development.

1. Introduction

An upsurge in economic growth and human mobility has resulted in the depletion of energy resources, studies show that from 2012 to 2040, the total consumption of energy marketed throughout the world increased by 48%, from 549 quadrillion British thermal units (Btu) in 2012 to 629 quadrillion Btu in 2020, which would further increase in 2040 [1].

On a global scale, the transportation sector is one of the largest energy users and *BBM* or Fuel Oil is the most widely patronized energy source [1]. It is feared that this can cause new problems, for example, air pollution. According to the Intergovernmental Panel on Climate Change (IPCC), the atmospheric levels of carbon dioxide and methane have increased by 35% and 148% respectively since the industrial revolution in 1750.

Worldwide, transportation is responsible for 25% of total CO_2 emissions from the fuel combustion and 20% of which was due to land transportation in 2014 [2]. Since the last 2 centuries, the increase in the amount of greenhouse gases caused by human activities has created the fears of global warming [3].

In an attempt to reduce the fuel consumption and curb the impeding problem, several countries launched the Electric Vehicles. Since the ratifying Kyoto Protocol in 2005, Japan has implemented a strategy to curtail CO_2 emissions in the industrial, service, transportation and energy conversion sectors, which have achieved some positive results. In particular, EV consumes the less fuel and it, issues less

GHG (Greenhouse Gases), and is expected to have a large effect in reducing CO2 emissions, hence, it has been adopted in the transportation sector [4].

The Electric Vehicles Initiative (EVI) is a multi-government policy forum established in 2009 under the Clean Energy Ministerial, whose aim is to accelerate the spread of Electric Vehicles throughout the world. The countries that are currently active in EVI include Canada, the People's Republic of China ("China"), Finland, France, Germany, India, Japan, Mexico, the Netherlands, Norway, Sweden, the United Kingdom and the United States. They possess the largest and fastest growing EV market in the world and accounts for the increased sales in 2017 [5].

According to the General Plan for National Energy (RUEN), to support the acceleration of the use of this technology, the government will develop the hybrids of EV in 2025 for 2200 units of 4 wheeled vehicles and 2.1 million units of the 2 wheeled ones. They will also gradually develop 1,000 units of the systems and the Public Electric Charging Stations (SPLU) in 2025. The electric cars and motorcycles are expected to be used with a share of 1% of the total new vehicle sales in Jabodetabek, which will further increase gradually to 100% by 2050. Considering this assumption, the number of electric cars and motorcycles were 21 thousand and 34 thousand units respectively, which further increased to 2.10 million and 3.40 million units in 2050 [6].

With every new technology, of course, an introduction to the market is often required before it is considered by the potential buyers. The community furthermore, plays an important role in the sustainability of this technological development, considering that there are still many weaknesses in it. The disadvantages of Electric Vehicles include: in one charging range, limited battery capacity, relatively long charging times compared to oil-fueled vehicles, and relatively expensive in price [7]. However, understanding the obstacles to community acceptance helps determine the market for these vehicles and their future potentials [8,9].

2. Method

2.1. Survey

A questionnaire survey was conducted in Surakarta City, Indonesia, which is one of the big cities with a fairly dense population and advanced construction of infrastructure and facilities. The questionnaires in the form of close ended questions are given directly to the respondent and the Likert scale 5 points was used to analyze the data. This included the query to explore of the extent to which the public perceives the price, performance and charging infrastructure (Table 2) and also to explore public acceptance of electric vehicles in Indonesia (Table 1).

Table 1. Acceptance variable.

No	Question	Item	Source
1	I want electric vehicles to be driven in Indonesia	1	[9]
2	I want electric vehicles to be developed in Indonesia	2	[7]
3	I want electric vehicles to be commercialized in Indonesia	3	[8]
4	I have the desire to buy an electric vehicle	4	[10]
5	I have the desire to recommend electric vehicles to others	5	[8]
6	I have the desire to know more about electric vehicles	6	[11]

The sample of 100 people was selected from the 335,397 people in this city between the ages of 15-54 according to the Department of Population and Civil Registration of Surakarta, using the calculation on Slovin formula with e = 10% [14]. The data collection technique used the proportionate stratified random

sampling method which involves sampling from the population regardless of the strata in the population, recognizing that each individual had the same opportunity to be the research subject.

$$n = \frac{N}{(1 + N \times e^2)} \quad (1)$$

Notes:
n = Total Sample
N = Total Population
e = Error tolerance limit

Table 2. Perception variable.

No	Question	Item	Source
1	The price of electric vehicles must compete with conventional vehicles	7	[12]
2	The performance of electric vehicles must be comparable to conventional vehicles	8	[13]
3	Battery charging infrastructure must be easily accessible	9	[7]

2.2. Data analysis
This involved the use of descriptive frequency analysis to determine the value of independent variables, without making a comparison or connecting others. This research was conducted to describe how the public perceive and accept the price, performance and the infrastructure of charging EV.

3. Results and discussion

3.1. Public acceptance
Based on the data in Figure 1, it is observed in item 1 that more than half (58%) of the respondents chose Agree, and 31% chose strongly agreeing, while the remaining 9% answered neutral and 2% disagree. This means that the people of Surakarta city possess the desire to drive the electric vehicles immediately. Furthermore, item 2 indicates the acceptance of the electric vehicle development sector in Indonesia with the answers dominated by Strongly Agree with 49%, Agree 40%, neutral 9% and 2% disagree. In items 3 and 4, the desire for EV to be immediately commercialized in Indonesia and the public's desire to buy electric vehicles is quite high, which means that the prospective consumers are substantially present, however, there are 17% and 26% neutral answers to items 3 and 4 respectively. This indicates that numerous people are hesitant to become EV consumers. Furthermore, item 5 indicates that the willingness to recommend EV to others is also very high with the results showing 54% responded with agree and 23% with strongly agree. However, there are still many people who are hesitant to recommend EV, which may be due to the lack of knowledge on this technology. Item 6 indicated that majority of the respondents have the desire to know more about EV with 47% answering agree and 41% strongly agree.

3.2. Public perception
In item 7, it was observed that 11% of the respondents disagree and 4% strongly disagreed. This indicates that the community is understands the current conditions that there is currently no EV that can compete with ICE in the sector of sales and maintenance prices. Furthermore, the public perception of prices in comparison with ICE is high with 40% of respondents answering agree and 17 respondents answering strongly agree. In item 8, 43% of respondents answered agree and 36% answered strongly agree, that the performance of EV must be comparable to ICE before it is adopted in Indonesia. In item 9, which relates with the public perception of the battery charging infrastructure sector, a majority of respondents chose strongly agree and agreed with 43% and 40% respectively. This indicates that the

public has a desire for the government to immediately build the infrastructure like a gas station that prospective consumers and users can conveniently get charge supply or replace the batteries.

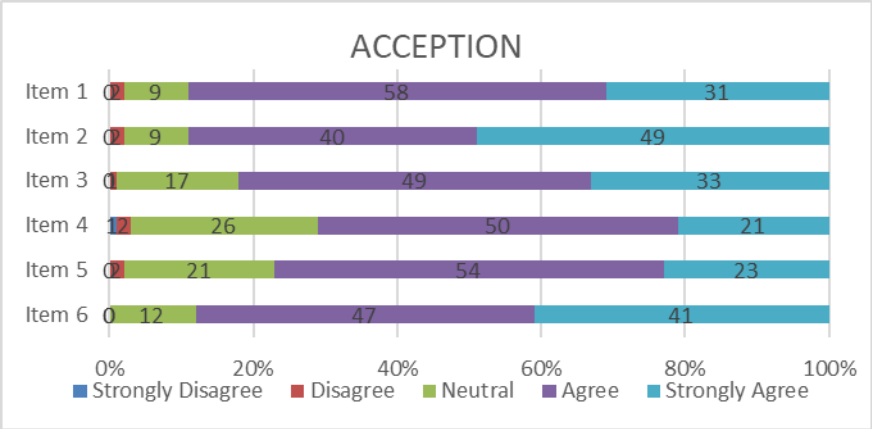

Figure 1. Frequency distribution of acceptance variable.

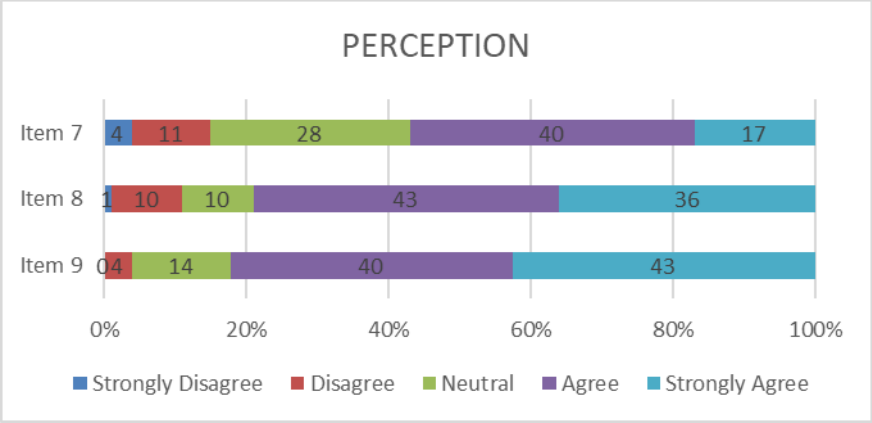

Figure 2. Frequency distribution of perception variable.

4. Conclusions

The sample used in this study may not be a true representative of the entire population due to variation in educational background, age and gender. However, this research is expected to provide a useful insight into the perception and acceptance of the community on EV. The results show that public acceptance is very high alongside the perceptions of price, performance and charging infrastructure. A small number of respondents did not have too high expectations about its price when compared with ICE vehicles but most of them expected that they were comparable or even cheaper than ICE. With regards to vehicle performance, the respondents expect similarity with ICE vehicles, perhaps for the vehicle mileage and durability. Furthermore, charging infrastructure should be built immediately by the government itself in an attempt to support the development of EV in Indonesia.

These vehicles are currently circulating in the world market and the inability for the community to adopt its use serves as a barrier to this technology in developing countries such as Indonesia. In Indonesia, the price and performance of electric vehicles itself has not met the expectations of the public and cannot compete with the conventional vehicles or ICE and the infrastructure for charging or changing batteries are not yet available in the community like a gas station used by conventional vehicles [8, 9].

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