ANALYSIS OF THE USE OF ELECTRIC GRAB BIKE IN CREATING SMART CITY DIMENSIONS OF SMART ENERGY IN THE CITY OF BANDUNG

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Abstract. One of the impacts of population density in Indonesia is the increase in domestic motorcycle sales, which directly leads to the depletion of petroleum fuels (BBM) and an increase in air pollution by 2025. One way to address this is by implementing the concept of a smart city, focusing on the smart energy dimension, and utilizing electric vehicles such as electric grab bike. The objective of this research is to determine the smart energy index value of electric grab bike usage in the city of Bandung and its impact on the community, particularly in Bandung. The research method employed was a mixed-method approach, utilizing the quadruple helix approach involving government, business actors, academia, and the community. The results revealed that the smart energy index value for the case study of electric grab bike usage in the city of Bandung is 72.78, indicating a fairly good and satisfactory performance, although there are still some areas for improvement. Additionally, the use of electric grab bike has positive impacts, such as reducing the consumption of petroleum fuels (BBM) and promoting an environmentally friendly mode of transportation in the city of Bandung.

Keywords: smart city; smart energy; electric grab bike; Bandung city

I. INTRODUCTION

The population density in Indonesia has resulted in rapid traffic mobilization, and one supporting indicator of mobilization efficiency is the usage and demand for motorcycles as a means of transportation [1]. According to the report from the Indonesian Motorcycle Association (AISI), the cumulative domestic motorcycle sales from January to June 2022 reached 2,246,627 units, while the volume of motorcycle exports reached 346,547 units. Motorcycles are the most commonly used mode of transportation by the Indonesian population [2]. The majority of motorcycle propulsion energy sources currently rely on petroleum-based fuels (BBM) [3]. Petroleum (BBM) is a non-renewable energy source derived from fossil fuels and plays a crucial role in societies worldwide. However, it is estimated that by 2025, petroleum reserves will be depleted. [4]. Indonesia's energy consumption is still predominantly reliant on fossil fuels, particularly petroleum, coal, and natural gas. There is a concern that by 2046, if renewable energy sources are not found, it will lead to an energy deficit [5]. Therefore, the pricing and distribution of petroleum fuels are regulated under the Basic Law 1495, the Oil and Energy Law. In 2022, the Ministry of Finance made an initial decision to increase the budget for fuel subsidies by 3.4 times, resulting in the rise of Indonesia Crude Petroleum (ICP) prices above $100/barrel. This was triggered by the increase in global oil prices due to the ongoing conflict between Ukraine and Russia. According to the Central Statistics Agency (BPS), the impact of the fuel price hike resulted in a year-on-year inflation rate of 4.61% in September 2022 and a further increase to 4.47% in October

2022. The increase in inflation has had an impact on Indonesian society, especially those who are less economically privileged. According to DetikJabar in 2022, there was a scarcity of petroleum fuels, specifically pertalite, in the city of Bandung, resulting in long queues at several gas stations. Online motorcycle taxi drivers (Ojol) also expressed their difficulties due to this situation, as it hindered their ability to efficiently use their time for refueling purposes. According to data from the Research and Development Agency (Balitbang) of the Ministry of Transportation (Kemenhub), a survey revealed that 18.69% of the population use online motorcycle taxis as a side job, with the majority being employees of state-owned enterprises or private companies. From the graph above, it can be observed that the increasing number of motorcycle taxi drivers indicates a rise in the total number of motorcycles operating in Indonesia.

Additionally, the increasing number of motorcycles has resulted in traffic congestion on several roads in major cities, and the transportation sector accounts for 60% of air pollution [6], therefore, the implementation of the smart city concept in the smart energy dimension is considered one of the solutions to urban energy issues, aiming to provide better services to the community [7]. Utilizing digital technology in the infrastructure of a region or city for smart energy purposes [8] has become a government priority. One example of this is the promotion of the transition to electric vehicles through public awareness campaigns. As reported by the Ministry of Energy and Mineral Resources in 2022, the city government of Bandung initiated the transition to electric motorcycles by organizing a convoy of 200 electric motorcycles. The aim of this initiative was to promote clean energy and reduce

pollution caused by vehicles. The government's support for the transition to electric vehicles is further evidenced by the presence of Presidential Regulation No. 55/2019 concerning the acceleration of the Battery Electric Vehicle (BEV) program. Furthermore, the Indonesian government has a vision for the digital energy of Asia, which is pursued through the 1001 digital startup program **[9]**.

In a press release issued by PLN, Press Release No. 183.PR/STH.00.01/III/2023, it is stated that the use of electric motorcycles is increasingly popular among the Indonesian community due to lower operational costs. For example, if someone typically spends Rp 30,000 per week on purchasing gasoline, with an electric motorcycle, they would only need to spend Rp 4,100 for two charges per week. This demonstrates the affordability, comfort, and efficiency of electric motorcycles. In an effort to develop the electric vehicle ecosystem in Indonesia, PT. PLN (Persero) continues to provide support to the community in reducing fuel operational costs by up to 75% **[10]**. According to jendelakaltara.co, in 2020, the presence of electric motorcycles was considered as part of the efforts to realize the smart city program, with the aim of reducing air pollution. Local public energy companies were requested to act as promoters in the introduction of electric motorcycles. According to grab.com, in 2020, PT. Grab Indonesia collaborated with Hyundai, Kymco, VIAR, and SELIS to provide 5,000 electric vehicles, such as electric grab bike, electric grab car, e-scooters, and bicycles, as part of their transportation services. In 2021, PT. Grab Indonesia operated more than 8,500 units of electric grab bike across eight provinces in indonesia, as the operation of electric grab bike has rapidly expanded compared to other vehicles. this includes the deployment of electric grab bike in the city of Bandung. According to the Fleet Operation Manager of electric grab bike in Bandung, Fachmi, approximately 410 units of electric grab bike are already in operation. Additionally, according to the President of PT. Grab Indonesia, Ridzki Kramadibrata, electric grab bike has successfully reduced carbon dioxide emissions by 4,600 ounces, which is equivalent to the absorption of carbon dioxide by 200,000 trees in a year. This aligns with the implementation of smart city principles, specifically in the smart energy dimension, which aims to facilitate the transition to electric vehicles and provide a better energy source for the economy, society, and the environment.

The research was conducted in the city of Bandung, as Bandung is one of the cities that has adopted the concept of a smart city **[11]**. According to grab.com in 2020, Bandung is one of the cities that has provided electric vehicles, and the number of electric vehicle operations in the city has been continuously increasing. This availability of electric vehicles, including electric grab bike users spread across various areas of Bandung, can assist researchers in conducting accurate research. Additionally, as reported by jabarprov.go.id, in 2022, the government of Bandung city has provided facilities for Public Electric Vehicle Charging Stations (SPKLU). This proves the government's support for the transition to electric vehicles. The research **[12]** on Identifying Smart Energy Indicators to Measure Smart Cities: The Indonesian Perspective has produced variables and indicators to measure the parameters of smart energy implementation and the research conducted **[8]** in the book "This is How to Measure the Readiness of a Smart City" has produced a smart energy implementation index value of 69.67 in the city of Bandung, which is interpreted as poor. There are still many deficiencies, but they are still within reason. Based on previous research literature and the phenomenon observed in the electric vehicle program in Bandung City, further research efforts are needed to explore the "Analysis of The Use of Electric Grab Bike In Creating Smart City Dimensions Of Smart Energy In The City of Bandung"

II. RESEARCH METHODS

The analytical method used is a mixed method approach. According to **[13]** The mixed method is a research approach that combines qualitative and quantitative methods to obtain more comprehensive, valid, reliable, and objective results. The qualitative method involves analysis based on the philosophy of post-positivism, allowing for in-depth results that emphasize or contain meaning. On the other hand, the quantitative method aims to observe a problem using a certain population or sample, where data is collected to test the hypothesis determined by the researcher **[13]**. The research utilized quantitative methods to obtain data by distributing questionnaires to respondents who use electric grab bike.

The research objectives include descriptive and exploratory aims to analyze the collected data appropriately, leading to a conclusion that has an important impact on society and ultimately results in new findings. Descriptive research involves describing objects that occur in the research **[13]** Exploratory research involves creating something that has never existed before. The research utilized a case study approach. According to **[13]** The case study research method is utilized by researchers to explore a program, process, event, or activity in detail, involving individuals or groups bound by continuous time, and collecting data using specific procedures.

The approach to theory development in research is deductive, as it allows for a more specific and detailed conclusion **[14]**. This study uses individual data on each respondent as the unit of analysis to ensure that the involvement of the researcher does not intervene with the data. The research background utilizes non-contrived settings **[15]** According to Uma Sekaran, non-contrived settings are used to observe natural activity in the research subject, without the involvement of the researcher. According to **[13]** Cross-sectional data is collected from the same or different objects or respondents at different times. In this study, a cross-sectional method was used to collect data at different times.

This research uses a quadruple helix approach, which is a triple helix development that combines government, industry, and academia, along with the community, to promote innovation and knowledge exchange. This collaboration can foster innovation among creative

citizens and drive economic growth **[16]**, using several populations such as:

1. The government acts as a facilitator for smart energy service providers in the city of Bandung.
2. Business player play a role in implementing smart energy utilization, namely PT. Grab Indonesia.
3. Academics play a role in the development of research in a particular field.
4. Communities play a role in enjoying or experiencing the implementation of programs provided by business players and the government.

So that on the basis of **[8]** there are eight indicators that reflect the characteristics of the four populations involved in the quadruple helix approach, which include government, business players, academics, and communities or users. This study uses a model with variables and indicators proposed for the smart energy dimension by **[12]**. The research involves 8 variables, including Active Users, Access to Energy Services, Advanced Distribution Management System, Data Management, Energy Efficiency, Management Integration and Renewable, Resilience Management System, Security & Privacy, with a total of 23 indicators.

III. RESULTS AND DISCUSSION

According to **[17]**, a research can be considered valid when the researcher conducts proper observation, identification, or investigation. In the validity test study, it was conducted with a sample size or N of 31 respondents. Therefore, when N = 31 with a significance level of 0.05, the degrees of freedom (DF) is calculated as 31 - 2 = 29, resulting in a tabulated r value of 0.367. In translation, if the calculated value of r is greater than the tabled value of r, then the data is considered valid. Conversely, if the calculated value of r is less than the tabled value of r, then the data is considered invalid. The results of the validity test of the 7 variables with 20 indicators of smart energy indicate that they are valid for assessing the smart energy index in realizing a smart city in the case study of the use of electric grab bikes in Bandung City. However, one variable with 3 indicators of smart energy is considered invalid. According to **[17],** reliability in research is focused on the stability and consistency of the measuring tool or instrument. In the study, the *Cronbach's Alpha* technique is used, where a *Cronbach's Alpha* value > 0.7 indicates reliability, while a *Cronbach's Alpha* value < 0.7 indicates unreliability **[18]**. The reliability test, the Cronbach's Alpha value was > 0.7, specifically 0.882, indicating that all indicators meet the reliability criteria.

Based on the research conducted with the respondents, it was found that each variable has an average value that influences the implementation of smart energy in Bandung City, in the case study of the usage of Grab electric bikes. Additionally, the average value of the index is used to calculate the smart energy index value in realizing a smart city, based on the case study of the usage of Grab electric bikes in Bandung City. The following are the smart energy values for Bandung City in the case study of the usage of Grab electric bikes.

Table 1. Smart Energy Readiness Index

Variables	Value	Category
AU1	67,90	Bad
AU2	68,74	Bad
AES1	67,45	Bad
AES2	68,19	Bad
ADMS1	72,90	Fair
ADMS2	71,20	Fair
ADMS3	78,40	Fair
ADMS4	60,74	Bad
ADMS5	74,32	Fair
DM1	75,24	Fair
DM2	80,60	Good
DM3	81,36	Good
DM4	74,20	Fair
DM5	76,17	Fair
EF1	78,22	Fair
FEF2	71,26	Fair
RS1	71,83	Fair
RS2	63,40	Bad
SPM1	74,83	Fair
SPM2	78,66	Fair
Smart Energy Readiness Index	**72,78**	**Fair**

Source : Data that has been processed by researchers, 2023

According to Table 1. indicates that the smart energy index value in realizing a smart city, based on the case study of the usage of Grab electric bikes in Bandung City, is 72.78. Therefore, it can be concluded that the progress is quite good and satisfactory, although there are still some areas that need improvement. The government has actively participated in building smart energy initiatives, and transportation companies have also started to develop and innovate their businesses by adopting electric fuel for increased convenience. However, there is still room for improvement in the implementation process, and further adjustments are necessary to optimize the outcomes. Based on the results of triangulation research through interviews, observations, and the collection of documents or literature studies, it is suggested that the government has started to make efforts towards the implementation of smart energy programs in the transportation sector. According to the Ministry of Energy and Mineral Resources, in 2022, a convoy of 200 electric motorcycles toured around the city of Bandung with the aim of raising public awareness about the use of electric motorcycles. The objective of this initiative is to accelerate the transition towards Net Zero Emissions by 2060, provide opportunities for micro, small, and medium-sized enterprises (UMKM) that own workshops, and promote the adoption of cleaner and more efficient energy use while reducing dependence on imported fossil fuels. This effort is expected to contribute to saving foreign exchange and reducing fuel subsidies. In addition, businesses have started to support the implementation of smart energy programs. For example, PT. Grab Indonesia has implemented a new breakthrough by providing a rental program for electric motorcycles known as Grab electric bikes or i-Motors. This initiative has provided significant benefits to the environment, as it has successfully

reduced over 5,000 indicated CO2 emissions and saved more than 2 million liters of fossil fuels. Grab electric bikes also provide convenience for online motorcycle taxi drivers who do not own a motorcycle, and the price or tariff of electric fuel is much cheaper. With the presence of Grab electric bikes, it has a positive impact on the transportation sector in Bandung City. A city can become a smart energy city where its energy sources can be utilized or consumed over a long period of time and can contribute to the future energy ecosystem, such as reducing the use of fossil fuels and creating a more environmentally friendly transportation system in Bandung City.

The research results show that the smart energy index value in realizing a smart city in the case study of the use of electric grab bikes in Bandung City is 72.78, which is considered quite good and satisfactory. However, there are still some areas that need improvement. This indicates that the transition from conventional motorcycles to electric motorcycles in Bandung City can have an impact on fuel savings and the environment, this research demonstrates the emergence of electric motorcycles such as electric grab bike, supported by programs from the government, businesses, academia, and the community. This gives hope for the progress of Bandung city in the field of transportation, aiming to create a pollution-free city, reduce vehicle noise, and provide comfortable traffic conditions.

Based on previous research conducted in Portland, North America, it was found that electric bicycles (e-bikes) provide a solution for reducing greenhouse gas (GHG) emissions in transportation systems. This research refers to an earlier study by Mason et al. (2015) that presented optimistic results, showing a 14% increase in the market share of electric bicycles (e-bikes) through a combination of policies that go beyond congestion pricing, including the development of bike lane networks and bike-sharing programs, the implementation of laws that enhance cyclist safety, transit investments, improved land use and transportation planning, elimination of parking and fuel subsidies, and the allocation of new government funding for active transportation investments.

Therefore, in 2020, a study conducted by [19] resulted in an analysis showing the continuous growth of electric bicycle (e-bike) population in Portland, North America. It is observed that the lower price compared to cars and the perceived significant benefits over conventional gasoline-powered motorcycles contribute to this growth. The use of electric bicycles (e-bikes) can also estimate the aggregate changes in the number of trips made by individuals based on the transportation modes used, along with the total gas emissions produced. Additionally, a single electric bicycle (e-bike) can contribute to an average reduction of 225 kg of CO2 emissions per year, urban noise, and traffic congestion. This is consistent with the research on the Analysis of Electric Grab Bike Usage in Realizing the Smart City Dimension of Smart Energy in Bandung City, which shows the positive impact of the transition to electric motorcycle vehicles.

IV. CONCLUSION

Based on the research results on the Analysis of The Use of Electric Grab Bike In Creating Smart City Dimensions Of Smart Energy In The City of Bandung, using the quadruple helix approach through interviews and questionnaire distribution, numerical data and respondents' reasons were obtained during the research, and the following conclusions can be drawn The smart energy index score in realizing a smart city in the case study of Electric Grab Bike usage in Bandung city is 72.78. This score can be interpreted as the implementation of smart energy being considered quite good and satisfactory, although there are still some areas that are lacking. The presence of Electric Grab Bike has brought positive impacts to the transportation sector in the city of Bandung. A city can become a smart energy city where its energy sources can be utilized or consumed in the long term, thus creating a future energy ecosystem that can reduce the use of fossil fuels and make transportation in Bandung more environmentally friendly.

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