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MORALITY BEFORE KNOWLEDGE

Optimizing public space design through odd-even policy: Reducing traffic congestion and pollution in DKI Jakarta

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ABSTRACT

Background: The Provincial Government of DKI Jakarta issued Governor Regulation No. 155 of 2018 and its amendments regarding Traffic Restrictions with the Odd-Even System. This regulation aims to reduce congestion levels on 16 main roads. By decreasing congestion, the expected outcome is a reduction in air pollution levels in DKI Jakarta. However, there is concern that the implementation of Governor Regulation No. 155 of 2018 might lead to an increase in conventional car purchases, as affluent individuals may buy two cars with odd and even license plates. This choice is driven by the continued use of fossil fuel-based energy. This study aims to evaluate the effectiveness of Governor Regulation No. 155 of 2018 in reducing traffic congestion and air pollution in DKI Jakarta. Additionally, the study seeks to understand the relationship between the implementation of the odd-even traffic restriction system and electric vehicle sales. **Methods:** The research was conducted by analyzing secondary data obtained from government agencies and other institutions. Furthermore, a questionnaire survey was administered to individuals active on the 16 main roads where the odd-even policy is enforced. The study also analyzed the purchase levels of electric cars, which is one method for Jakarta residents to avoid fines on odd-even roads. **Result:** Based on the research findings, Governor Regulation No. 155 of 2018 and its amendments have not yet effectively reduced traffic congestion and air pollution in DKI Jakarta. **Conclusion**: The increase in electric car purchases potentially introduces new issues, such as the unsustainable management of nickel mines required for electric vehicle battery production. Therefore, other sustainable strategies are needed to address traffic congestion and air pollution. **Novelty/Originality of the study:** This study shows that Governor Regulation No. 155 of 2018 has yet to reduce congestion and air pollution in DKI Jakarta effectively. In addition, the increase in the purchase of electric cars as a solution to avoid fines has raised new problems related to the environmental impact of electric vehicle battery production.

KEYWORDS: air pollution; electric cars; odd-even; traffic jams.

1. Introduction

Traffic congestion is a complex issue occurring in almost all major cities, including DKI Jakarta. As the capital city of Indonesia and a hub for business and government, the number of vehicles in Jakarta continues to rise. The trend of population growth, coupled with the need for mobility, leads to traffic congestion (Farda & Balijepalli, 2018). According to the 2021 Numbeo database report, Jakarta ranked as the second most congested city in Southeast Asia after Manila, Philippines (Sulistyono, 2022). Based on data from the Central Bureau of Statistics, in 2021, there were 21,758,695 motor vehicles in DKI Jakarta, including passenger cars, buses, trucks, and motorcycles.

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The Provincial Government of DKI Jakarta has implemented several policies to address this issue. In 2018, Governor Regulation No. 155 was issued, introducing the Odd-Even Traffic Restriction System. After evaluation and trials on several roads in Jakarta, the system showed positive impacts in terms of improving road space efficiency and effectiveness as well as air quality. Consequently, the DKI Jakarta Provincial Government updated the regulation by expanding the designated roads through Governor Regulation No. 88 of 2019. The odd-even policy scheme appeared effective in its initial implementation; however, vehicle owners have since adapted by purchasing a second vehicle or using fake license plates (Farda & Balijepalli, 2018).

At least two major sectors suffer losses due to traffic congestion: the economy and the environment. Economically, it is predicted that there will be a fuel waste of 71.4 trillion rupiahs due to increased travel time and distances caused by traffic jams (Sulistyono, 2022). From an environmental perspective, air pollution is a primary issue that is consistently associated with transportation problems. The transportation sector is the largest contributor to carbon emissions (Liu et al., 2021). In Indonesia, the majority of vehicles are still powered by fossil fuels, directly emitting carbon into the air. Carbon emissions from fossil fuel-powered vehicles in the transportation sector in Indonesia account for 30% of the total carbon emissions, with the highest emissions coming from land transportation, contributing 88% of the total emissions in this sector (IESR, 2020).

In 2019, President Joko Widodo issued Presidential Regulation No. 55 of 2019 on the Acceleration of the Battery Electric Vehicle (BEV) Program for Road Transportation. Through this policy, the government aims to enhance energy efficiency, energy security, and energy conservation in the transportation sector by promoting the use of electric vehicles for road transport to achieve clean energy, clean and environmentally friendly air quality, and Indonesia's commitment to reducing greenhouse gas emissions.

However, this policy has not significantly improved the environmental conditions. The zero emissions goal from using electric vehicles can only be achieved during their use, not during the battery charging process (Liu et al., 2021). Furthermore, electricity generation in Indonesia is still predominantly coal-fired. Additionally, batteries, as energy storage devices, are crucial components of electric vehicles, accounting for 60% of the total importance of electric vehicle components (Ulfa et al., 2021).

Given Indonesia's abundant nickel resources, the country aims to produce electric vehicle batteries domestically (Ulfa et al., 2021). According to the 2020 Mineral Commodity Summaries released by the United States Geological Survey (USGS), Indonesia has the world's largest nickel reserves, with 21 million tons equivalent out of the world's total reserves of 89 million tons equivalent, or about 24% of the world's reserves. Indonesia's total nickel production was 606,000 tons in 2018 and 800,000 tons in 2019 (USGS, 2020). Indonesia has nickel mines covering an area of 520,877.07 hectares spread across seven provinces, including Maluku, North Maluku, Papua, West Papua, South Sulawesi, Central Sulawesi, and Southeast Sulawesi. Southeast Sulawesi has the largest nickel mining area in Indonesia.

On the other hand, the electric vehicle battery industry is considered to have an impact on the social conditions of communities and the environment. Morowali, one of the regencies in Central Sulawesi Province, has helped Indonesia become the largest nickel producer in the world. The processing of nickel from the Indonesia Morowali Industrial Park (IMIP) area has environmental impacts. Massive deforestation occurs on land, while the sea receives the waste disposal. The disposal of mining waste into the sea causes damage to coral reefs. The livelihoods of the local communities as fishermen are affected because fish and other marine catches become harder to find along the Morowali coast. Marine pollution causes fishermen to lose their livelihoods. Waste leads to marine sedimentation, damaging coral reefs and fish habitats (Syarifuddin, 2022).

Electric batteries also have issues related to production and waste (Coffin & Horowitz, 2018). There is evidence that CO2 emissions are generated during the production process of electric vehicle batteries, which can impact climate change (Ulfa et al., 2021). CO2 emissions are very high during the battery production phase; the life cycle CO2 emissions

of battery electric vehicles tend to be greater than those of internal combustion engine vehicles (Kawamoto et al., 2019). The components of lithium-ion batteries can cause the chemicals used to spill and contaminate water during mining (P&S Intelligence, 2020). Overall, the strategy of reducing traffic congestion and air pollution by switching to electric vehicles does not fully achieve its initial objectives.

Furthermore, according to the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2021 on the Procedures and Requirements for the Management of Hazardous and Toxic Waste, dry batteries can be classified as Hazardous and Toxic Substances (B3). The disposal of electric vehicle batteries can also cause pollution if not done properly. Electric vehicle batteries contain toxic materials that can harm the environment if released into it. If battery waste is not managed properly, it will lead to environmental pollution, which in turn will affect public health.

2. Methods

The variables to achieve the research objectives are analyzed by assessing public satisfaction with traffic restriction policies, air pollution levels, and the purchase levels of conventional and electric cars. The research approach used to identify these variables is qualitative. The variables are then further analyzed using descriptive analysis, which provides a description or depiction of the research subjects based on the variable data obtained. This analysis aims to give a comprehensive picture of the data in both verbal and numerical forms related to the studied data.

3. Results and Discussion

The development of major cities always brings both positive and negative impacts. One of the negative impacts commonly seen in urban areas or even metropolitans is traffic congestion. Almost all major cities worldwide face congestion issues. Based on data from one of the Global Positioning System (GPS) device manufacturers, Jakarta is among the top 50 most congested cities globally. The Provincial Government of DKI Jakarta has implemented various methods to alleviate traffic congestion. Starting with the implementation of the 3 in 1 policy in 2003, which was later revised in 2016. The 3 in 1 policy was deemed ineffective due to the prevalence of "jockeys" for drivers seeking to pass through protocol roads, resulting in minimal significant changes in congestion levels. Then, in 2016, a traffic restriction policy based on the odd-even system was introduced on the same 5 roads where the 3 in 1 policy was enforced. In 2018, through Governor Regulation No. 155 of 2018 concerning Traffic Restrictions with the Odd-Even System, the Jakarta Provincial Government established a permanent odd-even traffic restriction policy. In addition to these policies, the DKI Jakarta Government also plans to implement the Electronic Road Pricing (ERP) system. However, due to the unavailability of infrastructure and readiness, ERP has not been implemented yet.

Based on research findings, the current implementation of the odd-even policy on 16 protocol roads in DKI Jakarta yields the following results:

3.1 Community satisfaction with the implementation of odd-even

The analysis of questionnaires distributed to the public indicates that there are still two different opinions among the community regarding the implementation of odd-even policy in DKI Jakarta. Based on the questionnaires distributed to individuals who have passed through the 16 protocol roads subject to the odd-even policy, an analysis was obtained. Out of 48 respondents, 27.1% stated that the odd-even policy effectively reduces congestion levels. Meanwhile, the remaining 72.9% expressed that the odd-even policy is not effective in reducing congestion levels. The questionnaire results are illustrated in the following Fig. 2.

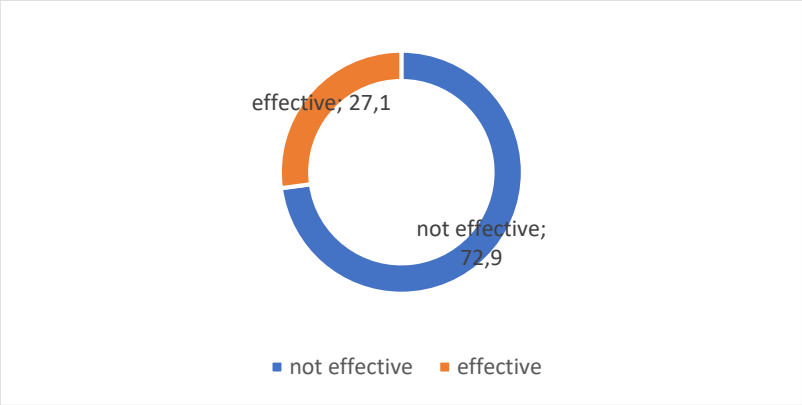

Fig. 2. Questionnaire graph of the level of public satisfaction with the implementation of odd-even in DKI Jakarta

Further analysis of the questionnaire revealed that 27.1% of the satisfied communitymembers with the odd-even policy implementation stated that: (a) There is a reduction in the number of vehicles passing through the 16 protocol roads, leading to an increase in the average vehicle speed, (b) There will be an increase in the use of public transportation if supporting facilities for public transportation are improved, which can enhance the comfort and safety of public transportation users. Currently, there are adequate public transportation options available to the public, such as TransJakarta buses, MRT, LRT, and commuter trains (KRL), (c) There is a decrease in air pollution in the areas traversed by the 16 protocol roads.

The subsequent questionnaire results revealed that 72.9% of the satisfied community members with the odd-even policy implementation on the 16 protocol roads indicated that the odd-even policy in DKI Jakarta did not demonstrate an effective impact in reducing congestion levels in DKI Jakarta Province. This can be discerned from the questionnaire responses of some respondents who stated that the odd-even policy is ineffective because: (a) The implementation of the odd-even policy prompts some affluent individuals to purchase additional vehicles with different license plates, enabling them to still use cars interchangeably. (b) The air pollution levels in Jakarta only decreased during the implementation of the Large-Scale Social Restrictions (PSBB) at the beginning of the Covid-19 pandemic, when almost all offices and schools implemented Work From Home (WFH) or Distance Learning (PJJ) policies. However, after the relaxation of the PSBB, Jakarta's roads became congested again, and air pollution levels rose once more. (c) There are exemptions for certain vehicles, leading to a sense of unfairness among some road users. (d) The public transportation system is not fully integrated, requiring commuters to switch between various types of public transportation and sometimes resort to online motorcycle taxis.

The results indicate that the majority of DKI Jakarta residents are dissatisfied with the implementation of the odd-even policy on the 16 protocol roads. The Jakarta Provincial Government needs to find solutions to reduce congestion levels on the roads. Several methods for reducing congestion levels in DKI Jakarta Province have been under study. However, not all of these studies have been conducted, or at least, they are still incomplete. Some studies on reducing congestion levels in DKI Jakarta Province include: (a) Optimizing traffic light management. Traffic management optimization can be achieved by adjusting the timing of traffic lights at intersections along the 16 protocol roads, prioritizing lanes with heavier traffic flow. (b) Utilizing CCTV for traffic congestion monitoring. The use of CCTV aims to expedite responses from traffic police and transportation officials to promptly address congestion issues. (c) Enhancing the quality of public transportation. Both the central government and the Jakarta Provincial Government have made efforts to improve the quality of public transportation. This includes optimizing commuter train (KRL) routes from Bekasi, Bogor, and Tangerang, as well as completing the second phase of the MRT from Bundaran HI to Jakarta Kota Station, and finishing the construction of the LRT from Bekasi and Cibubur. Other endeavors include revitalizing TransJakarta bus stops to provide better

services to the public. (d) Implementing public transportation integration. The Jakarta Provincial Government is striving to integrate all modes of public transportation, synchronizing routes between KRL, MRT, TransJakarta buses, and city transportation, with future plans for integration with LRT. This is to enable commuters to travel without frequent transfers between transportation modes or resorting to more expensive public transportation options such as taxis or online motorcycle taxis. (e) Employing Electronic Road Pricing (ERP). The implementation of ERP is still in the trial phase. This is because ERP support equipment is not yet synchronized with other facilities, such as vehicle license plates. Cameras or sensors in the ERP system have not been able to detect vehicle license plates optimally. Furthermore, the payment mechanism for vehicles passing through the 16 protocol roads under ERP has not been resolved. ERP would greatly assist in reducing congestion levels on protocol roads because the high tariffs would prompt drivers to reconsider using private vehicles and opt for public transportation. However, as seen in other countries, especially developed nations, effective ERP implementation must be complemented by good public transportation to avoid reluctance among the public, particularly those with higher incomes, to switch from private vehicles to public transportation. (f) Regulating parking areas. Regulating parking areas or creating parking zones outside the main areas or before entering the 16 protocol roads can also reduce congestion levels in the city center. Establishing parking zones with low costs or receiving subsidies from the government would incentivize the public to use public transportation when heading to the city center. Parking zone creation should be integrated with bus stops, terminals, or public transportation stations so that commuters do not require additional transportation when heading to these facilities. (g) Expanding bicycle lanes. Enhancing bicycle lanes or creating dedicated bike lanes is expected to increase public interest in cycling. Mass bicycle usage would help reduce air pollution levels in DKI Jakarta Province. However, promoting bicycle usage in the Jakarta city center must be accompanied by intensive public awareness campaigns, as the average commuting distance between residences and workplaces in Jakarta requires more than 30 minutes. With hot and dusty road conditions, this poses a challenge for cyclists.

3.2 Air pollution levels for odd-even implementation

According to the Air Visual's World Air Quality Report, it is noted that since the implementation of the odd-even policy in 2018, the air pollution index based on PM 2.5 in DKI Jakarta actually experienced an increase in 2019. The pollution index decreased in 2020 and 2021. The data for the past five years regarding air pollution levels based on PM 2.5 in DKI Jakarta is as follows:

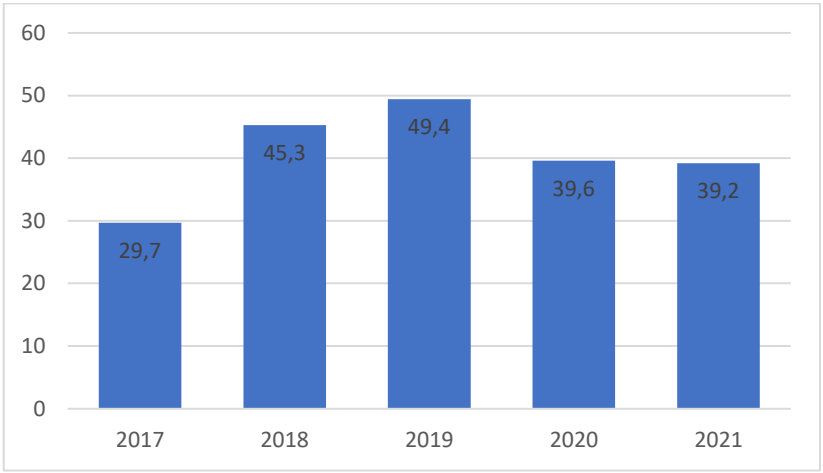

Fig. 3. air pollution index based on PM 2.5 in DKI Jakarta Province
(Processed from World Air Quality Report 2017 – 2021)

Based on the data in the Fig. 3, it is evident that the pollution index in DKI Jakarta shows a trend of increase from 2017 to 2021. Although there was a decrease in air pollution levels

in 2020 and 2021, it was primarily due to the Covid-19 pandemic, which resulted in many people staying at home. However, when compared to the data from 2017, before the implementation of the odd-even policy, there was actually an increase in pollution levels in 2018 and 2019. This leads to the conclusion that the odd-even policy implementation in DKI Jakarta did not reduce air pollution levels.

One of the efforts being promoted by the government to reduce air pollution is the use of electric cars. The use of electric cars in Indonesia can emulate the electric vehicle program in Norway. 'The Norwegian government has implemented an emission-free vehicle policy since the 1990s. To boost electric car sales, Norway offers tax incentives for electric vehicles. Norway is the largest crude oil producer in Western Europe. Oil revenues contribute to Norway's wealth fund, valued at 1.3 trillion USD. Currently, Norway is beginning to use renewable energy and is transitioning away from oil and gas.

According to the Norwegian Electric Vehicle Association, with tax incentives in place, the prices of most electric vehicles become cheaper compared to those running on gasoline. Buyers also enjoy other incentives such as the use of bus lanes, reduced fees for ferries, and state road tolls. As for charging facilities, Norway already has 10,000 charging locations available to the public.

According to data published by the Norwegian Road Federation (OFV) on January 5, 2021, the market share of electric cars in Norway reached 54 percent in 2020. This figure increased by about 12 percent compared to 2019, which was only 42 percent. If hybrid vehicle sales data are included, the market share of electric vehicles even reached 83 percent last year. Sales of conventional fuel cars (petrol and diesel) were only 17 percent. However, in 2015, the combined market share of petrol and diesel cars reached 71 percent.

Norway, located in the Scandinavian region of Northern Europe, has pledged to stop the presence of fossil fuel vehicles by 2025. This program is driven by significant tax incentives to ensure zero-emission new passenger car and van sales. The record-breaking sales of electric vehicles in 2020 signify an acceleration of the electric vehicle program in Norway ahead of schedule.

Based on the experience of developed countries that have previously adopted electric vehicles, the sale of electric cars must be accompanied by the development of supporting facilities or infrastructure, such as charging stations. Additionally, the source of electricity production must come from renewable energy to prevent air pollution at the upstream level (electricity source). Another issue is the source of raw materials for batteries, specifically nickel. The Indonesian government is highly protective of its battery raw material sources, as nickel is currently a highly valuable mineral. The Indonesian government aims for the people of Indonesia to benefit as a nickel-producing country by establishing battery manufacturing plants in Indonesia.

3.3 Conventional and electric car purchase rates

Climate change has become a serious issue and a significant concern for several countries. The use of alternative energy is now crucial in reducing carbon emissions and supporting environmentally friendly energy resilience for the present and future. Continuous energy consumption poses various threats, including energy crises and environmental pollution in the form of carbon emissions, which are key factors in climate change. According to the IPCC (Intergovernmental Panel on Climate Change) report, human activities contribute to the accelerated rise in greenhouse gas concentrations in the atmosphere. The accumulation of greenhouse gas concentrations in the atmosphere leads to excessive heat absorption, resulting in increased global temperatures (Sudjoko, 2021).

A major contributor to the increase in greenhouse gas emissions in daily life is the use of fossil fuel vehicles, as evidenced by the rising purchase of motor vehicles each year. This trend can be observed in the graph provided in Figure 4.

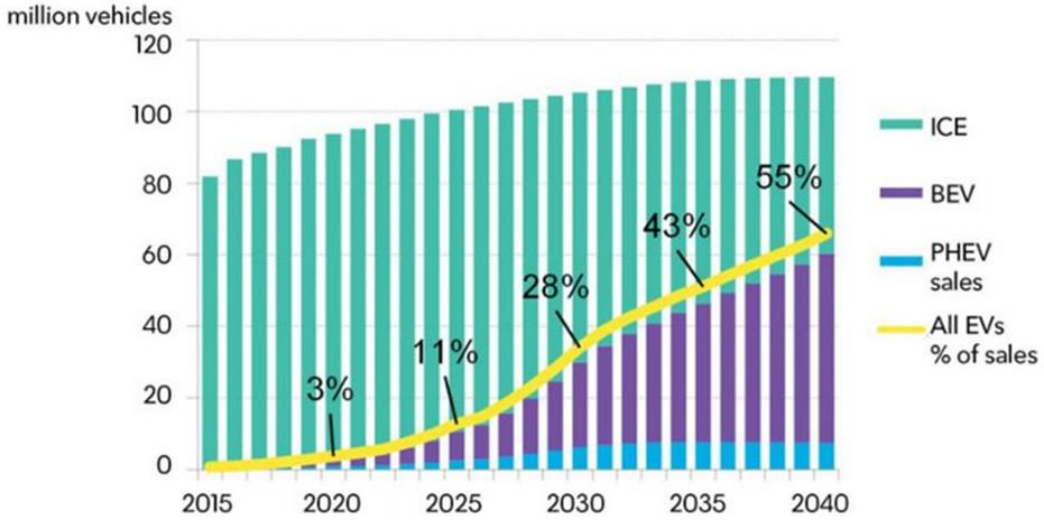

Figure 4. World vehicle sales prediction graph
source: Bloomberg New Energy Finance, 2022

The graph above depicts the increasing trend in the purchase of vehicles, including Internal Combustion Engine (ICE), Battery Electric Vehicles (BEV), Plug-In Hybrid Electric Vehicles (PHEV), and other Electric Vehicles (EV) each year. However, the purchase of electric vehicles shows a continuous rise each year, peaking in 2040, where it is projected to reach 55% or more, surpassing the purchase of fossil fuel vehicles. The predictions indicated by the graph could have positive impacts, especially on the environment, which continues to receive emissions from fossil fuel vehicles. This trend is expected to reduce greenhouse gas emissions, particularly by decreasing the use of fossil fuel vehicles and increasing the use of electric vehicles.

According to Sudjoko (2021), electric vehicles can help address air pollution issues in urban areas. The development of electric cars and electric motorcycles has the potential to significantly reduce pollutant emissions (CO, NOx, HC, SO2, and PM). Among the total CO2 emissions released, three components have the most significant impact on these high emissions: the electricity sector (42%), transportation (23%), and housing (6%). Currently, the government is encouraging the development of electric vehicles and charging station infrastructure through Presidential Regulation No. 55/2019. Battery electric vehicles have advantages over Internal Combustion Engine (ICE) vehicles in reducing air pollution and GHG emissions. Electric vehicles produce significantly less air pollution and can be considered close to zero compared to ICE-based vehicles. Electric vehicles are suitable for addressing air pollution issues, especially in urban areas.

The Battery Electric Vehicle Program (KBLBB) is an acceleration step taken to realize the implementation of electric vehicles in Indonesia according to the planned targets. The KBLBB provides a solution and can assist the government in saving energy costs and reducing dependence on fuel imports. As a pollution-free and environmentally friendly mode of transportation, it also serves as an alternative solution in supporting emission reductions in Indonesia.

Related to the Sustainable Development Goals (SDGs), with one of Indonesia's priorities in development strategies, especially those related to the environment, such as clean energy and efforts to address climate change, Indonesia is committed to targeting a reduction in CO2 emissions by 29% - 41% by 2030. The use of electric vehicles can be a solution to current environmental issues due to the use of environmentally friendly technology and sources. Additionally, the use of electric vehicles can anticipate the impacts of energy crises and reduce air pollution. Thus, electric vehicles can be an alternative in the sustainable transportation sector and support the Sustainable Development Goals (SDGs) program in Indonesia (Sudjoko, 2021). This could also serve as a policy replacement for the odd-even regulation to reduce the emission impacts of motor vehicles, especially in the Special Capital Region of Jakarta.

Government policies promoting the implementation of electric vehicles are strongly supported by the community. According to data from the Indonesian Automotive Industry Association (Gaikindo), during January-September 2022, the sales volume of battery electric vehicles (BEV) or Battery Electric Vehicle-Based Motor Vehicles (KBLBB) in the domestic market reached 3,801 units. The sales graph of KBLBB in Indonesia for January-September 2022 can be seen in Fig. 5 below.

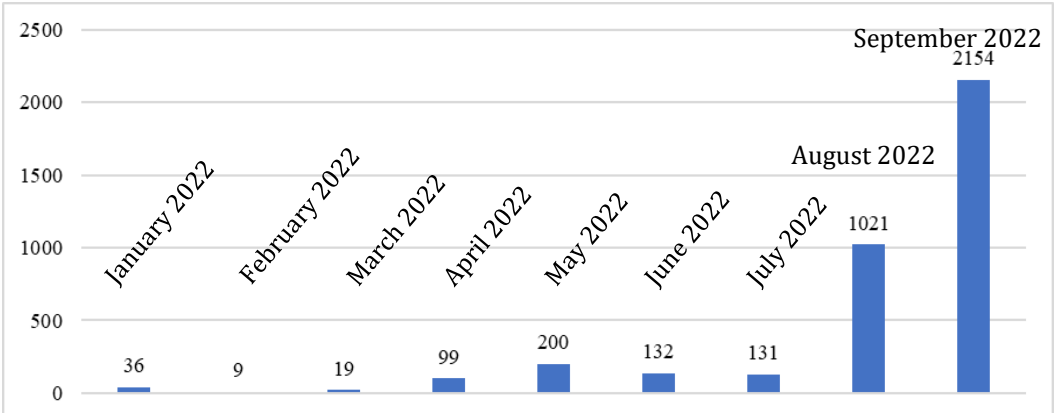

Fig. 5. KBLBB sales graph in Indonesia in January-September 2022
(Gaikindo, 2022)

The graph above illustrates the significance of electric vehicle purchases in 2022, reaching its peak in September with a total of 2154 electric vehicles sold. During this period, the most popular electric vehicle was the Wuling Air EV Long Range, with sales reaching 1,973 units. This success in achieving the highest sales this year is attributed to its participation in the G20 Summit held in Bali in November 2022, where 300 units of the Air EV were used as official car partners to support the mobility of G20 delegates and participating international organizations.

The graph indicates a high level of public enthusiasm for purchasing electric vehicles. However, this data is not accompanied by the reasons why individuals choose to buy electric vehicles, whether to support government policies in reducing motor vehicle emissions or for other reasons.

The development of electric vehicles has shown great potential as a viable solution to the global challenges facing the world today regarding energy use, safety, and its impact on environmental pollution. However, its implementation is still very limited due to the small number of vehicles available, limited range, and inadequate battery charging procedures. This is also correlated with the relatively high prices of electric vehicle units (Harahap et al., 2017). According to Nugraha & Kusumathalhah (2022), the total cost of owning an electric vehicle in the initial years is higher compared to conventional vehicles. In the city car class, the total cost of owning an electric vehicle becomes more advantageous than conventional vehicles after the 7th year of use. In the sport utility vehicle (SUV) class, this occurs after the 21st year of use. The depreciation value of electric vehicles is lower than that of conventional vehicles. Therefore, the asset value of electric vehicles is greater than conventional vehicles by the 10th year. The operational cost per kilometer of electric vehicles is lower compared to conventional vehicles. After the 10th year of use, electric vehicles have a better economic value compared to conventional vehicles.

As the use of electric vehicles increases, the reduction in CO2 emissions will also be more significant, potentially mitigating greenhouse effects. Especially if the electricity sources for electric vehicle charging stations and battery exchange stations come from

renewable energy sources, electric vehicle use will contribute 100 percent (end to end) to environmental improvement and air quality (Nugraha & Kusumathalhah, 2022).

Electric vehicles are vehicles powered by batteries. Batteries are a crucial component of electric vehicles, serving as a source of current for the entire electrical system and as a storage unit for energy. Batteries function to supply electric current during the starting system to start the engine, operate lights, and other electrical components (Sudjoko, 2021). Lithium batteries are commonly used in electric vehicles as a medium for storing electrical energy. These batteries have high energy density, high open circuit voltage potential, fast energy charging, low self-discharge, and are environmentally friendly. One example of a lithium battery type is lithium polymer.

Given the high demand for nickel batteries, Indonesia's position in the global nickel industry is crucial. This is evident from the significant nickel deposits in Indonesia, prompting electric vehicle battery manufacturers to plan and build smelter factories in the country. The scarcity of nickel sulfide resources has led the battery industry to rely more on nickel laterite (Sudjoko, 2021).

Globally, nickel mineral resources amount to approximately 21 million tons with a production of 800 thousand tons in 2019. Indonesia is among the countries with the largest mining production globally, where Indonesia's nickel mining production comes from laterite mining to extract limonite and saprolite. The world's nickel Ni reserves are about 139.419 billion tons, with Indonesia having approximately 72 million tons of Ni reserves, including Limonite. This amount represents the largest reserves globally, comprising 52% of the world's reserves. Other countries such as Australia account for 15%, Brazil 8%, Russia 5%, and 20% from other countries like China, the Philippines, and others (Zaidan et al., 2021).

Nickel is a naturally occurring metallic element with a lustrous, silvery-white appearance. It is one of the five most common metals found on Earth, widely present in the Earth's crust. Nickel is also a good conductor of electricity and heat. By 2030, the consumption of nickel for electric vehicle batteries and Energy Storage Systems (ESS) is projected to reach 800,000 tons, up from less than 200,000 tons in 2020. The use of nickel for battery production in 2020 was below 200,000 tons, and by 2030 it is expected to be around 800,000 tons, or 30% for battery materials. Additionally, it is estimated that 48% of nickel will be used for stainless steel, with the remainder for alloys, plating, and other uses. By 2030, it is predicted that 20% of the global nickel consumption will be for electric vehicle batteries and ESS batteries, with this percentage expected to grow to 37% by 2040. Electric batteries are a crucial component of electric vehicles, serving as the energy source to power the engine. This energy source distinguishes electric vehicles from conventional fuel-powered vehicles, making them more environmentally friendly by reducing air pollution. Li-ion batteries use lithium and cobalt as electrodes, while NiMH batteries utilize nickel. As one of the significant nickel-producing countries, Indonesia's nickel resources need to be managed wisely and effectively to support battery raw material production.

The rapid development of the electric industry, coupled with increasing awareness among vehicle users to switch to electric vehicles, has drastically increased the demand for batteries as the main energy source component. This surge in demand has also driven the expansion of the nickel mining industry, which is a key component in battery production (Syarifuddin, 2022). The large-scale expansion of nickel mining is part of the government's ambition to make Indonesia a leading producer of electric vehicle battery components. With the nickel mining operations in Morowali, Indonesia has become the world's largest nickel producer. The rising demand for nickel in the era of low-emission vehicles has made nickel an important commodity for battery production.

In Morowali, located in Central Sulawesi, nickel processing from the Indonesia Morowali Industrial Park (IMIP) has severely impacted the coastal areas and marine ecosystems. The disposal of tailings has damaged coral reefs. The most immediate impact is on the livelihoods of fishermen, as fish have become harder to find along the Morowali coast. There has been massive deforestation on land, while the sea bears the brunt of waste disposal. Marine pollution has caused fishermen to lose their livelihoods, with waste leading

to ocean sedimentation, damaging coral reefs and fish habitats. Supporting the mission of converting low-emission energy to clean energy at the expense of the environment appears to be unwise (Syarifuddin, 2022).

There haven't been many studies analyzing the impact of nickel mining in the Morowali Regency area, particularly in maritime conditions, except for observations conducted by the Central Sulawesi Friends of the Earth (WALHI). However, many similar case studies involving nickel mining activities have impacted the surrounding marine conditions. Stakeholders in Morowali Regency should ideally refer to previous studies or, more concretely, conduct direct studies in the marine waters of Morowali Regency. Various options can be considered rather than direct tailings disposal or discharge into rivers flowing into the sea. For example, constructing tailing dams, creating waste paste, or treating waste for return to the land. Any plans for increasing mining facilities or production capacity should also include plans for waste disposal. It is concerning that mining companies seem to show resistance to complying with waste disposal regulations. Progress without environmental preservation will inevitably lead to disasters. Awareness campaigns for environmental care must continue locally, nationally, and internationally. The sea is one of the natural resources regulated to be utilized to the fullest extent by all Indonesian communities. The government is needed to regulate its utilization to ensure balanced utilization (Syarifuddin, 2022).

4. Conclusions

Governor Regulation No. 155 of 2018 regarding Traffic Restrictions with the Odd-Even System and its amendments have not been able to reduce traffic congestion and air pollution in DKI Jakarta. The transition to the use of private vehicles by Jakarta residents to still be able to use cars on the 16 protocol roads is through the purchase of electric vehicles. The increase in electric vehicle purchases has the potential to introduce new issues, such as the management of nickel mines for the production of unsustainable electric vehicle battery raw materials. Therefore, other sustainable strategies are needed to address traffic congestion and air pollution.

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