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The Progress of Electric Vehicles (EVs) Transition in Indonesia Aiming Environmental Sustainability

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Abstract

Environmental issues affect the lives of a large number of people; thus, they require greater attention. The growing number of motorized cars in Indonesia has made the environmental problems worsen day by day. Air pollution is caused by motor vehicle emissions, and in 2023 Jakarta is considered to rank as the 29th most congested city in the world. For many Indonesians, this has resulted in the increased production of emissions, which has a negative impact on their general way of life and health. The government has realized that switching to more ecologically friendly electric vehicles (EVs) from fossil fuel-powered vehicles is crucial and necessary. Because of its heavy reliance on non-renewable energy sources, Indonesia finds it difficult to promote and integrate EVs. Therefore, this study tries to analyze the progress that Indonesia has made in transitioning from conventional vehicles that run on fossil fuels to electric vehicles as part of the country's environmental diplomacy commitment. The authors employ a qualitative research approach through secondary data based on academic research journals. The authors also make a comparison of Indonesia's progress with the European Union (EU) and China's own progress, which have successfully implemented EVs into their markets for the past few years. Additionally, this article explains the setbacks Indonesia experiences in the form of challenges and risks that arise. Lastly, the study provides a number of solution recommendations that could help Indonesia gradually transition to the use of electric vehicles and solve this environmental issue.

Keywords: Indonesia's environmental diplomacy, electric vehicles (evs), technology transition, environmental policy, environmental issue

Abstrak

Isu lingkungan sangat berdampak terhadap kepentingan hidup orang banyak; oleh karenanya, penyelesaiannya membutuhkan upaya yang lebih. Semakin besarnya jumlah kendaraan bermotor di Indonesia telah memperburuk masalah lingkungan dari hari ke hari. Polusi udara disebabkan oleh emisi kendaraan bermotor dan pada tahun 2023 Jakarta dinobatkan sebagai kota terpadat pada peringkat ke-29 di dunia. Bagi banyak orang Indonesia, hal ini mengakibatkan pada peningkatan produksi emisi, yang berdampak negatif pada gaya hidup dan kesehatan. Pemerintah telah menyadari bahwa mengganti kendaraan berbahan bakar fosil dengan kendaraan listrik adalah langkah krusial yang perlu dilakukan. Karena ketergantungannya yang besar pada sumber daya energi yang tidak terbarukan, Indonesia kesulitan melakukan transisi ke kendaraan listrik. Untuk itu, penelitian ini berusaha menganalisis kemajuan Indonesia dalam transisinya dari kendaraan bermotor konvensional ke kendaraan listrik, sebagai bagian dari komitmen diplomasi lingkungan. Para penulis menggunakan pendekatan kualitatif dan menggunakan data sekunder yang diperoleh dari artikel jurnal akademis. Para penulis juga membandingkan kemajuan Indonesia dengan Uni Eropa (UE) dan Cina, yang telah sukses mengimplementasikan kendaraan listrik ke dalam pasarnya di beberapa tahun terakhir. Kemudian, penelitian ini juga menjelaskan kesulitan dan tantangan yang dihadapi Indonesia beserta risiko yang ada. Terakhir, penelitian ini juga menyediakan beberapa rekomendasi solusi yang dapat membantu Indonesia secara bertahap melakukan transisi ke kendaraan listrik guna menyelesaikan isu lingkungan.

Kata Kunci: Diplomasi lingkungan Indonesia, kendaraan listrik, transisi teknologi, kebijakan lingkungan, isu lingkungan

1. Introduction

Environmental issues are problems that need to be given more attention to, due to the impact that has affected many people's lives. By the time this article is written, Indonesia has been struggling with a particular environmental issue: smog. This prolonged issue needs to be addressed, as it continues to progressively worsen with each passing day. It is mainly caused by people who lack the initiative and care about the surrounding environment and how its degradation can and will impact their overall health. The smog problem does not only occur in Jakarta but is also widespread

throughout the large islands of Indonesia. This environmental problem has been going on for a long time and people seem to have resigned themselves to the situation.

The very serious pollution is caused by several reasons, one of which is the nature of motor vehicle exhaust. Smoke pollution from motor vehicles is one of the biggest contributors to air pollution. In Jakarta itself, traffic jams are commonplace; it has even become part of the capital's identity. In 2023, Jakarta ranked 29th most congested city in terms of motor vehicle use in the world, increasing drastically in just two years, whereas Indonesia was previously ranked in the 46th position in 2021 (Nurhaliza, 2023). This indicates that there is a large proportion of the population who use personal carbon-based motorized vehicles.

In 2023, the Indonesian Police recorded that there were 153,400,392 motorized vehicles in Indonesia (Gabungan Industri Kendaraan Bermotor Indonesia, 2023). With this figure, it was determined that 60% of the use of carbon-based motorized vehicles is mainly based on the capital island of Java. In consequence, Indonesia's conventional transportation now contributes 28% of the CO₂ emitted (IESR, 2019). The use of motorized vehicles is considered environmentally unfriendly and damaging due to its nature of releasing large quantities of CO₂ emissions into the atmosphere. In addition, air pollution and its negative effects are not exactly visible to the naked eye. A large number of sick people and a decrease in quality of life can be considered as negative impacts of using conventional or carbon-based motorized vehicles.

Cases of upper respiratory infections have increased in the Jabodetabek (Jakarta, Bogor, Depok, Tangerang, and Bekasi) area in the last few months. The Indonesian Ministry of Health reports that from August 29 to September 6, 2023, there were 90,546 cases of upper respiratory infections. Meanwhile, recorded daily cases have also progressively increased drastically. On September 3, 2023, there were 4,759 cases recorded. Then, it increased drastically on September 4, 2023, to 11,116 cases and 16,074 on September 5, 2023. This only includes cases in the Jabodetabek area in Indonesia and does not include other large provinces. Of the large number of cases reported, 55% occurred in the productive age group, 14% in toddlers, 14% in children and 8% in the elderly. The majority are of productive age due to their daily activities of work and commute under inadequate air quality (Arlinta, 2023).

The problem of smog from conventional vehicles is not a new issue that pops out of nowhere. This has been the government's concern for a few years. Going back several years, in 2016, the Indonesian government ratified the 2016 Paris Agreement which later became Law number 16 of 2016, concerning ratification of the Paris Agreement to the United Nations Framework Convention on Climate Change. Then, Indonesia's commitment to the Paris Agreement was conveyed through the National Determined Contribution (NDC). More clearly, Indonesia has its commitment to reduce greenhouse gas (GHG) emissions by 2030 independently by 29% and can reach 41% with international support (Ministry of the Environment and Forestry, 2016). It has shown that the countries have put high efforts in implementing environmental diplomacy as seen in the Paris Agreement above. Environmental diplomacy is public diplomacy that focuses on the environment and related issues such as climate change, loss of biodiversity (Sebastio & Soares, 2023, 210). The concept of environmental diplomacy itself first emerged at the end of the 20th century. The conventions were held between countries and transnational organizations to discuss aspects related to regulating the use of natural resources and pollution are the foundation pillars of this concept. Issues regarding the environment and measures to address some of its problems have been established over the years. Further, the Indonesian government's efforts to transition from conventional vehicles such as petrol or diesel engine cars to the use of electric vehicles is considered a good and wise decision. Apart from being able to reduce carbon gas emissions from motorized vehicles, the use of electric vehicles can also support the realization of Indonesia's vision of energy security.

Currently, Indonesia, like all countries, is heavily dependent on non-renewable energy and fossil fuels to meet the national demand for energy. This dependency will clearly continue to increase if the use of motorized or conventional vehicles continues to be allowed to perpetuate. As a response to this we can find that in fact, Indonesia's fossil energy is progressively being limited over time. According to Indonesia's Energy Outlook 2019 (Secretariat General – National Energy Council, 2019) Indonesia produced 949 thousand barrels per day or 346 million barrels in 2009 but decreased to 778 thousand barrels per day or 283 million barrels in 2018. This decrease was due to the old age of the mining wells. If it is forced and dredged until it is completely drained, this will have a negative impact on Indonesia's environment, as it would have already been too late to reverse. Gas emissions have caused air pollution, which will have a bad impact on the land, causing

land pollution. Therefore, the transition to the use of electric vehicles is the best step forward for a much more sustainable and stable environment for Indonesia. For the past two years, Indonesia's use of electric vehicles has increased 13 times (Annur, 2023). Additionally, after the UN Climate Change Conference (COP21) – which was held on December 12, 2015, and consisted of 196 parties – there are a lot of countries that are also progressing in the transition to electric vehicles.

The literature review found on the matter of EV transitioning in Indonesia is rather extensive yet mostly provides focus on the notion that the driving force of Indonesia's recent attraction and promotion of EVs into their markets is the health and environmental concern created by the steady and progressive increase of carbon emissions. These emotions are primarily caused by the abundance of ICE type vehicles that dominate the streets and markets in Indonesia. Therefore, many ways of transitioning have already been taken into account and implemented not only at the government level but also in companies and businesses. This is highlighted in an article authored by Amir and Prabawani “Sustainability-oriented innovation through shaping the ecosystem; a case of an e-bus industry in Indonesia” (Amir & Prabawani, 2023, #), who mention the introduction of the system-building sustainability-oriented innovation (SOI) concept which essentially provides companies with a set of guidelines (in this case the e-bus industry) to properly adapt and smoothly transition into a more sustainable system. Another case involving the EV market transition which much closely relates to the local preferences of the Indonesian people can be found in the article titled “Preferences for electric motorcycle adoption in Bandung, Indonesia” (Balijepalli et al., 2023, #) authored by a coalition between the University of Leeds and the Institute of Technology Bandung. The article highlights the potential use of local cultural preferences in Indonesia as a way to introduce the transition into EVs in Indonesia as a great majority of privately owned vehicles are motorcycles. The article shows several surveys and a total sample of 663 individuals to indicate differences in preferences and had concluded that the motorcycle EV transition would be widely accepted by the locals if it would provide quick recharge times to just up to 10 minutes and the availability of battery-swap stations. This marks that in order to succeed in transitioning into EV through the motorcycle route would mean the prioritization of necessary infrastructure that can provide quick and reliable recharge options. A widely successful case in which Indonesia managed to attract FDIs into investing in the Indonesian EV market can be found in the research report “The Indonesia Morowali Industrial Park: How Indonesia Courted Chinese Investments to

Set Itself on the Electric Vehicle Global Value Chains” from the book “How Indonesia Used Chinese Industrial Investments to Turn Nickel into the New Gold” (Angela Tritto, 2023, #) published by Carnegie Endowment for International Peace. The report takes a particular focus on the Chinese investment of the Morowali Industrial Park after extensive lobbying, and political and social support in part of Indonesia. The investment was based upon similar interests intertwining the Chinese trade agenda found in the MSR (Maritime Silk Road) and the Indonesian nationalistic trade agenda found in the 2014 unprocessed material export ban. Through much lobbying and bilateral interactions between China and Indonesia, the IMIP was brought under the facilities of the BRI and was supported by the investments coming from the mining company Tsingshan Group. This led to the employment of roughly 43,000 workers (5,000 of whom came from China), the joint total investment of \$8 billion into the park. With this development, it shows the immense potential that the EV market could possibly bring to Indonesia, considering its vast amounts of natural resources necessary to create EV batteries and vehicles and the great interest that trade giants like China and Japan have taken into Indonesia’s EV path.

This brings us to another case study made on the challenges that Indonesia is forced to face when committing to the idea of transitioning into EVs, alongside the role we expect EVs should take in the effort of decarbonizing the heavily polluted automobile/transportation sector. “The Role of Electric Vehicles in Decarbonizing Indonesia’s Road Transport Sector” (Adiatma & Marciano, 2020, #) authored by Julius Christian Adiatma, highlights the roles EVs should and could take in terms of helping with the decarbonization of Indonesia’s notoriously polluted city streets. The article mentions that the transportation sector contributed 28% of emissions in 2018 alone, while also holding 45% of total energy consumption. Essentially, it is clearly proven and stated that a considerable chunk of Indonesia’s greenhouse emissions came from the transportation sector. This data is later used to argue for the very much needed use of EVs to help regulate and slowly check balance the emission scales. The article proposes a series of policy recommendations that could assist Indonesia in the EV transition process known as the demand-side policy instruments which basically appeal to the consumerist nature of the market through fiscal incentives like tax exemptions, non-financial incentives like EV infrastructure or free parking. However, the article also acknowledges the fatal flaws and severe lack of ability Indonesia has when it comes to actually

adopting the necessary tools and infrastructure needed to support an EV market, with the prediction of electric cars penetration staying well under 1% of the market shares until 2050 and very likely leaving Indonesia to grind its way into a somewhat stable EV market. This is also likely to happen if incentives fail to be given and thus are defeated by the already dominant ICE type vehicles.

In this journal article, the authors try to dig into the electronic vehicle transitioning process in Indonesia, which will also be accompanied by a comparison to the progress of the European Union (EU) and China's progress. More specifically, the authors identify the current state of Indonesia's EVs transition and see what the European Union and China – as the top two players in EVs – have done to make sure that progress is achieved. From this, the authors suggest the relevant footsteps from the European Union and China that Indonesia might need to consider following.

For this research, the authors employ a qualitative research approach to answer the problems that have been identified. The research relies on secondary data that is obtained through study literature and online searching methods. Authors seek to dive deeper into the current progress of Indonesia's transition from fossil-fueled vehicles and engines which cause insurmountable damage to the environment, into much more environmentally friendly and clean energy-based electric vehicles.

With this in mind, we seek to take upon analytical research based on the information that can be accessed online via government documents, reports, institutional journals, and academic articles that bring light to a number of similar topics of discussion. We begin the analysis by gathering all necessary information from trusted academic and official sources like journals and government reports. After gathering all the information, the authors begin to highlight the most influential articles and journals in this writing as a primary basis for the following research. The analysis will be primarily centered around the current progress of the Indonesian EV market by identifying the different factors that contribute to the overall condition and status of Indonesia in implementing it, especially the interaction between the policies with the market and the implications it brings. This research aims to provide a comparison with notable countries or groups that have successfully implemented EVs into their markets, namely the European Union and China. This comparison will serve as a healthy way to view the grand scheme of things and gain a much bigger view of

Indonesia's progress and what possible avenues it may take to overcome challenges and avoid unnecessary risks.

2. Electronic Vehicles Transition: Where is Indonesia Now?

Indonesian people, especially those who reside around Jabodetabek, are believed to be aware of the urgency of EVs. However, there are some factors that hinder the interest in switching to EVs. Among them are socio-demographic, technical, economic, and behavioral aspects. Research that involves 400 people concludes that the general incentive of people to purchase EVs is rather moderate, despite their complete awareness of the highly polluted air quality and how EVs could influence a better outcome. This is due to the surrounding factors that tend to deter people from purchasing EVs, which are, its price, tax, and other economic incentives, arguing that it may be far out of reach for average income. This is also followed by their opinions on the vehicle's durability, where the majority agree that EVs' battery durability reaches only up to three hours. Essentially, it appears that opinions on the adoption of EVs into the Indonesian markets would be rather beneficial, or at the very least, do not appear to be in any way contrary to the idea of EV adoption. It is safe to say that Indonesian people who are primarily centered around populated urban environments like Jakarta and Tangerang, are moderately agreeable to using EVs if the market can support it (Alamsjah et al., 2021).

Aside from enthusiasm, it is crucial to identify Indonesia's readiness to transition to EVs as part of its commitment to environmental diplomacy. Stakeholders' views, including those from the EVs start-up companies, government officials, and experts on EVs suggest that Indonesia's development parameter for EVs was already at an optimal point of readiness. However, the stakeholders also agree that some more work is needed in its commercialization, integration, and market, alongside the need for critical EVs infrastructure like charging stations and the development of much more affordable prices for the EVs to drive consumer incentives. Essentially, Indonesia has great potential to adopt and integrate the EV market into its economy, but it is still heavily dependent on non-renewables which makes renewable energy alternatives such as EVs entirely dismissible since the cost to develop such technologies is far greater than the status quo. The current renewable energy mix in Indonesia is only 7.7% as it is being held back by the dependence and convenience of fossil fuels and other non-renewable energies. Currently,

Indonesia's greatest challenge would be the low share of renewable energy in its own electrical grid and its overall unpreparedness of the industry's supply chains. If not done right, the forcing of renewable energy integration would risk destabilizing the country's energy grid. This along with a number of other challenges like the lack of efficient domestic production of EVs' parts will continue to prevent the country from ever reaching an integrated market for EVs. Following the steps of successful countries like China and Europe, where EVs reach 45% market shares in China and 24% in Europe, is worth a try (Maghfiroh et al., 2021).

Moreover, what Indonesia could learn more from the top two EVs players is the principle of *availability*, *accessibility*, *affordability*, and *acceptability* as outlined by the Asia Pacific Energy Research Centre (APEREC). The European Union and China were the first to include EVs in their import reliance and through its development, they now are capable of producing EVs. This leads to battery manufacturing to help them with their ambitions. In terms of *availability* and *accessibility*, both countries introduce EVs through public procurement projects subsidized into the vehicles whilst downsizing the use of Internal Combustion Engine (ICE) to first help secure demand in the market. As for *affordability* and *acceptability*, fiscal policies are the key to galvanizing the use of EVs to make them attractive in the market, gradually leading to the immense growth of consumption in their market (Campbell et al., 2021). Clearly, there is a lot that Indonesia must learn to make sure that the transition works.

3. The Progress and the Direction to Go

Indonesia is known as one of the most densely populated countries in the world, ranking in 4th place behind economic giants like the United States (the US), China, and India. This population problem translates to Indonesia's ever-rising levels of per capita gas emissions reaching up to 2.3 trillion tons in 2021, which pushes forward the urgency to tackle the issue (Ritchie & Roser, n.d.). The sense of urgency must be acted upon in all of Indonesia but primarily in urbanized, densely populated areas like the Capital City of Jakarta, where traffic congestion is a normal sight – noting how it ranks 29th as the most congested city in the world and 46th in 2019 – making it as a prime target for environmental recuperation and regulation efforts by the government (TomTom Traffic Index, n.d.). The aforementioned environmental damage taking form in total per capita CO₂

emissions could be traced back to a large number of ICE-based vehicle owners crowding the roads everywhere throughout dense urban regions, amounting to 153,400,392 billion total owned units. This mass ownership of ICE vehicles has impacted the overall lifestyle of the Indonesian people, where they experience limited, delayed commutes from their homes to work and fatigue from the long duration of said travels on a day-to-day basis.

Subsequently, this contributes greatly to the overall deteriorating health of the Indonesian people, where diseases and infections, such as upper respiratory infections, thrive in the highly stressful, highly contaminated environment, in place. And, as expected from a primarily airborne infection, upper respiratory infections do not discriminate by age. Data has shown that its presence is most notable amongst the productive age group, followed by children and toddlers (Arlinta, 2023). The infection itself can be traced back to the pollution emitted by fossil-fueled motorized vehicles, which contributes 28% of CO₂ emitted (Institute for Essential Services Reform, 2019). These numbers indicate that the infection itself is not only another byproduct of climate change but a side effect caused by the overwhelming amount of ICE-based privately owned vehicles that clog the roads and freeways of the most densely populated area of the entire country.

Granted, not all the faults may befall the consumers for owning too many private vehicles, as the government also holds great responsibility in helping regulate the market and, most importantly, procure a much more efficient and effective commute system that can help relieve congestion. Alas, the problem still stands, the overindulgence of ICE-based vehicles congesting highly dense cities like the Capital of Jakarta has not only resulted in commute problems and environmental damage, but it has now also led to the deterioration of health of what can be argued as the most important demographic when it comes to productivity, economic development, and political participation, the productive age group. The government sees this as a challenge and has already sought different ways to alleviate the situation. This is seen through Indonesia's ratification of the 2016 Paris Agreement and as a result, effectively making the commitments within the agreement part of the national constitution, under Law Number 16 of 2016.

This could be considered as one of Indonesia's first steps into committing themselves to forming real environmentally friendly policies and setting the groundwork for future decisions and policies alike. Like other countries in the world aimed to innovate the markets while also balancing said

innovation with environmental protection, Indonesia found genuine interest in EVs as one of the best alternatives in solving the question of the environment. The government, under President Jokowi, views EVs as the one solution that may finally quell their headache-inducing, persistent issue of congestion and pollution centered around their most important regions for economic development, while also simultaneously solving the issue of sacrificing their economic development over environmental restoration by ensuring economic benefits in the long-term through an open EVs market, and perhaps even the creation of a central hub for EVs battery production.

However, unsurprisingly, the government struggles to decide exactly how to effectively integrate EVs into its market, while also implementing proper steps to make the market appear attractive, all in the hopes for a large-scale transition towards a much more sustainable use of energy and a more economically beneficial one. Considerations such as tax adjustments, charging infrastructure, and price sensitivity from consumers that encompass ideas of localized sourcing to manufacture batteries, and thus make it affordable, are calculated so that the industry will later find its place and persist within Indonesia's market—helping the nation to grow its economy rapidly. This all must also be tied to the ongoing trend surrounding EVs and their related markets, as the government could use this increasing trend to boost its appeal for an alternative market to those found in China or the US and hopefully grant Indonesia the ability to create its own production hub. Indonesia has actually cut taxes after they announce the umbrella law that embraces EV, yet in an interview with

In terms of how ready the country is for EVs, Indonesia is still far from reaching its vision of an EV market and production hub. However, it may be much closer than one may expect. According to the research conducted by Hiroshi Onoda and his fellow authors on the market readiness in Indonesia to integrate EVs into its market using the Japanese Technology Readiness Assessment or J-TRA, found that Indonesia's development rate was already at an optimal position to integrate the EVs into the market. However, this developmental readiness is being halted back into fully succeeding by multiple fundamental factors. This is primarily due to the nation's fundamental dependence on the use of non-renewable energies, issues in its commercialization, and integration, alongside the need to build accessible critical EVs infrastructure like charging stations and the

development of much more affordable prices for the EV to drive consumer incentives and beat the already well rooted and established ICE-based vehicles.

This will not just be a simple change in policy and market, it would be closer in resemblance to rehabilitating individuals with chronic use of substances. These are monumental steps that Indonesia must first commit to in the name of integrating EVs into the market. Mass transitions would have to take place and its implementation process may continue for decades as the people of Indonesia and its market slowly adjust to the new model. The most fundamental step would be to adjust the people to the EVs market by cultivating popular opinions for EVs. In general, the current public opinion is mainly centered around the question of necessity, price, tax, and reliability (Asrol, 2021). Overall, public opinion on the transition to more renewable energies and the EVs market is moderately agreeable, especially to subjects that live within densely urbanized regions like Tangerang. Efforts to integrate EVs into the market, such as commercialization, domestic production, and raising consumer incentives through price management to make it more affordable and accessible are essential in order for its growth to finally be realized in the economic landscape of Indonesia.

Steps to allow its integration could be found in other countries' success stories, such as the EU and China, and many authors that have done research on this part highly suggest its introduction by subsidizing public procurements in order to allow its exposure to the public. China, for example, projects to have procured 421,000 electric buses taking 17% of the total number of bus fleets, and converted 22,000 units of taxis by 2023 (Crothers, 2021). The process is coupled with the gradual downsizing of the use of ICE-based vehicles as what the EU has also been practicing through several instruments, such as the Green Public Procurement (GPP) and Clean Vehicle Directive (CVD) – leading impactful outcomes as automakers have to switch up their productions from ICE to EVs if they want to persist within the EU's market; especially when the government is decreasing the tax so that consumers will be more incentivized to purchase EV. We see that there was a 146 percent increase in EVs sales all over Europe resulting in an overall of 1,356 sales and the number steadily increased – reaching over 80,000 sales in 2020 compared to ICE having 17,617 thousand units sold (European Commission, 2023).

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Additionally, generous private purchases of EVs should be done not only by the central government but also by regional and local governments of generous subsidies in their areas. This is coupled with substantial support for tax reductions, rebates, exemptions, and other similar policies for EV purchases. China, being a great example, managed to overcome the declining purchase of private subsidies with customers receiving over ¥100,000 (13,800-14,000€) in support of ¥128,000 (17,800€) from the government, and this action needed to be done simultaneously to avoid sales disparities in the region.

As one of China's largest trade partners, Indonesia has been reviewed to be potentially optimal. The challenge that needs to be addressed would be the cross-region coordination on how it will be employed to ensure that the whole archipelago is ready to embrace the technology transition – preventing itself from following the example of Eastern Europe where EVs regulations and commercialization are falling behind France, Germany, Spain, and Italy. Despite being slow in its steps, the EU already has a framework of the European Battery Alliance (EBA) to ensure full coverage over the whole value chain of the battery ecosystem. The EU involves almost all key actors from the regional government to private companies that focus on battery manufacturing to improve research and development of the value chain. Yes, there are costs and range anxiety – resulting in limited consumer acceptance when it comes to battery technology in EVs, despite the rapidly growing sales and the shrinking costs of batteries. Proper charging infrastructure development remains a challenge for Europe and the current policies want to ensure a minimum ratio of charge points to EVs – avoiding market fragmentation and region-wide coverage (Harrison & Thiel, 2017). Regardless, this would be a good starting point that Indonesia could apply in its policy formulation in envisioning EVs' future in a country with policies and infrastructure issues (European Commission, n.d.). In Indonesia, its introduction is heavily placed upon motorbikes as it accounted for 125.27 million units in 2022 and the subsidies for converting them to EVs have been expanded consistently from time to time. In March 2022, the government planned to allocate seven trillion rupiahs, and further beyond also announced to cover all Indonesians over 16 years of age where previously it was only aimed at those who are the registered recipients of government aid (Sulaiman & Petty, 2023).

Consumer preference will also be highly important in helping the ease of EVs' penetration into the market. In China, we see a phenomenon where the consumers prioritize cheap prices over quality; and it is not far off from what happened in the EU although they are left with no choice as cost competition between EVs and ICE-based vehicles makes the latter less palpable for them. This explains why the flood of cheap EVs entering the EU's market originating from China, raises hostility between the two, and the host country is not satisfied as its anti-subsidy commission started an investigation on how to impose tariffs upon the products as it does not want to go through another race to bottom phenomenon all over (Blenkinsop, 2023).

As with the issue of affordability, both China and the EU understand that the growth they experienced has led them to the idea of manufacturing their own batteries which led to the proliferation of battery ventures in both places. Notable companies such as the BYD and Contemporary Amperex Technology Co., Limited (CATL) generated 363 GWh of battery production capacity – or 72.5% of global capacity – in 2020 and they also have recently announced their partnership with Indonesia through ANTAM with joint investment valued nearly to six billion USD (CATL, 2022). To manufacture its own battery would be a major steppingstone for Indonesia and to have a short-term partnership with such a huge international company that would give enough insights and knowledge for the country to build its own battery infrastructure.

It is clear now how charging mechanisms and EVs overall infrastructures are not only necessary but vital. By equipping the country with those, the government could slowly lift subsidies, followed by gradual changes in prices, and attract consumers – the people – to choose EVs over ICE-based vehicles. It is proven by China through its generous local subsidies that provide a strong foothold in its early periods of EVs commercialization. As for the EU, through its GPP policy – which was optional – and CVD policy – which was mandatory – the supranational organization managed to push the ICE-based vehicles companies to cut 22 g CO₂/km from 2010 to 2016; although unfortunately, it was reversed later in 2017 and 2019 (Campbell, et al., 2021). Albeit unsuccessful, this attempt has shown how the EU – as a supranational intergovernmental organization – has the power to control its state members, and the ICE-based companies have little to nothing but to abide by the regulations. Therefore, developing the EU's own charging and battery infrastructures should go hand in hand with the outcomes it is striving for.

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In Indonesia itself, cost competitiveness is particularly difficult, given the frail funding scheme that is painted by corruption and other heinous practices that add to its long to-do list of being prepared to become one of the powerhouse of EVs supply chain and maintain its financial attractiveness although the value-added tax on electric vehicles (EVs) has also been drastically lowered by the Indonesian government, from 11% to just 1%. Indonesia is still facing a complex bureaucratic process regionally since the laws that support EV's development in the country are often clashing with new regulations issued by the ministries—functioning like the old ones, quoting Bhima Yudhistira Adhinegara, an economist from Institute for Development Economic and Finance (INDEF) (Hermansyah, 2016).

Under Jokowi's administration, 13 deregulation packages have been offered to boost investments penetrating the country – supporting the missions to achieve economic growth (Office of Assistant to Deputy Cabinet Secretary for State Documents & Translation, 2016). Moving forward, the Presidential Decree No.55 of 2019 has opened up corridors for EV automakers to invest and for the regulators to improve intra-regional coordination in meeting the 2025 goal of those institutions using electric cars, motorcycles respectively, amounting to 19,220 units, 757, 139 units, and 10,227 units. It has entrusted Perusahaan Listrik Negara (PLN) to establish EV charging infrastructure with spending estimated at 1 USD billion with plans to reach 6,318 EV charging stations and 10,000 battery swap stations. With other states, not only the Paris Agreement, Indonesia has sought to implement their ambitions that are poured into ASEAN Indonesia Master Plan Acceleration and Expansion of Indonesia Economic Development 2011-2025 and honed domestically within the National Medium-Term Plan 2020-2024. Their industrialization objectives are focused on two main areas: (1) manufacturing items that increase value and competitiveness, and (2) producing goods upstream of those used in the manufacture of metal, chemical, and agricultural commodities. Moreover, the government has placed the responsibility towards state-owned Perusahaan Listrik Negara (PLN) to establish EV charging infrastructures. Hence, investments became a priority and in order to qualify for its offered incentives, manufacturers must commit to producing at least 40% of electric vehicle components in Indonesia by 2026, according to the recently implemented more permissive investment legislation and even further extended additional two years for automakers to accomplish its requirements. This goes hand in hand with

their effort to pursue net-zero emission reduction goals by 2030 of 32% that was previously 29% (Cyrill, 2023; Simanjuntak, 2023).

4. Conclusion

In conclusion for this article, the authors have found that Indonesia's move to electric cars (EVs) is an essential initial move toward reducing carbon emissions and lessening the effects of global warming. It is the essential step of Indonesia's commitment to the Paris Agreement and the manifestation of its environmental diplomacy. Countries have acted to promote the use of electric vehicles after realizing the benefits of green technology. However, there are still a great number of challenging problems that need to be solved in order to speed up the changeover. It is critical to reduce emissions Indonesia being one of the leading emitters of carbon dioxide (CO₂) worldwide. The government has committed to reducing emissions and has established policies and guidelines to promote the advancement of electric vehicle technology. However, high public infrastructure costs, national regulations, and high prices of EVs are obstacles to the broad adoption of EVs. Electric vehicles continue to remain out of reach for many potential buyers, which raises concerns about their cost. The slow construction of the infrastructure needed for charging EVs and the lack of uniform, well-defined regulations governing EV subsidies also impede the market's growth.

To address these challenges, Indonesia has focused on creating supportive laws, growing the network of charging stations, and promoting domestic EVs manufacturing. Even though there are not many registered electric cars, the government has approved a strategy to improve infrastructure and EVs production in the coming years. With the concept, a significant step has been achieved to promote EVs adoption in Indonesia by outlining the goals for EVs manufacturing and infrastructure for charging them. However, obstacles still stand in the way of widespread adoption, such as low public awareness and a dearth of electric cars. Indonesia must collaborate with international partners, prioritize consumer education campaigns, and provide tax breaks and subsidies to encourage customers to purchase more electric vehicle models. Indonesia can gain from exchanging best practices and experiences with the European Union and China to promote the adoption of EVs.

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It is absolutely necessary for Indonesia to have incentive programs, such as tax cuts and favorable legislation, in order to encourage the usage of electric vehicles that does exist and fortunately has facilitated them through the numbers of regulations, although sometimes it is conflicting with each other as new laws from other institutions issuing similar old provisions. This has failed the country to create an assuring field for EV automakers to operate as what they have intended to. In order to guarantee that these initiatives are successful in easing the transition, Indonesia has helped subsidize private purchases although not successfully reformed corruption laws to help mitigate the potential decline of government subsidies by calling on aid from local and regional governments. The widespread use of electric vehicles is dependent on the development of new technology as well as advances in the sciences of batteries. The batteries that power electric vehicles are an essential component, and recent developments in battery technology have the potential to allay worries about the amount of time required for charging as well as range anxiety. The continued research and development of batteries, international cooperation, and the provision of solutions that are both more economical and efficient – as China accomplished – are all factors that speed up the transition to EVs.

Although Indonesia has made some progress toward making the switch to electric vehicles, the country still has a ways to go in terms of developing the necessary infrastructure, policies, and technology to eliminate roadblocks and implement policies that help balance transitioning from ICE-based vehicles to EVs in more sustainable ways. The legislation of regulations that stimulate the purchase of EVs, the provision of financial incentives for such purchases, the enhancement of infrastructure for EVs charging, and the cultivation of international alliances should be Indonesia's top priorities. By tackling these issues and enacting comprehensive regulations, Indonesia has the opportunity to establish itself as a global leader in the movement toward a more environmentally responsible and sustainable future in the transportation sector, battery production, and beyond.

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