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Trends and Implementation of Electric Vehicle Ecosystem in Indonesia: A Literature Study

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Abstract
This research discusses the implementation of the electric vehicle ecosystem in Indonesia as one of the steps to support the goals stated in the Paris Agreement, namely achieving net zero emissions (NZE) by 2060. Indonesia is one of the countries that implements electric vehicles to achieve NZE. However, Indonesia's technology is not yet established for producing electric vehicles and distributing them to the global market. Therefore, this research was motivated to look at 20 sources of literature that have discussed cooperative relations in the Indonesian automotive industry sector with electric vehicle-producing countries. This research maps this literature using a taxonomy method in three main topics, namely (1) the development of the transportation and automotive sector in Indonesia, (2) China, South Korea, and Japan as cooperation partners in the electric vehicle industry, (3) the readiness of electric vehicle ecosystem implementation in Indonesia. This research also includes the explanation of national interest theory to see the perspective of international relations in the purpose of the Indonesia government in achieving electric vehicle ecosystem.

Key Words: Electric Vehicle, Net Zero Emission (NZE), Indonesia, National Interest, Literature Study.

1. Introduction

In International Relations (IR) studies, environmental issues such as climate and environmental problems seem to be discussed quite often. During Conference of Parties (COP) negotiations during the United Nations Climate Change Conference, climate issues are one of the environmental problems that often become an important discussion. This is because people's activities can not be separated from nature and environmental aspects. In the context of Anthropocene studies, people's life has a direct influence and impact on the environment, as stated by Steffen (2011, p. 842). In COP26 negotiations, emissions from vehicles are of concern, since they are linked to environmental sustainability. The United Nations (UN) and the Global Environment Facility (GEF) decided to help and support 27 developing countries to accelerate the transition to a zero-emission electric mobility industry (UNEP, 2021).

Based on the Paris Action Agenda which was explained at COP21, it is explained that the transportation sector contributes nearly a quarter of greenhouse gas emissions, which amounts to 23%, and its growth is faster than other energy-using sectors. Greenhouse gas emissions resulted from the transportation sector are estimated to increase by almost 20% in 2030 and close to 50% in 2050 if preventive measures are not taken to overcome them (UNFCCC, 2015).

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The Zero Emission Vehicle Transition Council (ZEVTC), an international forum focused on global cooperation in the transition to zero-emission vehicles which was established in 2020, has announced key priorities to support the transition to zero-emission vehicles. The key priorities from ZEVTC include charging infrastructure, fuel efficiency standards, guidelines, and regulations, speed of transition, technology and innovation choices for zero-emission heavy-duty vehicles, as well as ensuring the ZEV transition (Carolina, 2021).

Regarding the electric vehicle ecosystem, the data presented by the Institute for Essential Services Reform (IESR) explain that the use of electric vehicles as an efficient measure to reduce emissions in the transportation sector is expected to replace fossil fuels-using vehicles. Electric vehicles which are considered to have higher efficiency require much less energy consumption compared to the energy consumption used by conventional vehicles. It means that this type of vehicle can produce much lower gas emissions. Furthermore, if these measures are supported by the act of using some renewable energy in the electricity system, electric vehicles potentially would become an effective decarbonization step, that would lead to a solution in the progress of the transportation sector. On the other hand, the effort to adopt electric vehicle types may have a positive impact on the economic aspect of Indonesia, especially through reducing fuel oil (BBM) consumption and the opportunity to develop the local electric vehicle industry. The data provided by IESR also shows that globally in 2019 there were 7.2 million units of electric cars and 350 million units of electric vehicles with two-wheel and three-wheel vehicle types. The majority of vehicle production is in China, the United States (US), and several countries in Europe. The country has succeeded in taking steps to adopt electric vehicles by implementing certain strategies and policies that build an electric vehicle ecosystem in the country.

Historically, several studies explain that Indonesia is still considered to be lagging in global automotive production networks and global markets (Irawati, 2008). However, the Indonesian automotive sector is starting to recover and start to rise from the economic recession which was the impact of the financial crisis in Asia in 1997-1998 (Natsuda, Otsuka and Thoburn 2015; Soejachmoen 2016). Thus, currently, the Indonesian government has made several policies that aim to shift to further developing the automotive industry to increase Indonesia's participation in the global value chain by holding the Making Indonesia 4.0 Roadmap and the Special Economic Zone (SEZ) program. Specifically, the Making Indonesia 4.0 roadmap aims to increase the production of raw materials and main automotive components, such as steel, plastic, and electronic components (Negara & Hidayat, 2021).

Based on the data from the World Population Review (2022), Indonesia is in 11th position as the largest producer of greenhouse gas emissions, producing around 2.09% of total greenhouse gas emissions. To face this problem, Indonesia intends to make a transition to more environmentally friendly electric vehicles. Replacing vehicles from ICEVs type to EVs type is also being implemented in several cities, especially in Jakarta, the capital of Indonesia, which is routinely included in the list of cities with poor air quality, even ranked in the top 6 cities with the worst air quality in 2019 period (IQAir, 2022). In order to encourage the adoption of electric vehicles in Indonesia, the President of the Republic of Indonesia Joko Widodo issued Presidential Regulation Number 55 of 2019 concerning the Acceleration Program for Battery-Based Electric Vehicles for Road Transportation (BEV Regulation). The Presidential Regulation outlines provisions aimed at accelerating the adoption of electric vehicles, including the existence of fiscal and non-fiscal incentives. Indeed in spite of the fact that there are fiscal and non-fiscal incentive policies contained in Articles 19 and 20, the number of electric vehicle users in Indonesia still tends to be low, this is due to the lack of attractive incentives from the government to accelerate the adoption of electric vehicles (Yuniza et al., 2021). Among 17 fiscal and non-fiscal incentives

provided by the government, only 4 incentives are aimed at consumers, while the rest are aimed at companies.

Fiscal and non-fiscal incentives are considered less attractive and unlikely to produce significant changes if there is no vehicle price subsidy policy (Yuniza et al., 2021). This is more likely not good progress, because some of incentive policies, such as purchase subsidies and tax exemptions, are more effective than other policies, especially when some incentive policies are targeted at certain groups (Li et al., 2019). Apart from that, the cost of one electric vehicle is still high compared to conventional vehicles. Several countries such as China, US, and France have implemented price reductions or subsidies as central policy (Volkswagen, 2019). For example, China has implemented an electric vehicle incentive system that requires the waiver of certain restrictions. In a few major cities in China, electric vehicles are exempt from registration requirements and driving restrictions that apply to conventional vehicles on certain days. Furthermore, US takes advantage of tax credits and exemptions. By acquiring electric vehicles, users can avoid all federal taxes associated with gasoline utilization. France offers an incentive program to encourage the purchase of electric vehicles. The maximum amount eligible to receive a subsidy is 8,500 euros per purchase of an electric vehicle (Volkswagen, 2019).

Regarding to electric vehicle fuel, currently Indonesia has nickel fuel reserves ranked number one in the world, which amounts to 30% of the world's nickel reserves. Due to the potential resources that Indonesia has, this country has a possibility and a huge opportunity to become a producer of battery fuel and lithium materials for electric vehicles (Indonesia.go.id, 2023). Given the growth of the electric vehicle industry and demand for battery fuel production, nickel is increasingly viewed as a strategically valued metal fuel, which is expected to have an important role in the future energy transition (Phua & Edwards, 2023). Indonesia has the highest nickel reserves in the world, which is arounds to 21 million tonnes. In 2022, Indonesia produced amount of 1.6 million tons of nickel, 10 times more than Australia's production (Kitco News, 2023), making Indonesia the richest country in nickel reserves and the largest nickel-producing country in the world. Correspondingly, Indonesia's processed nickel exports are estimated to reach US$30 billion in 2022 alone, increasing exponentially from only US$1 billion in 2015 (ASEAN Briefing, 2023).

Based on the explanation in the previous paragraph, it is known that the Indonesian government is starting to implement an electric vehicle ecosystem in the country. The reason is Indonesia wants to support the net-zero-emission (NZE) goal by 2030 which was declared in the Paris Agreement. Reflecting on this fact, Indonesia intends to make a transition to electric vehicles that are more environmentally friendly. However, due to technological limitations in producing electric vehicles, Indonesia still needs collaborative partners with several countries such as China, South Korea, and Japan which are involved in the electric vehicle sector and already have advanced technology in the automotive sector. Apart from that, the implementation of the electric vehicle ecosystem in Indonesia cannot be separated from the use of nickel to make electric batteries. Therefore, this research is interested in looking at the development of the transportation sector in Indonesia and how far the Indonesian government is ready to implement a global electric vehicle ecosystem?

2. Analytical Framework: National Interest

This research uses the theory of national interest to elaborate perspective of international relations in the purpose of the Indonesia government in achieving electric vehicle ecosystem. Every country has national interests that can be in the form of goals that the country and its people want to achieve, which are usually conveyed in international treaty conferences. The agreements produced in an international treaty cannot be separated from the national interests

of the state. Donald E. Nuechterlein in his writing, *National Interest and Foreign Policy: A Conceptual Approach for Analysis and Decision-Making*, explains that national interest is a need and desire to obtain a state interest through the relationship between a sovereign state and the environment outside the state (p. 247).

Based on Nuchterlein's theory, there is a definition of national interest that has points that can be elaborated. First, is about the perceived needs of a country. This point shows that a decision that is in the national interest is the result of a political policy formulation process, in which state leaders initially have different views but eventually come to a conclusion about an issue that is considered important. Second, explains that national interest is closely related to a sovereign state that is completely independent and has no connection with international organizations or dependent territories. This is because people still live in a world where decisions to use force, impose trade restrictions, and make alliances can only be made and decided by sovereign governments (p. 247). Third, the definition of national interest can distinguish between the external (international) and internal (domestic) interests of a state. Furthermore, this definition implies that national interest is closely related to the interests of the state and nation as a whole, not about the interests of a private group, bureaucracy, or political organization (pp. 247-248).

National interest can be used as a tool that can explain, describe, and evaluate the foreign policy of a country. On the other hand, policy is a tool for a country to realize the desires achieved in its national interest. Furthermore, Nuechterlein categorizes national interests into four types, namely defense interests, economic interests, world order interests, and ideological interests (p. 248). This research will use economic interests to elaborate on the Indonesian government's readiness to implement the electric vehicle ecosystem. National interest leads to the economic interest of a country to benefit from conducting trade relations with other countries. This theory can be used in this research because the Indonesian government has goals and interests in implementing an electric vehicle ecosystem in Indonesia. Indonesia is a country that has natural resources for electric vehicle battery manufacturing, however, the technology owned by Indonesia is still inadequate to process these resources. To fulfill this goals, Indonesian government decided to cooperate with several countries such as China, Japan, and South Korea to develop technology and support the readiness of the electric vehicle ecosystem in Indonesia.

3. Research Method

In this research, the author had several requirements and criteria for organizing and selecting literatures. First, this research limits the type of literature to only journal articles and book chapters. Second, the author uses several international journals indexed by Scopus as well as national journals that have been accredited by Sinta. Third, the author chooses literature that has been through a peer-reviewed process. Fourth, the author chose more literature published from 2019 onwards, because during this period, Indonesia had started to implement electric vehicles and Presidential Regulation No. 55 of 2019 which discusses electric vehicles and the acceleration of the electric motor vehicle program has been released. Fifth, this research determines many keywords to discuss Indonesia's cooperation with China, South Korea, and Japan as electric vehicle-producing countries, as well as Indonesia's readiness to implement the electric vehicle ecosystem. From the search results, this research obtained 20 pieces of literature related to the implementation of electric vehicles in Indonesia as well as Indonesia's cooperation with electric vehicle-producing countries.

In conducting literature analysis, the author uses the skimming technique, which means getting the main idea by reading quickly from the literature. After doing the skimming technique, the author carried out a scanning technique, which means looking for keywords related to the

research, checking the existence of keywords, and concerning each paragraph and sentence of the literature. This technique is very important for sorting the literature and related to the taxonomic research method used to categorize the literature results. In this way, the discussion of the literature will be more focused and research question can be answered in more detail.

4. Results and Discussions

4.1. Development of the Transportation and Automotive Sector in Indonesia

In the industrial structure, the automotive industry sector in Indonesia is still controlled by several large car manufacturers in the world, most of these manufacturers come from Japan, such as Toyota and Daihatsu. These global car manufacturers contribute to managing production, location, procurement of spare parts and components, and distribution (Natsuda, Otsuka, and Thoburn 2015; Natsuda and Thoburn 2021). Among all the countries in Southeast Asia, Indonesia is one of the countries that has the longest history of automotive production. We can take a look at the existence of the first automotive assembly plant founded by General Motors (GM) in 1928, with an initial production capacity of 6,000 units per year (Sato, 1992; Kompas, 2012).

However, the automotive assembly is still in a condition that is notional or has still not been fixed. At that time, cars were imported into Indonesia in packages of two units, this was done because it was considered cheaper than sending a complete vehicle or completely built-up (CBU). Thus, after World War II, Indonesia began to import automotive products in a completely knocked down (CKD) form (Witoelar, 1983, p. 18). After Indonesia's independence period, specifically in 1949, the non-operating GM factory in Indonesia was taken over by the state-owned Gaya Motors company in 1955. Then, in 1967 the factory was bought by a private company, named PT. Astra International. Even though the automotive industrial sector started early in Indonesia, this sector was considered to have failed to develop throughout the 1960s and only produced around 2,000 vehicles per year (Hansen, 1971, p. 38).

When President Soeharto served as Indonesia's second president in 1967, his government cabinet changed Indonesia's development policy, which previously had a vision of socialism initiated by President Soekarno's government, towards liberalizing trade and investment related to foreign capital (Chalmers, 1994). At that time, it was known that President Soeharto's government was very dependent on business from China. This fact can be seen in the automotive industry's expansion activities since the end of 1960, which were initially carried out by the Astra Group which was owned by a Chinese businessman in Indonesia, namely William Soeryadjaya, who carried out distribution and assembly management of automotive products with several automotive companies from Japan, including Toyota. This activity began and at the same time continued the operations of the GM factory which has an automotive assembly plant in the Tanjung Priok area (Natsuda et al., 2015).

During its development, Astra Group merged with other company groups, such as Salim Group which is owned by Liem Sioe Liong, which bought PT. Indomobil in 1980 and developed it from distribution to automotive assembly operations (Doner, 1991, p. 128). The Indonesian government implemented a series of localization policies in the automotive industry sector under import substitution industrialization activities. Import substitution industrialization activities in Indonesia are implemented in two stages. The first stage aims to shift from importing completely built-up (CBU) vehicles to locally assembled production. At that time, the Indonesian government gradually banned the import of CBU vehicles in various regions in Indonesia starting in 1969, until a national ban was implemented in 1974 (Sato, 1992, pp. 340-341).

Thus, the second phase, which began in 1976, aimed to achieve a higher low-cost (LC) ratio in vehicle assembly by introducing a mandatory write-off program for commercial vehicles, as well as replacing imported automotive product components with domestically produced

automotive product components (Aswicahyono et al., 2000, pp. 215). In 1993, the Indonesian government introduced a series of new deregulation policies for the automotive industry sector, ending the ban on imports of CBU vehicles, but reducing tariffs and luxury goods taxes on imported product components based on vehicle type and LC level. The steps implemented by the government allow automotive product assemblers to access more favorable tax rates in line with their localization efforts (Aswicahyono, Basri, and Hill, 2000). Along with its development, Japan's progress in the automotive industry sector has made Japan move to expand its automotive market in Indonesia. This can be seen in several automotive companies from Japan which are expanding their markets in Indonesia.

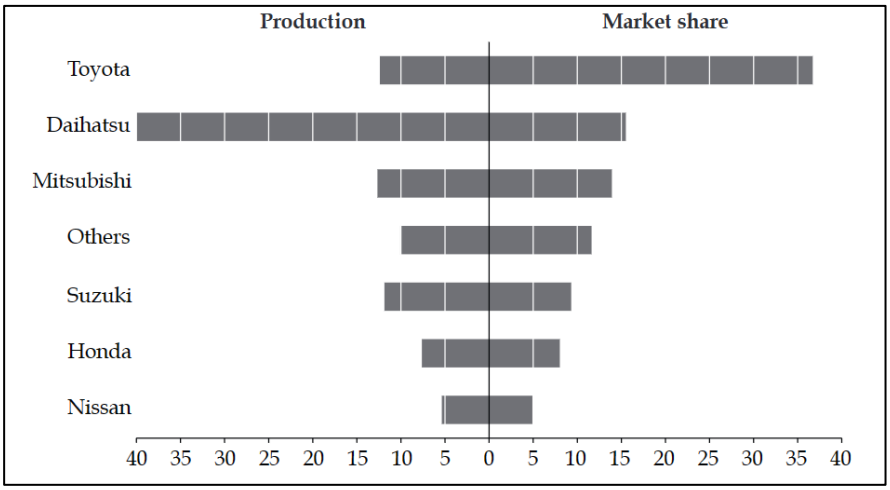

Figure 1. Production Data and Market Share of Automotive Manufacturers in Indonesia
Source: Natsuda, et. al (2015), Fourin (2011)

Research from Aswicahyono, et al. (2000) discussed the topic regarding development of the Indonesian automotive industry since 1970, by presenting trend data and comparative assessments in East Asia. This research investigates ownership patterns, political economy interventions, and structural policies in the automotive industry. By 1997, there had been a significant innovation in technological capacity; and several companies in the components and commercial vehicle sectors were already approaching international efficiency. This research shows that ownership patterns, structural policies, and state economic and political intervention greatly influence the development of the automotive industry. Government policies in 1997-1998 which were very interventionist had resulted in an inefficient automotive industry. It is characterized by back-to-front industrialization, un-economic production, and very small exports.

Concerning investment in the automotive sector in Indonesia, research from Natsuda & Thornburn (2021) states that the automotive industry in Indonesia is currently still controlled by Japan, and some investments in the production of components for other supporting automotive products are made by foreign investors. The increasingly rapid growth of the domestic market makes it possible for investment and cooperation in the automotive sector by countries or other parties without providing large incentives. The presence of suppliers of automotive spare parts or supporting components produced by foreign investors in Indonesia has provided an opportunity for local manufacturers to increase their production capabilities domestically. Automotive vehicle product investors from Japan have very strong and large confidence regarding the export potential in Indonesia. This research helps the author to see the dynamics of the Indonesian automotive industry, which is currently still in demand by Japanese and other

foreign investors. Then, after the transition to electric vehicles, this became a reference that Indonesia is still a large domestic market for electric vehicle manufacturers.

Apart from research from Natsuda & Thornburn (2021), research from Negara & Hidayat (2021) explains that automotive industry in Indonesia was initially only controlled by Japan, but as time progressed, there began to be several other automotive-producing countries such as South Korea and China. The growth of the middle class in Indonesia is the main driver of the rapid growth of the automotive industry in this country over the last decade. Even though there are indications of progress and improvement in the automotive sector in Indonesia, there are several structural weaknesses that hinder the movement of the automotive industry in Indonesia. Furthermore, even though Japan has a strong comparative advantage in producing Internal Combustion Engine (ICE) cars, these new entrants are targeting a new segment, namely electric vehicles.

Continuing the study review from Negara & Hidayat (2021), research conducted by Hale (2021) discusses the Indonesian government's decision in 1996 to establish a national car industry with the support from Korean manufacturer Kia Motors and the reasons for implementing this action. This is followed by a discussion of international trade pressures which sparked by the Indonesian government's protectionist policies, and how these pressures in turn combined with the regional economic crisis and the problems Kia faced domestically to derail the Timor project. The result of these developments left Indonesia's relations with multilateral trade bodies in unstable condition and also resulted in lower levels of foreign direct investment.

In Southeast Asia region, including Indonesia, research about automotive industry conducted by Yean (2021) states that the policies implemented to position or reposition each country in the regional and global automotive market also include private sector responses, both through foreign direct investment and through domestic investment. Even though Indonesia, Malaysia, the Philippines, Thailand aim to develop the electric vehicle market, if seen from a policy perspective, the concrete action plans and coordination needed to make this happen are still in the process stage in each country. In this case, Indonesia has the most ambitious vision, considering that Indonesia plans to utilize its wealth of nickel resources to develop electric vehicle battery production, in addition to attracting foreign direct investment for electric vehicle production in its efforts to lead the region in terms of vehicle production and consumption. electricity. However, all four countries face similar and significant demand challenges and a lack of human resources necessary to make a large-scale transition from ICE to EV models.

4.2. China, South Korea, and Japan as Cooperation Partners in the Electric Vehicle Sector

In the transportation sector, the Indonesian government seems to consider that the electric vehicle ecosystem has enormous potential to be implemented in Indonesia. Currently, Indonesia has nickel resources of around 21 billion tons, which is equivalent to 30% of the world's nickel reserves (Portal Informasi Indonesia, 2023). Furthermore, the number of resources that Indonesia has, such as tin, bauxite, and copper, can make Indonesia as a manufacturer of electric vehicle batteries and lithium batteries which are components of electric vehicles. Based on literature, several countries have decided to implement and support investment in electric vehicles in Indonesia, some of these countries are Japan, China, and South Korea.

4.2.1. Japan

The first electric vehicle-producing country which will be discussed in this sub-chapter is Japan. To support the development of the electric vehicle ecosystem in the ASEAN region, including in Indonesia, the Japanese government will invest US$ 1 billion or IDR 15 trillion (Hasan, 2023). This was explained by the Indonesian Minister of Foreign Affairs, Retno Marsudi, during a discussion

of the agenda for the High-Level Conference (KTT) celebrating 50 years of ASEAN and Japan relations in Tokyo. Furthermore, there are several discussions on priority cooperation between Indonesia and Japan at the summit, including strengthening cooperative relations through infrastructure investment, and accelerating the energy transition process by providing affordable funding to achieve the net-zero-emission (NZE) goal.

Thus, to strengthen increased production in the automotive industry sector, in 2022, the Ministry of Industry of the Republic of Indonesia will strive to further strengthen cooperation with Japan, especially in the automotive industry and digital industry. Indonesia agreed with Japan to implement a cooperation program to implement industry 4.0, namely New MIDEC (Manufacturing Industrial Development Center). The dynamics of cooperation between Indonesia and Japan in the New MIDEC program have several scopes, which are related to investment, employment, and the use of Natural Resources (SDA) and Human Resources (SDM). In terms of investment, the Ministry of Industry held a meeting with the President of Toyota Motor Corporation, Akio Toyoda, and reached an agreement that Toyota would develop electric vehicles in Indonesia and planned to prepare funds of IDR 28.3 trillion during its production (Ministry of Industry, 2019).

A study conducted by J. Patchell in 1999 presented an analysis of the establishment of Japanese electric vehicle industry by concerning how electric automotive companies overcame obstacles in bilateral and multilateral cooperation. This research provides another figure of the dynamism of inter-company relations in the Japanese automotive industry, and how actors react to the pressure of urgent demand for electric vehicle production. Furthermore, coordination for the overall development of electric vehicles is also carried out by the Japanese government and other multilateral institutions. However, these institutions provide only loose integration to the coordination necessary for the development of the electric vehicle industry, allowing for the competition that companies need to spur their development.

Apart from that, analysis by Patchell aims to explain the focus on how the electric vehicle industry can be created. The focus is on the uncertainties that hinder corporate collaboration. Japanese electric vehicle companies have proven adept at creating new variations of relational skills to overcome these obstacles. Therefore, research from Patchell also suggests that it would be wise for electric vehicle manufacturers to focus on relationships as inter-company relationships as well as increasing contributions such as attracting multilateral organizations to consider ways of corporate cooperation. Japanese electric vehicle companies emphasized that multilateral institutions are crucial in building the cooperation needed to build an electric vehicle industry.

Apart from Patchell's research, another study conducted by Sasongko, et. al (2017) explained that Japan currently has a clear roadmap and policy for reducing emissions produced by vehicles compared to Indonesia. In the transportation sector, especially for electric vehicles, the low electricity grid emission factor provides an advantage in encouraging environmentally friendly mobility in the future. Japanese automakers are promoting several innovations for future vehicle fuel economy standards. Sasongko uses Indonesia and Japan as a comparison in his research because the two countries have different situations, Indonesia has a large source of biofuel from palm oil, meanwhile Japan has a clean electricity supply. Apart from that, another important point is that the Japanese automotive sector dominates in Indonesia, and understanding the eco-friendly mobility policies of the main country is very necessary to adopt the best strategy.

4.2.2. China

The second electric vehicle-producing country which will be discussed is China. Indonesia and China are countries that have had cooperative relations for quite a long time. Despite the

implementation of this cooperation, relations between Indonesia and China did not go well from 1966 to 1990 (Fitriani, 2022). Relations between Indonesia and China have increasingly developed in recent years. In the economic sector, China is one of the second largest sources of foreign direct investment for Indonesia and one of Indonesia's main trading partners. In 2019, China was Indonesia's largest export destination country, with a total export value of US$25.8 billion or around 16.68% of total exports. Furthermore, in the same year, China was the largest source of imports for Indonesia, worth US$44.5 billion which was also worth almost a third of Indonesia's total imports (Agazade, 2021).

Historically, research conducted by Mazzocco & Sebastian (2023) explains that in 2009, China overtook the position of the United States (US) as the largest automotive market and producer in the world. However, this provides little reassurance to policymakers in Beijing who have long worried that China's auto sector is too dependent on foreign companies and that the industry is big but lacks power. Since the 1980s, China has had a localization policy that requires foreign automotive manufacturers to enter into joint ventures with local partners. However, the performance of Chinese companies continues to lag, and international brands maintain their leading position in global sales.

Furthermore, Mazzocco & Sebastian explained that China's Ministry of Science and Technology launched a series of policies aimed at developing the domestic electric vehicle industry in 2009. The goal is to establish leadership in new technologies that will enable Chinese companies to leapfrog and compete more effectively against companies that have long been active in the automotive sector. Then, in 2022, China surpassed Germany as the world's second-largest car exporter, and pioneered the industry in a way that had never been seen before since it was dominated by Japan in the 1980s and controlled by South Korea in the 1990s. In its development, as an automotive exporter, China is different from other countries in East Asia in at least two ways, the first is that the majority of China's exports consist of vehicles made by foreign companies and not by Chinese companies. Then secondly, new technology in the form of electric vehicles can encourage export growth in China's automotive sector.

In research written by Angela Tritto (2023), it is explained that Indonesia is currently attracting Chinese investment to place the country in the global chain of the electric vehicle sector. The coal-fired power plant located in Indonesia's Morowali Industrial Park (IMIP) is supported and funded by China Development Bank, China's export-import bank, namely Bank of China, Industrial and Commercial Bank of China, as well as the largest state-owned banks in the country. Furthermore, the IMIP industrial area also has special housing for workers from China to live in, hotel facilities for visitors to Chinese-owned company executives, an airport that has a runway 1,800 meters long, as well as a special telecommunications network that includes underwater cables connected to Chinese satellites. Production facilities include several items such as lime, coke, and acid plants; eleven smelters producing stainless steel, NPI, and ferrochrome; and two high-pressure acid leach (HPAL) facilities to extract nickel and cobalt from laterite minerals.

In Tritto's research, these two facilities are owned and operated by PT QMB New Energy Materials, IMIP, Japanese company Hanwa, and PT Huayue Nickel and Cobalt. The investments made by these companies accounted for more than $2 billion of the total $8 billion invested. Furthermore, this investment is another way to fulfill Indonesia's request to diversify its use of nickel, namely through the HPAL process. Presently, Indonesia produces battery-quality nickel and other materials that cater to the growing electric vehicle market. Currently, production facilities in Indonesia are spread across Morowali, Obi Island (North Maluku), and Weda Bay (Halmahera), supplying 9 factories that contribute more than 40% of global electric vehicle

production, thus placing Indonesia as a center for new electric vehicle production. and making Indonesia a global supply chain that supports the renewable energy transition.

4.2.3. South Korea

Apart from collaborating and investing with China, Indonesia is also investing with South Korea in implementing the electric vehicle ecosystem. South Korea is looking forward to becoming a global leader in the production and deployment of fuel cell electric vehicles (FCEV) and large-scale stationary fuel cells for power generation (Nakano, 2021). South Korea's current investments include building the country's first electric vehicle battery factory, which is scheduled to start production in 2024, as well as its first electric vehicle factory. South Korea began processing nickel for use in batteries starting in 2021, with more projects in the works, primarily due to Chinese investment (Huber, 2022).

Research conducted by Zein & Susanto (2023), states that Indonesia is one of the countries that is starting to focus on implementing and developing low-carbon transportation. However, Indonesia still does not have sufficient capacity to produce electric vehicles, both in terms of procuring funds and accelerating technology. To overcome this, Indonesia is establishing strategic partnerships and attracting foreign investment in the context of implementing the electric vehicle ecosystem. Zein & Susanto sees South Korea as a strategic partner for the development of electric vehicles. Cooperation in the electric vehicle transportation sector between the two countries is supported by the previous cooperation framework, namely the Special Partnership (SP) in 2006 which was later upgraded to the Special Strategic Partnership (SSP) in 2017.

Thus, investment in electric vehicles in Indonesia with South Korea, which is Indonesia's cooperation partner in the automotive industry, was also explained in a study conducted by Ismail & Mulyaman (2021), which stated that the existence of electric vehicles, especially electric cars, has become a global trend for society at the moment. Along with public awareness of the implementation and development of electric vehicles in Indonesia, it is considered quite important, along with the impact of using fossil fuel cars such as the impact on nature, health, the environment, the economy, and other impacts. This has become momentum for several world automotive manufacturers to compete to produce electric cars for all groups, including Hyundai from South Korea. Hyundai's seriousness in supporting the implementation of electric vehicles is marked by making direct investments in Indonesia by establishing a factory as its production base.

Furthermore, Ismail & Mulyaman stated that the Hyundai investment phenomenon was quite interesting, because there were several contradictory things, namely Hyundai invested at a time when Indonesia was experiencing stable economic growth, so the prices of Hyundai cars produced were still high compared to the prices of other car manufacturers in Indonesia. Thus, in Indonesia, Hyundai is still less attractive to the Indonesian market. In terms of readiness, Indonesia does not seem ready to face the global electric car trend because its infrastructure is also not ready. Therefore, Ismail & Mulyaman concluded that Hyundai's direct investment in Indonesia for electric cars is determined by at least two factors, namely push and pull factors. Push factors are generally understood as domestic conditions in the home country that support a multinational company to expand in other countries. Not only that, regional and global conditions full of business competition are also another driving factor. The driving factor in this research is that Hyundai has controlled the South Korean domestic market, therefore, Hyundai feels the need to expand its market share outside South Korea. Furthermore, in the context of global competition, Hyundai is targeting business opportunities where the global trend is

currently moving towards electric cars and competing with automotive manufacturers from other countries, especially in the ASEAN region (Indonesia).

Meanwhile, pull factors generally consist of efforts or conditions made by the Indonesian government as the host country to convince Hyundai to invest its capital in Indonesia. In this research, 4 points attract Indonesia, namely Hyundai's determination, economy, resources, and law and politics. The points in the pull factors show Indonesia's readiness and seriousness in receiving direct investment from the Hyundai company by preparing and preparing regulations and resources, such as the production of raw materials and labor. The combination of push and pull factor models is the right combination to answer Hyundai's reasons for making direct investments in Indonesia regarding the development of electric cars.

The next research that discusses South Korean electric vehicle investment in Indonesia is research from Simbolon, Rusli, and Candradewini (2022) which explains a literature review of electric vehicle policies which is an adoption of a comparison between electric vehicle policies in South Korea and Indonesia. The results of the research show that there are alternatives for producing electric vehicles, namely electric vehicles based on hybrid and hydrogen technology, as well as electric vehicles based on battery technology. The comparison results state that the BEV vehicle model has several advantages, namely that it does not cause exhaust gas emissions, can develop downstream steps for the battery industry to fuel electric vehicles in Indonesia, and supports domestic production of electric cars that use batteries. It is expected that the study conducted by Simbolon, Rusli, and Candradewini (2022) can be a consideration for the Indonesian government in implementing policies for developing battery-powered electric vehicles in Indonesia. Furthermore, this research suggests that the Indonesian government continues to collaborate and cooperate with various parties who are interested in investing in implementing the electric vehicle ecosystem in Indonesia.

4.3. Readiness of Indonesia to Implement the Electric Vehicle Ecosystem

This sub-chapter will explain literature review about Indonesia's readiness to implement the electric vehicle ecosystem. It is known that by 2025, Indonesia is targeting a total of 2.5 million electric vehicles in circulation, including 400,000 electric cars, and hopes that electric vehicles can contribute 20% of all car sales (Yee, 2023).

Research by Kumara, et al. (2021) shows that there has been a delay in the development of electric vehicles since 2013 since the start of production, namely in 1997. The existence of Presidential Regulation Number 55 of 2019 encourages re-advancing the automotive industry sector, especially in the development of electric vehicles. This research examines the status of electric bicycles and electric motorbikes produced in Indonesia which are sold commercially to the public. This research was carried out by conducting online survey activities from 2020 to 2021 which produced a database regarding the production of electric bicycles and electric motorbikes. The information and data presented in this research are intended to help stakeholders get quick exposure to the development situation of electric bicycles or electric motorbikes in the country and also as a benchmark for designing electric bicycles and electric motorbikes that are used to meet domestic needs in the country.

Concerning about policy, research conducted by Hidayat & Cowie (2023), explains that Indonesia has ratified the national commitment to reduce greenhouse gas emissions in the Nationally Determined Contribution (NDC) by 2030. Indonesia has a target to reduce greenhouse gas emissions which amount to 31.89% without international support or amount to 43.2% with international assistance (UNFCCC, 2022). Although the role of electric vehicle implementation is considered as one of the steps to reduce greenhouse gas emissions, this measure is still not included in the NDC in Indonesia. The Indonesian government has strengthened its support for

the development of the domestic electric vehicle industry through several policies and regulations. One of the regulations that is the basis for discussing electric vehicles is Presidential Regulation Number 55 of 2019 concerning Electric Vehicles, which aims to enable battery-powered electric vehicles to be made and used domestically (PP, 2023). This was followed by various regulations issued by various agencies.

Furthermore, Hidayat & Cowie in their study discussed the implementation of electric vehicle policies consisting of financial and non-financial incentives, which are commonly used by the government to encourage large-scale adoption of electric vehicles. Financial incentives are often combined with other non-financial incentives, for example, road priority and traffic restrictions, in order to attract more users. Although this is one of the main focal points of electric vehicle policy discussions, not all countries offer non-financial incentives to encourage electric vehicle adoption. In geographical scope, a review of Southeast Asian countries, especially Indonesia, is ideal because this is directly relevant. This is because consumer preferences and use of electric vehicles tend to be more empirically supported in countries with large markets. Although several policies have been implemented in Indonesia, further research is needed regarding policy support for electric vehicles, especially in low-middle-income countries, and to determine whether the policies that have been implemented can effectively encourage the use of electric vehicles in the long term.

Based on research conducted by Konewka, et al (2021), Indonesia has the largest car market and ranked in second biggest car producer among all of ASEAN countries. Indonesia's competitive advantage in developing the regional electric vehicle battery chain is due to its wealth of key battery resources, such as mineral resources, nickel, and crude oil. The wealth of mineral resources is not the only reason of why this country intends to build on its growing position in the electric vehicle supply chain, but Indonesia's geographical position is considered significant, because of the sea shipping routes to Japan and China, which are major countries which developing new technology, including the production of electric cells for various products. Some of China’s largest companies are investing in Indonesia's minerals industry to obtain supplies needed for battery production. This provides an opportunity for Indonesia to build a significant competitive advantage in this sector.

Furthermore, Konewka in his research explains that Indonesia appears to have a strong foundation in the automotive industry today, which makes Indonesia a country that can create conditions for developing a complete electric vehicle supply chain. Indonesian Battery Companies that focus on this goal may not be enough to transform Indonesia into a global player, not just a regional player in the ASEAN region and China. Indonesia could not become a global market leader without inviting big players in the electric vehicle battery industry, for example like China, Japan, or South Korea, to invest domestically. This should be done in the world-wide context of international supply chains. In reviewing the global electric vehicle market, foreign direct investment (FDI) also seems to have a very important role for Indonesia. This is in accordance with the results of the article discussed by Konewka that the role of FDI allows for the entry of resources and technology that are not available in Indonesia. This is considered very important for Indonesia which has limited resources. In this case, the Indonesian government has established cooperative partners with China, and the Indonesian government has a big role in ensuring a good level of reciprocal relations. However, if Indonesia is to build a competitive advantage in the electric vehicle battery market, it cannot allow China to dominate both relationships. In the long term, this could reduce Indonesia's role as a supplier of electric vehicle components to China. Therefore, to achieve this level of diplomacy, the Indonesian economy must be more open to other countries in the long term.

A research from Haryanto et al. (2020) about production of electric vehicles in Indonesia stated that the Indonesian government has manage a mass production target for electric vehicles of 20% of total vehicle production in 2025, followed by a policy of stopping sales of internal combustion engines (ICEVs) in 2040 to achieve net-zero emissions by 2060 (Haryanto et al., 2020), following the data presented by CSRI in 2019 which discussed plans for mass production of electric vehicles in 2025. However, based on research conducted by Yuniza et al. (2021), the progress of electric vehicle ecosystem in Indonesia is still considered in a very slow pace compared to other countries (Yuniza et al., 2021). The reason behind this statement is because the incentives provided by the Indonesian government which are included in the Presidential Regulation are not capable to attract Indonesian people to choose electric vehicles. Thus, there are more obstacles to implementing electric vehicles ecosystem in Indonesia, including the price of electric vehicles, scarcity of spare parts, lack of vehicle repair, lack of maintenance services, lack of charging infrastructure, and limited resources of battery fuel.

According to Yuniza's statement in the previous paragraph, it is supported by statistical data in 2023 showing that in the Asia-Pacific region, Indonesia has not yet entered the top 5 countries that use and implement electric vehicles. This shows that Indonesia still has a huge task to accomplish its international interests. Especially if Indonesia wants its produced electric vehicles to have a high sales value in the global market.

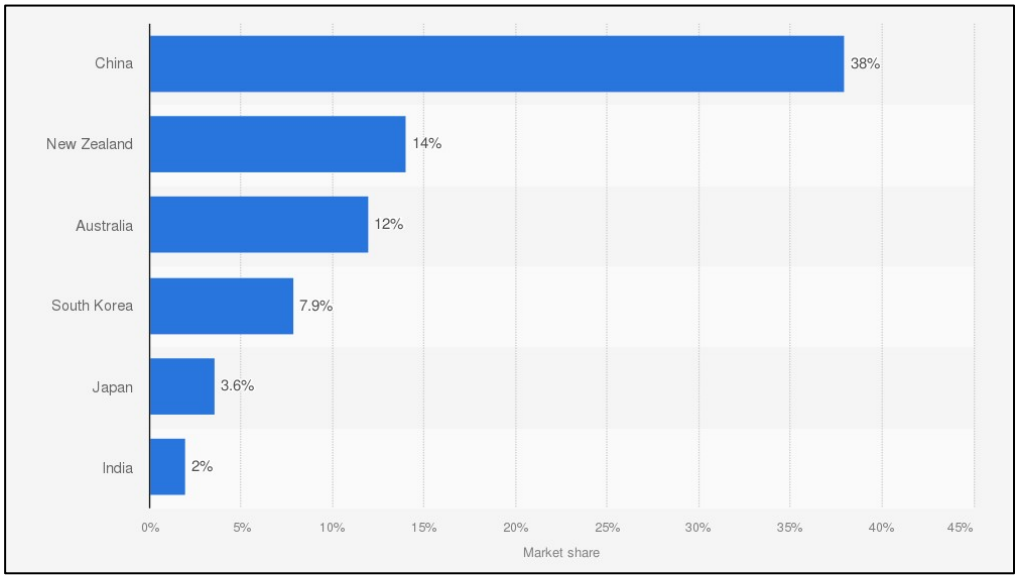

Figure 2. Market share of electric vehicle in Asia-Pacific Region in 2023
Source: Ganbold, S. in Statista (2024)

Thus, the data from IESR (2023) and McKinsey (2022) as below, shows that the progress of electric vehicle in Indonesia is still very slow at the first time of its implementation. Compared to several Asian countries, Indonesia's target for electric vehicle implementation is still rather small, as well as charging facilities with only 570 units produced in 2022. This shows that the government's plan for the electric vehicle ecosystem in Indonesia is good and structured, however, it also needs to be balanced with the plan to provide charging facilities and maintenance.

Table 1. Comparison Table of Indonesia and Asian Countries on EV Implementation

Country	Electric Vehicle Target (EV)	Charging Infrastructures (units)
China	100% EV by 2035.	1.1 million in 2022.
Singapore	100% vehicle running on cleaner energy by 2040, 100% zero-emission vehicle (ZEV) sales by 2030.	3,000 in 2022; 60,000 by 2030.
South Korea	33.3% EV by 2030 (3.62 million units).	170,000 in 2022; 1.8 million by 2030.
India	E4W: 30% by 2030. E2W: 40% by 2030.	1,640 in 2022; 23,524 by 2030.
Thailand	5.4 million units by 2030, 50% of total EVs are domestically produced by 2030.	2,572 in 2022; 12,000 by 2030.
Malaysia	Undefined.	700 in 2022; 10,000 by 2025.
Vietnam	3.5 million units by 2040.	40,000 in 2022; 150,000 target.
Indonesia	E2W: 13 M by 2030, E4W: 2M by 2030.	570 in 2022; 25,000 by 2030.

Source: IESR (2023) and McKinsey (2022)

Apart from that, other obstacles such as lack of public awareness, slow charging speed, range of electric vehicles in Indonesia, and scarcity of vehicle models are concerns and reasons why Indonesian people have not yet switched to implementing and using electric vehicles (Haryanto et al., 2020; Huda et al. , 2019; Natalia et al., 2020; Sidabutar, 2020; Other obstacles such as the high price of electric vehicles will not be a big problem for Indonesian people in the future (Thorn, 2021). This is because Indonesia has the resources and raw materials that are the basis for making electric vehicles, such as nickel and cobalt which are the main components of electric vehicle batteries. However, the technology and infrastructure that Indonesia needs to process these raw materials is still very limited, forcing Indonesia to continue importing them from abroad or collaborating with other countries (Setiawan, 2021).

The research conducted by Maghfiroh, et al. (2023), analyze stakeholders' perceptions and points of view towards the electric vehicle industry. This research uses Japanese technology readiness assessment (J-TRA) parameters to better understand the current level of electric vehicle readiness in Indonesia. Maghfiroh also reviewed extensive literature related to the history of electric vehicle adoption in other countries which was also used as the basis for this research. Research by Maghfiroh et al. contribute to seeing how far the production and development of electric vehicles in Indonesia is ready, where Indonesia is a developing country with the quality of electric resources still inadequate. The assessment parameters carried out by the author sufficiently show that safety, commercialization and integration aspects are key for the Indonesian government in developing investment in electric vehicles.

Apart from discussing the problems of implementing electric vehicles, research by Huda, et al. (2019) also discussed the dynamics of electric vehicle production in Indonesia which is still

experiencing problems between balancing high production demand and limited energy supply. Research by Huda, et al. (2019) shows that additional services for electric vehicle components are one solution for the community to utilize electric vehicles. The increase in the market share of electric vehicles in Indonesia can show global concern about climate change. The pressure factor on the electricity network can trigger a problem when there is high penetration of demand for charging electric vehicles. In Indonesia, because the current power grid's ability to balance supply and demand is very limited, massive charging of electric vehicles also worsens environmental conditions due to a lack of energy storage. This research analyzes the feasibility evaluation of vehicle-to-grid (V2G) on the Indonesian electricity network. The results show that the power absorbed and released by electric vehicles after charging and discharging is suitable for supporting the electricity grid in Indonesia if electric vehicles are controlled properly.

Regarding the impact of the implementation of electric vehicles in Indonesia, research from Berliandaldo & Prasetio (2022) states that government regulations regarding electric vehicles are aimed at encouraging accelerated programs in the use of electric vehicles in all tourism destinations in Indonesia, which also aims to fulfill the principles sustainable in the environmental, social and cultural fields. After the issuance of Presidential Regulation no. 55 of 2019, electric vehicles are one solution to overcome the impact of CO2 gas, maintain environmental sustainability and energy security. This research contributes to the author's research in providing insight into state laws and regulations regarding the use of electric vehicle facilities, especially in the tourism sector.

Talking about electric vehicle fuel in Indonesia, research conducted by Pandyaswargo, et. al. (2021), stated that nickel is an important component in the production of electric vehicles in Indonesia. Nickel is also considered to be an important component for manufacturing lithium nickel cobalt manganese oxide (NMC) fuel components as the cathode material of choice for electric vehicle applications. Indonesia, which is one of the largest suppliers of nickel ore in the world, has implemented a ban on nickel ore exports which will take effect in 2020. This movement was carried out by the Indonesian government to start the domestic electric vehicle industry and encourage foreign investors to push their manufacturing activities to Indonesia. This is because the main electric vehicle producing and consuming countries around the world are focusing on developing technology for electric vehicle energy storage. Most of these countries are developed countries that have high GDP per-capita. Indonesia's initiative to reduce national carbon emissions in the transportation sector by joining the shift to an electric vehicle world is supported by a large amount of domestic mining reserves needed for battery production.

5. Conclusion

Based on the Paris Action Agenda prepared at COP21, it is declared that the transportation sector contributes almost a quarter of greenhouse gas emissions. Indonesia is in 11th position as the largest producer of greenhouse gas emissions, contributing around 2.09% of total greenhouse gas emissions. In order to face this problem, Indonesia intends to make a transition to more environmentally friendly electric vehicles. Based on the research question presented previously, namely how prepared the Indonesian government is to implement a global electric vehicle ecosystem, this research reviews literature studies and maps them into 3 sub-discussions, namely the development of the transportation and automotive sector in Indonesia; China, South Korea, and Japan as cooperation partners in the electric vehicle sector; as well as readiness to implement the electric vehicle ecosystem in Indonesia.

The first discussion is to review the development of the transportation sector in Indonesia. Of all the countries in Southeast Asia, Indonesia is one of the countries that has the longest history of automotive production. This can be seen in the existence of the first automotive

assembly plant founded by General Motors (GM) in 1928, with an initial production capacity of 6,000 units per year. The growth of the middle class in Indonesia is the main driver of the rapid growth of the automotive industry in this country over the last decade. At first, the transportation and automotive sector in Indonesia was only controlled by Japan, but over time, several other automotive-producing countries such as South Korea and China have begun to offer electric vehicle technology which is considered more advanced.

The second discussion was regarding cooperative relations with China, South Korea, and Japan as partners for electric vehicle investment cooperation in Indonesia. In this case, it can be concluded that Japan has a clean electricity supply to support electric vehicles. However, Japan does not yet dominate the electric vehicle market in Indonesia compared to South Korea and China. In Indonesia, China funded and established a company that facilitates nickel and cobalt technology from laterite ore owned by Indonesia to make electric vehicle components. Meanwhile, Indonesia established a Special Strategic Partnership (SSP) collaboration with South Korea in 2017 to grow investment in electric vehicles and establish the Hyundai company as its production base.

The third discussion concerns Indonesia's readiness to implement the electric vehicle ecosystem. Along with the issuance of Presidential Regulation No. 55 of 2019, encourages Indonesia to advance the automotive industry sector again, especially in the development of electric vehicles. Indonesia appears to have a strong foundation in the automotive industry today, which makes Indonesia a country that can create conditions for developing a complete electric vehicle supply chain. Even though the implementation of electric vehicles often encounters obstacles such as unattractive incentives, a lack of chargers in every location, and a lack of electric vehicle maintenance facilities, the Indonesian government has created a roadmap for the electric vehicle ecosystem and set mass production of electric vehicles by 2025.

Based on the conclusions explained, this research can provide recommendations both academically and practically. At an academic level, there are not too much social and economic literature discussing the topic of electric vehicle investment in international relations studies. Based on the results of the literature review, there has been no other paper that analyzes the implementation of electric vehicles in Indonesia using national interest theory, specifically economic interest. National Interest theory is sufficient to explain that a country in its diplomatic practices tends to have national interests towards other countries that are achieved in an international agreement. Furthermore, this theory states that national interest is more closely related to the interests of the state and nation as a whole, in this case, the interests between countries, and not just about the interests of a private group of political organizations. However, it is necessary to explain further what are the more dominant indicators that determine that an interest can be realized in an international treaty in a cooperative relationship between countries in the world. Apart from that, previous literature mostly discussed electric vehicles from a technical perspective and used quantitative methods. Therefore, it can be recommended for further research to discuss investment and implementation of national and global electric vehicles using other IR theories and perspectives. For example, in the field of International Political Economy, we can discuss more about international cooperation on the implementation of electric vehicles and the political implications using qualitative methods.

Thus, at a practical level, to implement an electric vehicle ecosystem sustainably until 2030, the Indonesian government needs to be consistent in increasing cooperative relations with countries and investors who have more sophisticated facilities and technology to produce electric vehicles. The Indonesian government can continue to collaborate by investing with countries that have advanced automotive sectors other than China, South Korea, and Japan. For example, the

Indonesian government can establish cooperative investment relations with Germany and the United States (US).

Conflicts of Interest

The author has declared that there are no potential conflicts of interest concerning this article's research, authorship, and/or publication.

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