Policy, Supporting Infrastructure and Market of Electric Cars in Indonesia

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Abstract

The zero-emission transportation target has driven the development and adoption of Electric Vehicles (EV) across the globe, including Indonesia. This policy aims to reduce greenhouse gas and fossil fuel use. Indonesia is one of the countries with the most significant automotive development in ASEAN. This condition also makes the electric cars market in Indonesia has enormous potential. This research will discuss the trend of electric cars in Indonesia, including the policy, technology, supporting infrastructure, and electric cars market in Indonesia. Based on Presidential Regulation No. 55 of 2019 concerning the Acceleration of the Battery Electric Vehicle Program for Road Transportation, the government encourages the development of the electric car technology industry. The government encourages electric car technology by providing incentives to consumers and manufacturers. The government has also built quality 148 public electric vehicle charging stations (PEVCS) and 39 standards related to electric cars. Sales of electric cars in Indonesia increased 74,18% in 2020 and 52,61% in mid-2021. In this study, we found that the challenge for electric cars in Indonesia is the lack of charging station infrastructure and standards related to electric cars. The government's program to encourage electric cars in Indonesia is achieved. A complete and integrated intelligent transportation management system is needed where all entities are aware of the efficient use of energy to create sustainable transportation. The integration of transportation management systems is not possible without the cooperation and collaboration of car manufacturers, scientists, power companies, governments, and standards organizations.

Keywords
Electric Vehicle (EV), EV Policy, EV Infrastructure, EV Technology, EV Market

1. Introduction
The government policy to reduce greenhouse gas emissions and the use of fossil fuels are electric vehicles (EV) (Li et al. 2021). Electric vehicles can contribute to the decarbonization of the transportation sector and reduce climate change because electric vehicles produce fewer emissions than conventional vehicles (Malinauskaite et al. 2021). This electric vehicle revolution aims to meet global targets for reducing greenhouse gases and improving air quality in urban areas (Malinauskaite et al. 2021). This condition has encouraged many countries to develop electric vehicle technology (Choi, Yong & Ree, SW., 2020), including Indonesia. EV research and development in Indonesia in 1997 by LIPI through the Center for Electric Power and Mechatronics Research. In 2005, this research resulted in a product design and several prototypes of electric cars. However, there are many problems so that electric cars in Indonesia cannot develop into a national scale industry (Subekti et al, 2014).

In 2019, the Indonesian government made a policy for the Acceleration of the Battery Electric Vehicle Program for Road Transportation. The government is committed to developing a transportation energy system that leads to the policy of Battery-Based Electric Motorized Vehicles. The government's commitment to shifting conventional vehicles to BEV is due to new technology for transportation energy to anticipate the projected growing demand for fuel oil. The main impact of the mass transition of road transportation to electric cars is the increase in the need for electrical energy on a large scale (Peraturan Presiden Republik Indonesia, 2019).

The automotive trade in Indonesia may be a pioneer within the growth of the producing industry in Indonesia. The expansion of the automotive industry will increase the national economy (Bintang et al. 2019). Based on the Association of Indonesian Automotive Industries (Gaikindo) data, Indonesia's automotive sales growth is 23.6% per year. Indonesia is one of the countries with the most significant automotive development in ASEAN. This condition also makes the electric car market in Indonesia has enormous potential. This study will discuss the trend of electric cars in Indonesia, including the policy, supporting infrastructure, and electric cars market in Indonesia.

2. Materials and Methods

This study is descriptive research that aims to present a complete picture of electric cars in Indonesia. This study will discuss policies, supporting infrastructure, and the electric car market in Indonesia. The data is collected from peer-review literature and news or press releases because information related to electric cars in Indonesia is very dynamic.

3. Results and Discussion

3.1 Policies of Electric Cars Development

Electric vehicles (EV) can reduce air pollution compared to ICE vehicles, but consumers still find it challenging to accept EVs because of their higher prices. Governments around the world are implementing financial incentive policies to increase public acceptance of EVs and convince consumers that EVs are environmentally friendly and economical. These financial incentives can be divided into two parts based on the recipients, namely consumers and producers. Incentives for consumers mainly contain tax credits, tax deductions, tax exemptions or direct subsidies during purchases, free road and parking taxes, and cheap electricity prices for EV users. Incentives for producers such as sales tax reductions depend on emission levels and subsidies for EV production so that EV quality and quantity targets can be guaranteed (Zhang et al. 2014).

Based on Presidential Regulation No. 55 of 2019 concerning the Acceleration of the Battery Electric Vehicle Program for Road Transportation, the Government encourages the development of the electric car technology industry. The government encourages the development of the electric car technology industry by providing incentives to the Baterry Electric Vehicle (BEV) industry. The incentives referred to include import duty incentives on the import of battery-based EV is completely knockdown (CKD) or incompletely knockdown (IKD) or main components for a certain amount and period time. Other incentives are in the form of Sales Tax on Luxury Goods (PPnBM) incentives, namely the exemption or reduction of central and regional taxes, import duties on the import of machinery, goods, and materials for investment purposes, suspension of import duties in the context of exports and incentives for import duties borne by the government on imported materials, raw materials, and auxiliary materials for the production process (Peraturan Presiden Republik Indonesia, 2019).

The government also provides incentives for the manufacture of Public Electric Vehicle Charging Station (PEVCS) equipment, export financing incentives, fiscal incentives for research and development, parking rates, charging cost, installation of PEVCS, competency certification for BEV human resources, and products certification and technical standards for BEV industrial companies. The fiscal incentive relates to the financial support provided by the government, which is shown in Figure 1. The non-fiscal incentives that can be given include exemptions from restrictions on using certain roads, a delegation of production rights to the technology related to BEV, and the development of operational security in the industrial sector. Finally, additional fiscal and non-fiscal incentives for the national branded BEV industry (Peraturan Presiden Republik Indonesia, 2019).

Efforts to develop electric cars are the restriction of nickel exports. The government is trying to downstream the nickel industry to produce lithium batteries as the main component of electric cars. Based on the Regulation of the Minister of Trade Number 1 of 2017 concerning Provisions for Export of Processed and Refined Mining Products, nickel with low levels below 1.7% is no longer allowed to be exported from December 2019. Indonesia will build an electric car factory PT. HKML Battery Indonesia in Karawang in 2021. This factory is an investment project between a consortium from South Korea, namely Hyundai Motor Company, KIA Corporation, Hyundai Mobis, and LG Energy Solution with PT. Industri Baterai Indonesia or Indonesia Battery Corporation (IBC) consists of PT. Inalum, PT. ANTAM, PT. Pertamina, PT. PLN and Contemporary Amperex Technology. The first phase of this plant will have a capacity of 10 GW hours (Kompas, 2021).

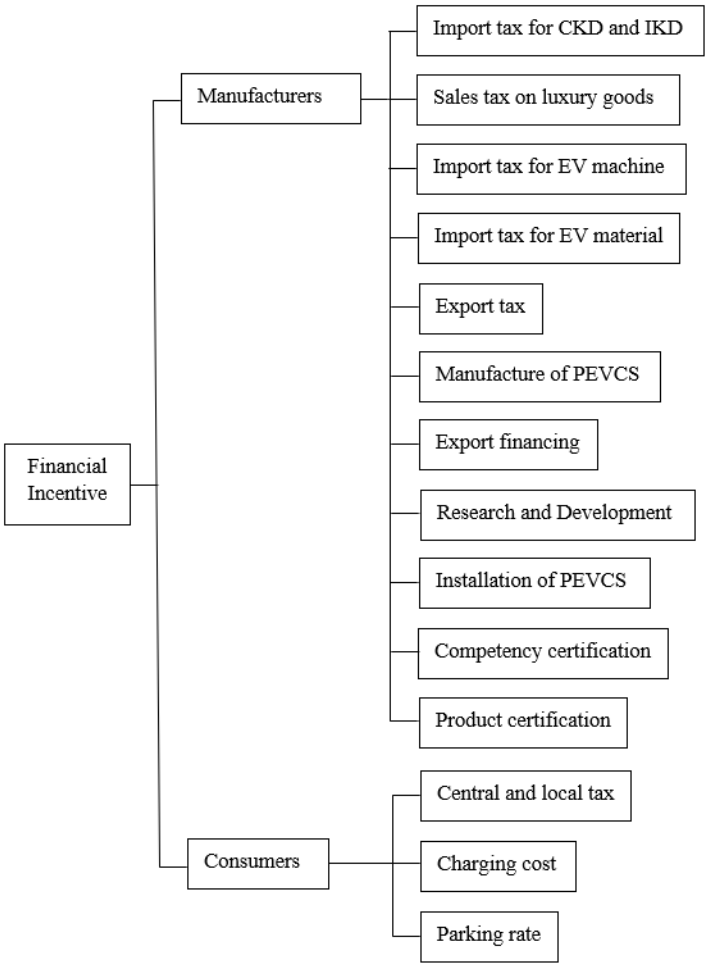

Figure 1. A Framework of financial incentives in Indonesia

3.2 Technology and Supporting Infrastructure

Development of EV requires high R&D investment costs and should be supported by tax reductions and subsidies from the government. Long-term EV development relies oncritical technologies, and EV production costs will be reduced through technological advances. Many countries, such as America, Germany, Japan, and China, attach great importance to the R&D of relevant EV technologies. These countries have proposed several plans and policies on technological progress based on their technical resources and national development strategies (Zhang et al. 2014)

The government has also set a roadmap for developing the electric vehicle industry and its main components until 2030, as shown in Figure 2. This roadmap is stated in the Regulation of the Minister of Industry No. 27 of 2020 concerning Specifications, Development Roadmaps, Calculation of Domestic Component Level Values for Battery-Based Electric Motor Vehicles (Battery Electric Vehicle) (Perpres, 2019). The development of Indonesian EV technology will be carried out from 2020 to 2030. The development of EV battery technology including battery pack assembly, battery cells production, battery management system, and battery material. Indonesia will produce two types of cell batteries including Li-ion & NiMH in cylindrical form and Li-ion in prismatic & pouch form. Indonesia will also develop converter/inverter technology with two types, including > 95% inverter efficiency, low parasitic impedance, high power density, and > 96% inverter efficiency (HFET). The charging system technology with two types includes AC level I & Level II Charger and DC Fast Charger or Ultra-Fast Charger. The government is also focusing on recycling of consumable batteries for Li-Ion and NiMH types (Peraturan Menteri Perindustrian, 2020).

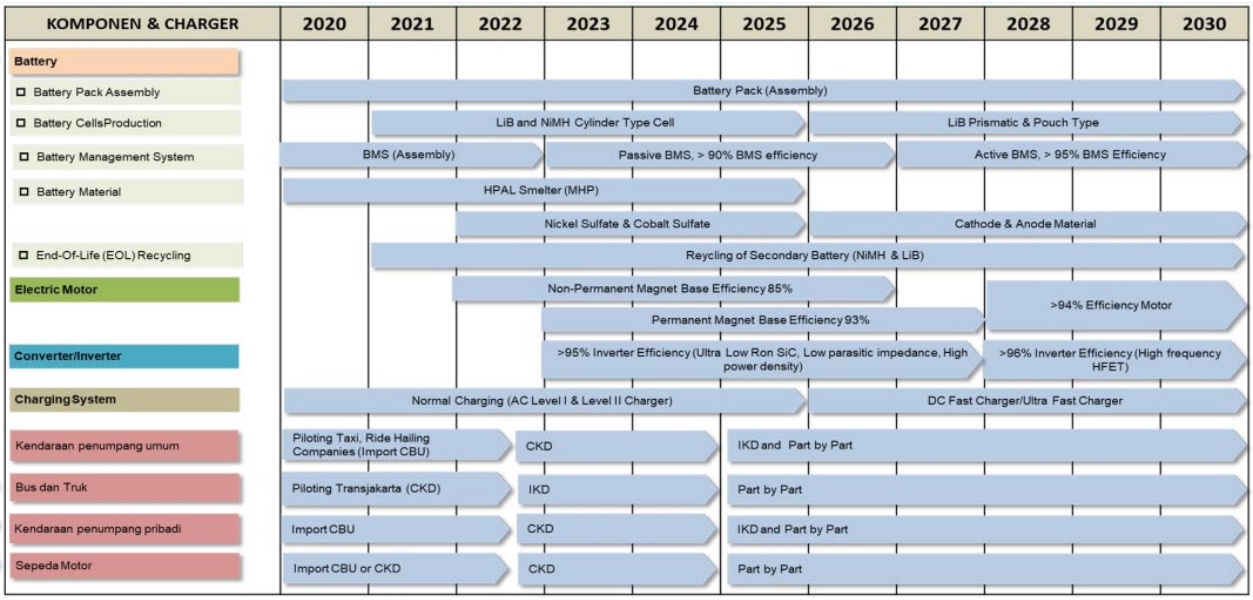

Figure 2. Roadmap for the Development of the Electric Vehicle Industry and its Components

In developing the charging system, the government, through the Agency for the Assessment and Application of Technology (BPPT), has developed fast charging PEVCS in Indonesia. This PEVCS was built at the BPPT Jakarta office and B2TKE-BPPT in South Tangerang in 2018. BPPT and PT LEN worked together to build PEVCS located at PT LEN Industri Bandung in 2019. This work supports the development of the PEVCS manufacturing industry in Indonesia. In 2021, BPPT succeeded in developing 22 kW fast AC type PEVCS for electric cars with an AC type 2 plug and a Public Electric Vehicle Battery Exchange Station (PEVBES) capacity of 12 Gesits battery lockers (Antaranews[1], 2021).

BPPT cooperates with several industrial partners, including PT LEN Industri, PT Wijaya Karya Industri Manufaktur (WIMA), and PT Wiksa Daya Pratama, in developing the PEVCS and PEVBES industries. BPPT has downstream the prototype PEVCS type fast AC 22 kW and PEVCS type AC Home Charger 7 kW for electric cars to PT LEN Industri. By the end of 2021, BPPT will produce a prototype PEVCS type combination of rapid DC 50 kW and fast AC 22 kW for electric cars with three plug chargers at once, namely CCS 2 Combo and CHAdeMO for DC charging and AC Type 2 for AC charging. This type of charger will be downstream by PT LEN Industri in 2022. BPPT conducts PEVCS development not only from the hardware but also from the software aspect (Antaranews[1], 2021). BPPT is developing a Charging Station Management System (CSMS) that will monitor all PEVCS facilities that have been built. The result of CSMS development is named SONIK. This technology has been tested for operability and security. SONIK will be tested on the PEVCS in collaboration with BPPT and PT. Pertamina in terms of operability. Meanwhile, in terms of security, SONIK can detect and overcome various disturbances in the PEVCS. The advantages of SONIK CSMS will be an attraction for partners to be developed together (Antaranews[1], 2021).

The Ministry of Energy and Mineral Resources stipulates the Minister of Energy and Mineral Resources Regulation Number 13 of 2020 concerning The Provision of Electric Charging Infrastructure for Battery-Based Electric Motor Vehicles. Matters regulated in the Ministerial Regulation include the responsibilities of Business Entities, the licensing process, business schemes, electricity tariffs, incentives provided, and matters relating to the safety of running a business. Based on data until August 2021 from the Directorate General of Electricity, Ministry of Energy and Mineral Resources (ESDM), there are 148 PEVCS spread over 120 locations, including Jakarta 74 units, East Java and Bali 23 units, West Java 18 units, Banten 15 units, Java Central 13 units, Sumatra 3 units, Sulawesi 1 unit and Maluku 1 unit. The list of PEVCS in Indonesia is presented in Table 1.

Table 1. List of PEVCS in Indonesia

Area	Location	Number of Unit
Sumatera	GOR Jakabaring	1
	Hyundai Palembang	1
	Rest Area Bakauheni – Terbanggi Kayu Agung Km 20	1
Banten	PLN UID Banten	6
	B2TKE – BPPT Tangerang Selatan	1
	Angkasa Pura II	1
	Mitsubishi	2
	Hyundai	5
West Java	PLN UID Jawa Barat	1
	BPPT/LEN	1
	Ruas Tol Jakarta - Surabaya	2
	Hyundai	18
Jakarta	PLN Kantor Pusat	1
	PLN UID Jaya	6
	BPPT Jakarta	1
	Pertamina	5
	Blue Bird	15
	Shell Indonesia	2
	Mitsubishi	13
	Hyundai	21
	Marcedez-Benz	1
	BMW	2
	Medco	1
	Starvo	2
Central Java and Yogyakarta	PLN UID Jawa Tengah - Yogyakarta	1
	Ruas Tol Jakarta - Surabaya	4
	Hyundai	8
East Java, Bali and West Nusa Tenggara	PLN UID Jawa Timur	1
	PJB	2
	PLN UID Bali	3
	PLN Jasa Marga Bali	3
	PLN UIW NTB	1
	Mitsubishi Bali	2
	Hyundai Jawa Timur	10
	Hyundai Bali	1
Sulawesi	PLN Mattoangin	1
Maluku	PLN Kota Ambon	1
	Total	148

The most important in EV adoption is the construction of charging infrastructure. Sierzchula (2014) analyzed the relationship between charging infrastructure and EV adoption in different countries. Study results show that constructing a charging station for every 100,000 residents can have twice the impact on a country's EV market share than a $1000 financial incentive to consumers. Governments can enter into public-private partnerships with service providers when building charging infrastructure, such as the United States, Japan, and France. Governments are usually investors, and managers can be other stakeholders. In short, the market for building and managing charging stations is open to all companies (Zhang et al. 2014).

Through the National Standardization Agency (BSN), the government has also built quality infrastructure by establishing 39 Indonesian National Standards (SNI) and the appointment of the Conformity Assessment Institute related to EV. The appointment of this Conformity Assessment Institute is based on the Decree of the Head of BSN Number 587/KEP/BSN/12/2020 on December 11, 2020, for the scope of SNI 8613:2018 ISO 13063:2012 Mopeds and electric-driven motorcycles – safety specifications to the Product Certification Agency of the Center for Materials and Goods Engineering (B4T) Ministry of Industry. The development of quality infrastructure is aimed to enable the national electric vehicle industry to develop. In addition, the standard can also provide security and safety guarantees to vehicle users and improve the quality of national products to compete with foreign products. The list of 39 SNI related to electric cars is presented in Table 2.

Table 2. SNI of Electric Cars

Category	Description	Standard of SNI/ISO/IEC
General	Istilah dan Definisi	SNI ISO/TR 8713:2017 (ISO/TR 8713:2012, IDT)
Safety	Electrification safety (vehicle)	SNI ISO 6469-1: 2009 SNI ISO 6469-2: 2018 SNI ISO 6469-3:2011
	Electrification safety (post-impact)	SNI ISO 6469-4:2015
Performance	Power consumption	SNI ISO 8714:2002
	Vehicle performance	SNI ISO 8715::2001
Battery	Battery cell size	ISO/PAS 16898
	Battery cell testing and safety	SNI IEC 62660-1 2017 (IEC 62660-1:2010, IDT SNI IEC 62660-1 2017 (IEC 62660-1:2010, IDT SNI IEC 62660-3:2016
	Battery pack performance test	SNI ISO 12405-4:2018
	Battery pack safety	SNI 8872:2019
	Other battery	IEC 61982 *)
	Li-ion + Lead acid battery	ISO 18300 *)
	Recycle Li-ion + Non Li-ion	N/A
Electric Drive Components	Electric Drive Components (Motor, Inverter & Converter)	SNI ISO 21782
Charging System	Conductive Charging System	SNI IEC 61851-1:2017 SNI IEC 61851-23:2014 SNI IEC 61851-24 2014
	Safety requirements for the household battery charger	SNI IEC 60335-2-29:2012
	Wireless power transfer	IEC 61980-1 *) IEC 61980-2 *) IEC 61980-3 *) ISO 19363 *)
	Safety requirements of connection to external power supply	ISO 17409 *)
	EMC (On-board)	SNI IEC 61851-21-1-2017
	EMC (off-board)	IEC 61851-21-2 *)
	Sistem Battery Swap	IEC 62840-1 *) IEC 62840-2 *)
	In-cable control	IEC 62752 *)
	Charging Cable	SNI IEC 62893-1:2017 SNI IEC 62893-2:2017 SNI IEC 62893-3:2017

Charging Connector	Charging connector	SNI IEC 62196-1:2014 SNI IEC 62196-2:2014 SNI IEC 62196-3:2014
Communication Interface	Identification	IEC 62831 *)
	Vehicle to network	SNI ISO 15118-1; ISO 15118 series
	Roaming service	IEC 63119-1:2019 *)

*) in the development process

The International Standards Organization (ISO) has published 44 standards on the technical committee of 43,120 electric Road Vehicles, including their components and systems. The International Electrotechnical Commission (IEC) has four technical committees to develop electric vehicle standards, consisting of IEC TC 69, IEC SC 23H, IEC/SC 37A, IEC SC 23H, and IEC/TC 77. The IEC TC 69 technical committee has published 35 standards, technical committees. The IEC/SC 23H published eight standards, the IEC/SC 77A technical committee published four standards and the IEC/TC technical committee published two standards. The IEC has published a total of 49 EV-related standards. Some of these international standards can be a reference for Indonesia in developing SNI for electric vehicles.

Financial incentive policies, technology support, and charging infrastructure on EV adoption in America qualitatively demonstrated the relationship with EV purchases. The descriptive analysis also indicates that policies, such as government financial incentives or technology support, can influence EV adoption. This analysis provides visual support for each specific policy as a significant way to drive the EV's purchases (Zhang et al. 2014).

3.3 The Market of Electric Cars in Indonesia

Electric cars are classified into 3 include Hybrid Electric Vehicles (HEV), Plug-in Electric Vehicles (PHEV), and Battery Electric Vehicles (BEV). Sales of electric cars in Indonesia began in 2019, dominated by international brands such as Toyota, Mitsubishi, BMW, Hyundai, Lexus, Tesla, and Nissan. Several producers who have commercialized their products in Indonesia are described in Table 3.

Table 3. Types and Manufacturers of Electric Cars in Indonesia

Classification of Electric Cars	Type	Manufacturer
Hybrid Electric Vehicle (HEV)	Camry Hybrid	PT. Toyota Astra Motor
	Toyota C-HR	PT. Toyota Astra Motor
	Toyota Corolla Altis	PT. Toyota Astra Motor
	Toyota Corolla Cross	PT. Toyota Astra Motor
	Toyota Alphard Hybrid	PT. Toyota Astra Motor
	Lexus Es 300h	PT. Toyota Astra Motor
	Lexus Es 300h Ultra Luxury	PT. Toyota Astra Motor
	Nissan Kicks e-Power	PT. Nissan Motor Distributor Indonesia
Plug-in Hybrid Electric Vehicle (PHEV)	Toyota Prius	PT. Toyota Astra Motor
	Mitsubishi Outlander	PT. Mitsubishi Motors
	BMW i8 Roadster	PT. BMW Indonesia
	BMW i3	PT. BMW Indonesia
Battery Electric Vehicle (BEV)	Hyundai Ioniq EV	PT. Hyundai Motor Indonesia
	Hyundai Kona EV	PT. Hyundai Motor Indonesia
	BMW i3	PT. BMW Indonesia
	Lexus UX 300e	PT. Toyota Astra Motor
	Tesla	PT. Tesla Indonesia
	Nissan Leaf	PT. Nissan Motor Distributor Indonesia

Toyota has an electrification vehicle penetration strategy to support the government's electric car development program. Toyota has completed the line-up of electrified cars ranging from HEV, PHEV and BEV. Toyota will also assemble hybrid cars in Indonesia starting in 2022 through Toyota Motor Manufacturing Indonesia (TMMIN). Toyota will also build an electric car ecosystem with the EV Ecotourism concept collaborating with the Indonesia Tourism Development Corporation or ITDC in Nusa Dua, Bali (Antaranews[2], 2021). Hyundai has an innovative strategy for

electrified mobility in Indonesia. Hyundai will prepare charging infrastructure and build a factory in Indonesia. The factory has an investment value of around USD 1.55 billion until 2030. The optimal capacity of this factory will be to be able to produce 250,000 units annually to meet the needs of electric cars in Indonesia and Southeast Asia (Oto, 2021).

Nissan wants to build an electric car ecosystem in Indonesia through collaboration with the government, charging companies, and private parties, including electricity companies (Merdeka, 2021). Mitsubishi supports the government's program on electrification vehicles. They will invest about IDR 11.2 trillion in Indonesia for production capacity expansion, preparation for electrification, and export expansion (Otomotif Kompas, 2021). BMW's strategy in Indonesia is to release 12 new BEV models by 2023. If sales of electric cars in Indonesia increase, BMW will assemble their cars in Indonesia to eliminate import costs (Otomotif Tempo, 2021)

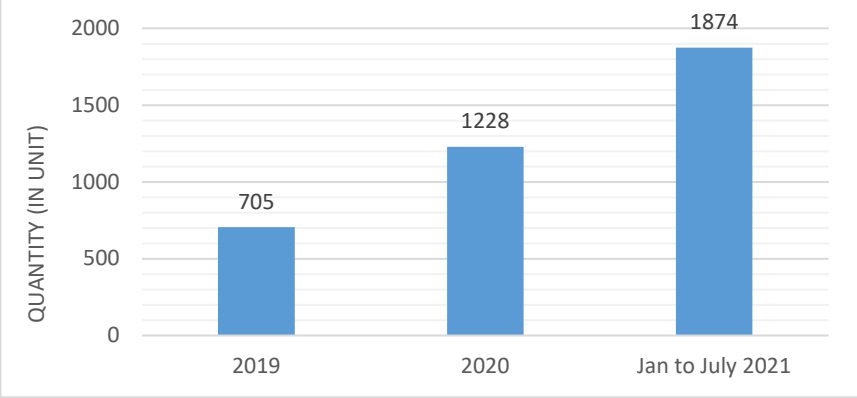

Figure 3. Sales of Electric Cars in Indonesia

Sales of electric cars in Indonesia have increased significantly every year. According to Gaikindo data, electric car sales in 2020 increased to 74.18%. The sales value also increased 52.61% in mid-2021. Data on electric car sales in Indonesia is shown in Figure 3. The sales value of electric cars in Indonesia is still shallow compared to conventional cars. The main barrier for consumers to switch from conventional to electric cars is the limited range of electric vehicles. Research and development aspects have a robust correlation with the company strategy in facing the era of electric vehicles within the future (Nurhadi et al. 2021). Individual automotive industries can conduct research to increase vehicle mileage and general charging costs giving electric car users the confidence to complete the journey and increase vehicle power when needed (Heidrich et al. 2017).

Conclusion

The government has issued many regulations for the development of national electric vehicles. The Government has also set a roadmap for developing the electric vehicle industry and its main components. The challenge for electric cars in Indonesia is lack of charging station infrastructure and standards related to electric cars. Besides, Indonesia also faces significant challenges in ensuring the power generation and energy management needed for electric car consumption. Electric cars have a short driving capacity and relatively short distances compared to conventional cars (Brady and O'Mahony, 2016). For this reason, a charging network is needed in many vehicle charging stations. The most significant challenge compared to producing affordable batteries is constructing a charging infrastructure on a national scale. Another challenge is the need for universal standards and regulations for the electric facility and electric car market (Ruiz et al. 2018). Each developed country has different standards related to electric cars, for example, the standard of electric energy utility for variations in steering patterns/driving cycles (Brady and O'Mahony, 2016), design standards for the battery management system (Hauser and Kuhn, 2015), electric charging standards integrated with electric vehicle regulations (Shaukat et al. 2018), spare parts (Habib et al. 2015), and as well as a standard platform for electrical infrastructure to protect consumers (Ahmad et al. 2018). For the government's program to encourage the use of electric cars in Indonesia to be achieved, a complete and integrated intelligent transportation management system is needed. All entities are aware of the efficient use of energy to create sustainable transportation. The integration of transportation management systems is not possible without the cooperation and collaboration of car manufacturers, scientists, power companies, governments, and standards organizations (Mehar et al. 2015).

Acknowledgement

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Biographies

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