Ecoment Global Journal

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

Development of Electric Vehicle Charging Infrastructure in Indonesia to Achieve the Target of Nationally Determined Contribution by 2030

Anshori, M.R.[1], Boedoyo, M.S[2], Saputro, G.E.[3]

[1]Defense Management, Faculty of Energy Security, Indonesian Defense University, Jakarta, Indonesia.

[2]Defense Management, Faculty of Energy Security, Indonesian Defense University, Jakarta, Indonesia.

[3]Defense Management, Faculty of Energy Security, Indonesian Defense University, Jakarta, Indonesia.

Correspondence

rizky.anshori@mp.idu.ac.id

Abstract

Objective: This Study aims to identify the current condition of the electric vehicle charging infrastructure in Indonesia and make predictions to achieve the 2030 Nationally Determined Contribution (NDC) target.
Design/Methods/Approach: The method used in this research is literature review, where the author conducts a study of literature in a number of journals and articles related to the research theme which is Development of Electric Vehicle Charging Infrastructure in Indonesia to Achieve the Target of Nationally Determined Contribution by 2030. There are several stages conducted in this research such as data collection, data analysis and drawing conclusions. These stages are carried out to determine the development of the existing conditions of Electric Vehicle Charging facilities in Indonesia to achieve the target of Nationally Determined Contribution by 2030.
Findings: Considering the target number of electric vehicles in 2030, which is 600 thousand electric cars and 2.45 million electric two-wheelers, and the charging time or battery exchange time for electric vehicles, it is estimated that Indonesia needs to build 76,562.5 Public Electric Vehicle Charging Stations (PEVCS) for electric two-wheelers and 18,750 Public Electric Vehicle Charging Stations (PEVCS) for electric cars to support the 2030 National Determined Contribution target. As for the battery exchange system for electric two-wheelers, 17,014 Public Electric Vehicles Battery Exchange Stations (PEVBES) are needed to support the 2030 National Determined Contribution target.
Originality/Value: This study builds upon previous research that discusses the condition of electric vehicle infrastructure in Indonesia, by adding predictions regarding the amount of infrastructure needed to meet the 2030 Nationally Determined Contribution (NDC) target.
Practical/Policy implication: The research findings have significant implications for management and business practices, as well as policy aspects. In developing Public Electric Vehicle Charging Station facilities, there are many things that stakeholders need to consider, such as; Expanding the coverage of Public Electric Vehicle Battery Exchange Station facilities in rural areas, Establishing battery standards for Electric Vehicles to become a specific type of battery for Electric Vehicles that use a battery exchange system, Create battery exchange facilities for 4-wheeled vehicles.

Keywords: PEVCS, PEVBES, 2030 NDC Target

JEL Classification: M, M Received in April, 18, 2024.; Received in revised form: Mei, 30, 2024; Accepted in Juni13, 2024

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

Introduction

Indonesia still relies on fossil energy sources such as crude oil, coal, and natural gas. These fossil fuels are predicted to continue dominating until 2050. This is evidenced by the influence of coal, crude oil, and natural gas usage, which still accounts for 69 percent, comprising coal at 25 percent, crude oil at 20 percent, and natural gas at 24 percent (Djoko Siswanto, 2022).

Fossil energy itself is a primary energy source that is non-renewable and will be depleted if continuously used. According to Government Regulation Number 79 of 2014, the high consumption of fossil energy is caused by subsidies, which make energy prices cheaper, leading to frequent wastefulness in energy use by the public. On the other hand, fossil energy can also cause air pollution, which impacts global warming, and dependence on fossil energy threatens Indonesia's energy security. One of Indonesia's commitments in responding to this issue is the signing of the Paris Agreement, which took place in New York City, United States, on April 22, 2016.

The Paris Agreement itself is a significant global step in addressing the issue of climate change worldwide. The agreement is supported by 195 countries, including Indonesia. Countries that have ratified the Paris Agreement are required to provide Nationally Determined Contributions (NDCs), which include targets for reducing greenhouse gas (GHG) emissions by 2030 (Ministry of Environment and Forestry, 2021). There are five sectors that play a role in reducing GHG emissions: energy, waste, industrial processes and production use (IPPU), agriculture, and forestry (Nunu Anugrah, 2021). Indonesia's NDC target for 2030 is to reduce greenhouse gas emissions by 29 percent with its own efforts and 41 percent with international support (Nunu Anugrah, 2021).

Specifically in the field of energy, one program implemented by the Indonesian government is the transformation of vehicle fuels from oil to electricity. This transformation has been applied to several types of transportation, including electric buses, trains, LRT (Light Rapid Transit), MRT (Mass Rapid Transit), cars, and two-wheeled vehicles (electric motorcycles). Indonesia targets 600,000 electric cars and 2.45 million electric two-wheeled vehicles by 2030 (Ikhsan Permana S.P & Febri Hendri Antoni Harif, 2023). To support this transformation, the government has issued a policy written in Government Regulation Number 55 of 2019 concerning the Acceleration of Battery Electric Vehicle Programs for Road Transportation. According to Minister of Industry Regulation Number 6 of 2022 Republic of Indonesia, the utilization of electric vehicles must adhere to specified requirements set by the government. These include specific functions such as the use of electric motor power (kW), utilization of battery capacity (kWh), and electric power replenishment (direct charging or battery exchange).

In Indonesia, the facilities for charging electric vehicles are divided into three categories: Public Electric Vehicle Charging Stations, Public Electric Charging Stations, and Public Electric Vehicle Battery Exchange Stations. Regarding this charging infrastructure, the Ministry of Energy and Mineral Resources issued Regulation Number 13 of 2020 concerning the Provision of Electric Charging Infrastructure for Battery-Powered Electric Vehicles.

The next step of this research will focus more on detailing the development of Electric Vehicle Charging infrastructure especially Public Electric Vehicle Charging Stations and Public Electric Vehicle Battery Exchange Stations to support Indonesia's achievement of its Nationally Determined Contribution (NDC) targets for 2030. This information is expected to assist Researchers that interested in studying the development of Electric Vehicle Charging Infrastructure in Indonesia and to provide recommendations to the government to achieve Indonesia's NDC targets for 2030.

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

Literature Review

Public Electric Vehicle Charging Stations

Referring to Minister of Energy and Mineral Resources Regulation Number 1 of 2023, it is explained that Public Electric Vehicle Charging Stations are facilities for charging electric motor vehicles based on batteries that are provided for the public. These installations are usually located in public places such as malls, PLN offices, government offices, gas stations, and other public places. There are also Private Electric Vehicle Charging Installations used for the owner's own purposes, which are typically installed in private homes.

Facilities that must be available at both public and private Electric Vehicle Charging Station installations include:

1. Having electrical power supply equipment or equipment that functions as a power source to supply electrical energy to battery-powered electric motor vehicles.
2. Having a current and voltage control system.
3. Having a facility protection and security system.

In addition, there are several types of electric power charging technologies available in Indonesia, such as:

1. Slow Charging technology, which is a recharging technology at Public Electric Vehicle Charging Stations with an output power of up to 7 (seven) kilowatts.
2. Medium Charging technology, which is a recharging technology at Public Electric Vehicle Charging Stations with an output power of more than 7 (seven) kilowatts up to 22 (twenty-two) kilowatts.
3. Fast Charging technology, which is a recharging technology at Public Electric Vehicle Charging Stations with an output power of more than 22 (twenty-two) kilowatts up to 50 (fifty) kilowatts.
4. Ultra-Fast Charging technology, which is a recharging technology at Public Electric Vehicle Charging Stations with an output power of more than 50 (fifty) kilowatts.

Electric current in electric vehicles is generally divided into two types: DC (Direct Current Motor) and AC (Alternating Current Motor). Therefore, in Public Electric Vehicle Charging Stations, there are usually three types of electric plugs available: Type 2 AC Charging, DC Charging CHAdeMo, and DC Charging Combo Type CCS2 (ESDM, 2020). With this setup, one Public Electric Vehicle Charging Stations can accommodate 1 to 3 vehicles simultaneously. Electric vehicles that typically use Public Electric Vehicle Charging Stations are those with Charging Onboard or Charging Offboard types. In the Onboard type, the battery is part of the electric vehicle itself and needs to be brought close to the power source for recharging. In contrast, the Charging Offboard type allows users to bring only the battery for recharging at Public Electric Vehicle Charging Stations or Public Electric Charging Stations, whether private or public (Omazaki Group, 2024). Public Electric Vehicle Charging Stations undergo development every year, as shown in the following table:

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

Table 1. Development of Public Electric Vehicle Charging Station Facilities

Reference	Number of Public Electric Vehicle Charging Station Facilities	Year
(Rida Mulyana, 2021)	93 Unit	2020
(Arifin Tasrif, 2022)	267 Unit	2021
(Darmawan Prasodjo, 2022)	570 Unit	2022
(Darmawan Prasodjo, 2024)	1081 Unit	2023

Source: Processed by the author (2024)

Public Electric Charging Stations

Public Electric Charging Stations are public electric charging facilities that serve multiple functions, unlike Public Electric Vehicle Charging Stations, which are specifically for electric motor vehicles. Public Electric Charging Stations can be used for various purposes, such as charging electric lamps for street vendors, outdoor activities, construction activities and electronic kitchen equipment (Akmal Alfarizi et al., 2022). On the other hand, Public Electric Charging Stations are created to minimize cases of electricity theft, which often occur and are typically carried out by street vendors to illuminate their stalls (Aswan, 2018). Public Electric Charging Stations themselves have an output power ranging from 5.5 kVA to 22 kVA (M Asaad Ikhsan, 2019).

Public Electric Vehicle Battery Exchange Station

Referring to Minister of Energy and Mineral Resources Regulation Number 1 of 2023, a Public Electric Vehicle Battery Exchange Station is a facility for exchanging batteries of electric motor vehicles, where the batteries will be automatically charged by the Charging Station. This allows electric vehicle users to simply exchange their depleted batteries with fully charged ones. The process takes only 3 to 5 minutes and each Public Electric Vehicle Battery Exchange Station typically provides 1 to 10 or more batteries.

In its development, the first Public Electric Vehicle Battery Exchange Station in Indonesia was launched on November 3, 2020, at three locations: PLN 3 UP3 Cikokol Tanggerang, provided by Grab Indonesia and Kymco; Alfamart Gandaria 3, Jl Jatayu, Kebayoran Baru South Jakarta, by Oyika; and the Directorate General of Electricity Kuningan Office, Ministry of Energy and Mineral Resources in South Jakarta, by Ezyfazt and Oyika.

The Public Electric Vehicle Battery Exchange Station is a system that is highly suitable for 2-wheeled electric vehicles. Not only is the battery exchange process fast, but we can also monitor the readiness of the batteries at the station using an application provided by the station's provider. In 2024, these stations can only be accessed for 2-wheeled electric vehicles, with hopes that in the following years, they will be applicable to 4-wheeled vehicles as well.

The owner of an electric vehicle must register their vehicle in an application provided by the government or related institutions for using the Public Electric Vehicle Battery Exchange Station facility. The battery exchange facility also continues to develop every year:

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

Table 2 Development of Public Electric Vehicle Battery Exchange Stations

Reference	Number of Public Electric Vehicle Battery Exchange Stations	Year
(Arifin Tasrif, 2022b)	266 Unit	2021
(Dadan kusdiana, 2023)	1415 Unit	2022
(Nadia, 2024).	1772 Unit	2023

Source: Processed by the author (2024)

Applications for Electric Vehicle Charging Stations in Indonesia

There are various types of applications that help electric vehicle users access electric vehicle charging facilities, whether it's Public Electric Vehicle Charging Stations, Public Electric Charging Stations, or Public Electric Vehicle Battery Exchange Stations. Here, the author will explain about applications that are commonly used in Indonesia, namely:

Table 4 Electric Vehicle Charging Station Infrastructure Usage Application

Paper	Application Electric Vehicle Charging	Ownership	Value
(Perdana et al., 2023)	SONIK App	Badan Riset Inovation Nasional	• Finding the nearest Electric Vehicle Charging Station. • Making and cancelling reservations for charging stations. • Starting and stopping electric vehicle charging through the application.
(Wendy Zulfikar et al., 2023)	Combination of application Wanwaytrack with GPS Tracker	Shanghai Wanway Tech Co.,ltd	• Tracking the location of electric vehicles through the application. • Being able to turn on or off electric vehicles remotely.
(Haq et al., 2022)	Pln mobile	PT PLN (Persero)	• Facilitating the addition of electrical power or installation of new electricity at home, anywhere and anytime. • Being able to self-record electricity meters. • Customers can easily report disruptions. • Providing information on the nearest Electric Vehicle Charging Station location.
(Aini Fika Nur et al., 2023)	Wiksawsap	Wiksa Daya Pratama	• Monitoring the battery status at Electric Vehicle Battery Exchange Station facilities. • Knowing the nearest Electric Vehicle Battery Exchange Station location.
(Dharmawan et al., 2021)	Charge.In	PLN (Persero)	• Knowing the nearest Electric Vehicle Battery Exchange Station location. • Knowing the real-time condition during electric charging. • Making electricity payments through LinkAja.
Voltron.id	Voltron Mobile Aplication	Voltron	• Knowing the nearest Electric Vehicle Battery Exchange Station location. • Knowing the real-time condition during electric charging.

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

		• Paying electricity bills with many payment options.
(Adiki et al., 2022)	PlugShare Xatori.Inc	• Knowing the nearest Electric Vehicle Battery Exchange Station location. • Providing reviews of visited Electric Vehicle Charging Station and viewing reviews from other users. • Sending messages to other users of the application.

Source: Processed by the author (2024)

Method

The method used in this research is literature review, where the author conducts a study of literature in a number of journals and articles related to the research theme, which is "Development of Electric Vehicle Charging Infrastructure in Indonesia to Achieve the Target of Nationally Determined Contribution by 2030". There are several stages conducted in this research such as data collection, data analysis and drawing conclusions. These stages are carried out to determine the development of the existing conditions of Electric Vehicle Charging facilities in Indonesia to achieve the target of Nationally Determined Contribution by 2030.

The data search engine used includes Google Scholar, ResearchGate, the official website of the Ministry of Energy and Mineral Resources, and other related websites. The first step the author will take is to discuss Public Electric Vehicle Charging Stations, Public Electric Charging Stations and Public Electric Vehicle Battery Exchange Stations. Next, the author will explain the applications commonly used for electric vehicles, provide conclusions and recommendations for the development of Electric Vehicle Charging infrastructure in Indonesia.

Result and Discussion

Public Electric Vehicle Charging Stations

Based on the Nationally Determined Contribution (NDC) target, where Indonesia is committed to producing 600 thousand electric cars and 2.45 million electric two-wheeled vehicles, and with the assumption that the average charging time for electric vehicles is 1.5 hours per vehicle, the capacity of 1 public electric vehicle charging station equipped with 4 vehicle dispensers, and the operating hours of the public electric vehicle charging station is 12 hours per day, then each Public Electric Vehicle Charging Station can accommodate up to 32 electric vehicles per day. With the assumption data used by the author, we can use the formula:

$$\text{PEVCS For } 4-\text{wheeled electric vehicle} = \frac{Target\ Nationally\ Detemined\ Contribution}{Capacity\ of\ Pevcs\ Facility}$$

$$\text{PEVCS for } 2-\text{wheeled electric vehicle} = \frac{Target\ Nationally\ Detemined\ Contribution}{Capacity\ of\ Pevcs\ Facility}$$

From the formula described above, we can input the data that has been discussed previously, namely:

$$\text{PEVCS For } 4-\text{wheeled electric vehicle} = \frac{600.000}{32} = 18.750$$

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

$$\text{PEVCS For } 2-\text{Wheeled Electric Vehicle} = \frac{2.450.000}{32} = 76.562{,}5$$

From the calculation above, the difference between the number of Public Electric Vehicle Charging Stations needed for 4-wheeled electric vehicles and 2-wheeled electric vehicles is 57,812.5. If we add them together so that the Public Electric Vehicle Charging Stations can accommodate both types of vehicles, then the required number of Public Electric Vehicle Charging Stations is 95,312.5 units.

Public Electric Vehicle Battery Exchange Station

Based on the Nationally Determined Contribution (NDC) target, where Indonesia is committed to producing 2.45 million electric two-wheeled vehicles, the author approaches this by assuming that the battery charging for 2-wheeled electric vehicles at Public Electric Vehicle Battery Exchange Stations takes 1 hour per battery, with a capacity of 12 Charging Boxes per station, and operating hours of 12 hours per day. Therefore, each Public Electric Vehicle Battery Exchange Station can charge up to 144 batteries in a day. However, to accommodate the capacity of the NDC target of 2.45 million, the calculation is as follows:

$$Charging\ Box = \frac{NDC\ Target}{Number\ of\ Charging\ Box\ Per\ Facility}$$

$$Charging\ Box = \frac{2450000}{12} = 204.167$$

From the calculation above, it is found that Indonesia needs 204,167 Charging Boxes to accommodate the target based on the Nationally Determined Contribution (NDC). The required facilities are as follows:

$$PEVBES = \frac{Number\ of\ Charging\ Boxes\ used\ to\ Accomodate\ NDC\ Target}{Number\ of\ Charging\ Box\ Per\ Facility}$$

$$PEVBES = \frac{204.167}{12} = 17.014$$

Therefore, to accommodate 2,450,000 electric two-wheeled vehicles, 17,014 Public Electric Vehicle Battery Exchange Stations are needed, each containing 12 Charging Boxes per station.

Conclusion and future direction

The issuance of Presidential Regulation Number 55 of 2019 on Acceleration of Battery Electric Vehicle (BEV) Program for Road Transportation has led to various developments such as the emergence of various types of electric charging stations such as Public Electric Charging Stations, Public Electric Vehicle Charging Stations and Public Electric Vehicle Battery Exchange Stations, which have been proven to increase from year to year. On the other hand, supporting factors such as regulations and technology have also developed, such as the availability of supporting applications that can facilitate the use of electric vehicle charging facilities and new regulations that support the creation of an ecosystem for the use of electric vehicles.

Considering the target number of electric vehicles in 2030, which is 600,000 electric cars and 2.45 million electric two-wheelers and the charging or battery swapping time for electric vehicles, the difference between the two can be calculated as follows:

Table 5 Comparison of the difference in the target development of electric vehicle charging facilities based on the Nationally Determined Contribution (NDC) targets

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

No	Types of Electric Vehicle Charging Facilities	The total number needed to achieve the Nationally Determined Contribution (NDC) target
1	Public Electric Vehicle Charging Stations for Electric Two-Wheelers	76.562,5 Unit
2	Public Electric Vehicle Charging Stations for Electric Four-Wheelers	18.750 Unit
3	Public Electric Vehicle Battery Exchange Stations for Electric Two-Wheelers	17.014 Unit
4	Difference between Public Electric Vehicle Charging Stations for Electric Two-Wheelers and Public Electric Vehicle Battery Exchange Stations for Electric Two-Wheelers	59.548,5 Unit

Source: Processed by the author (2024)

From the table above, it can be seen that the difference between Public Electric Vehicle Charging Stations for Electric Two-Wheelers and Public Electric Vehicle Battery Exchange Stations for Electric Two-Wheelers is 59,548.5 units. This proves that the battery exchange system at Public Electric Vehicle Battery Exchange Stations is suitable for implementation in Indonesia, especially for electric two-wheelers. This system is more practical compared to the charging system at Public Electric Vehicle Charging Stations. Specifically, Indonesia needs to build a total of 17,014 Public Electric Vehicle Battery Exchange Stations to accommodate 2,450,000 electric two-wheelers by 2030. However, if we compare it with the Public Electric Vehicle Charging Stations, the number of stations needed would be 76,562.5 units. On the other hand, for electric four-wheelers, 18,750 Public Electric Vehicle Charging Stations are needed to accommodate the NDC target of 600,000 units by 2030.

Implication

In using the Public Electric Vehicle Charging Station facilities, there are many things that stakeholders need to consider, such as:

1. Expanding the coverage of Public Electric Vehicle Battery Exchange Station facilities in rural areas.
2. Establishing battery standards for Electric Vehicles to become a specific type of battery for Electric Vehicles that use a battery exchange system.
3. Create battery exchange facilities for 4-wheeled vehicles.

References

Adiki, M., Affan Hameed, S., & Shariff, I. (2022). An Android Application for Electric Vehicle Utilities. In *International Journal of Creative Research Thoughts* (Vol. 10, Issue 6). www.ijcrt.org

Aini Fika Nur, Fabroyir Hadziq, & Hariadi Ridho Rahman. (2023). Desain dan Evaluasi Antarmuka dan Pengalaman Pengguna Aplikasi WiksaSwap untuk Stasiun Penukaran Baterai Kendaraan Listrik Umum. *JURNAL TEKNIK ITS*, *12 No 3*.

Akmal Alfarizi, M., Novita Sari, L., Ulya, H., Purwo Yudi Utomo, A., Pendidikan Bahasa dan Sastra Indonesia, P., Bahasa dan Seni, F., & Negeri Semarang, U. (2022). Analisis Tata Bahasa Fungsional dalam Teks Promosi Motion Graphic Stasiun Penyedia Listrik Umum (SPLU). In *Jurnal Implementasi* (Vol. 2, Issue 2). http://jurnalilmiah.org/journal/index.php/ji/index

Arifin Tasrif. (2022a, January 12). *Semakin Bertambah, 267 SPKLU dan 266 SPBKLU Telah Dibangun*. KEMENTRIAN ENERGI DAN SUMBER DAYA MINERAL. https://www.esdm.go.id/en/berita-unit/directorate-general-of-electricity/semakin-bertambah-267-spklu-dan-266-spbklu-telah-dibangun

Arifin Tasrif. (2022b, January 12). *Semakin Bertambah, 267 SPKLU dan 266 SPBKLU Telah Dibangun*. KEMENTRIAN ENERGI DAN SUMBER DAYA MINERAL. https://www.esdm.go.id/en/berita-unit/directorate-general-of-electricity/semakin-bertambah-267-spklu-dan-266-spbklu-telah-

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

dibangun#:~:text=Sebanyak%20267%20Stasiun%20Pengisian%20Kendaraan,SPBKLU)%20telah%20dibangun%20pada%202021.

Aswan, R. (2018). *KAJIAN STRATEGI VISUAL PADA MEDIA PROMOSI MOTION GRAPHIC STASIUN PENYEDIA LISTRIK UMUM (SPLU)*.

CNN Indonesia, & Djoko Siswanto. (2022, March 18). *DEN: RI Masih Bergantung pada Energi Fosil sampai 2050*. Www.Cnnindonesia.Com. https://www.cnnindonesia.com/ekonomi/20220318095705-532-772974/den-ri-masih-bergantung-pada-energi-fosil-sampai-2050

Dadan kusdiana. (2023, February 2). *ESDM Menargetkan Jumlah SPKLU Tembus 3.000 Unit pada 2023*. Kompas.Com. https://otomotif.kompas.com/read/2023/02/02/070200015/esdm-menargetkan-jumlah-spklu-tembus-3.000-unit-pada-2023

Darmawan Prasodjo. (2022, December 23). *Hingga Akhir 2022, 570 POM Listrik PLN Siap Melayani Masyarakat di Seluruh Indonesia*. Perusahaan Listrik Negara. https://web.pln.co.id/media/siaran-pers/2022/12/hingga-akhir-2022-570-pom-listrik-pln-siap-melayani-masyarakat-di-seluruh-indonesia#:~:text=Jakarta%2C%2023%20Desember%202022%20%E2%80%93%20Hingga,melayani%20masyarakat%20di%20seluruh%20Indonesia.

Darmawan Prasodjo. (2024, January 20). *Terus Tingkatkan Jumlah SPKLU Selama 2023, PLN Berhasil Penuhi Kebutuhan Pengguna Kendaraan Listrik di Indonesia*. Perusahaan Listrik Nasional. https://web.pln.co.id/media/siaran-pers/2024/01/terus-tingkatkan-jumlah-spklu-selama-2023-pln-berhasil-penuhi-kebutuhan-pengguna-kendaraan-listrik-di-indonesia#:~:text=Hingga%20akhir%20tahun%202023%2C%20telah,PLN%20maupun%20mitra%20dan%20swasta.

Dharmawan, I. P., S Kumara, I. N., Budiastra, I. N., Raya Kampus UNUD, J., & Bukit Jimbaran, K. (2021). *PERKEMBANGAN INFRASTRUKTUR PENGISIAN BATERAI KENDARAAN LISTRIK DI INDONESIA* (Vol. 8, Issue 3).

Haq, A. A., Tinggi, S., Komunikasi, I., & Samarinda, M. (1193). *Penggunaan Aplikasi Pln Mobile Sebagai Sarana Komunikasi Digital dalam Upaya Meningkatkan Kualitas Pelayanan Pelanggan*. *2*(7), 1192–1200. https://doi.org/10.36418/comserva.v2i07.447

Ikhsan Permana S.P, & Febri Hendri Antoni Harif. (2023, September 11). *Kemenperin Targetkan Produksi Mobil Listrik Tembus 600.000 Unit di 2030*. Inews. https://www.inews.id/finance/bisnis/kemenperin-targetkan-produksi-mobil-listrik-tembus-600000-unit-di-2030

M Asaad Ikhsan, A. K. D. D. P. (2019, November 9). *Apa Perbedaan SPLU dengan SPKLU buat Kendaraan Listrik? Artikel ini telah tayang di Kompas.com dengan judul "Apa Perbedaan SPLU dengan SPKLU buat Kendaraan Listrik?", Klik untuk baca: https://otomotif.kompas.com/read/2019/09/11/082200715/apa-perbedaan-splu-dengan-spklu-buat-kendaraan-listrik-. Kompascom+ baca berita tanpa iklan: https://kmp.im/plus6 Download aplikasi: https://kmp.im/app6*. Kompas.Com.

Nadia. (2024, January 18). *Total SPKLU di Indonesia Capai 932 Unit dan SPBKLU 1.772 Unit pada 2023* . Gatra.Com. https://www.gatra.com/news-590517-ekonomi-total-spklu-di-indonesia-capai-932-unit-dan-spbklu-1772-unit-pada-2023.html

Nunu Anugrah, R. (2021, March 19). *Perkembangan NDC dan Strategi Jangka Panjang Indonesia dalam Pengendalian Perubahan Iklim*. Kementrian Lingkungan Hidup Dan Kehutanan. https://ppid.menlhk.go.id/berita/siaran-pers/5870/%20perkembangan-ndc-dan-strategi-

Omazaki Group. (2024). *Electric Vehicle Charging Station (EVCS)*. Www.Omazaki.Co.Id. https://www.omazaki.co.id/stasiun-pengisian-mobil-listrik-evcs/

Volume 9 Nomor 1 Edisi April 2024 ISSN : 2540 – 816X

Perdana Rachmawan Atmaji, Hindratno M Nurkhoiri, Santoso Tanzi M, & et al. (2023). SONIKApp dari brin. *Jurnal Teknologi Informasi Dan Ilmu Komputer (JTIIK)*, *Vol. 10, No. 6*.

Rida Mulyana. (2021, January 13). *Capaian Kinerja Ketenagalistrikan 2020, Rasio Elektrifikasi Capai 99,20%*. KEMENTERIAN ENERGI DAN SUMBER DAYA MINERAL. https://www.esdm.go.id/id/media-center/arsip-berita/capaian-kinerja-ketenagalistrikan-2020-rasio-elektrifikasi-capai-9920

Wendy Zulfikar, M., Purwo, R., Raya Puspiptek, J., Tangerang Selatan, K., Banten, P., Kunci, K., Pengendalian Sistem Sepeda Listrik, E., Tracker, G., & Android, A. (n.d.). *Efektifitas Pengendalian Sistem Sepeda Listrik Menggunakan GPSTracker Berbasis Aplikasi Android (Effectiveness Analysis of Electric Bike Control System Using GPS Tracker Based on Android Application)*.