Charging Indonesia’s vehicle transition: Infrastructure needs for electric passenger cars in 2030

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Introduction

In Indonesia, air pollution is on the rise. Vehicle emissions substantially contribute to that pollution and to climate change. The ICCT’s analysis of passenger cars in the country showed that battery electric vehicles (BEVs), which have no tailpipe emissions and are more efficient than internal combustion engine (ICE) vehicles, could reduce life-cycle greenhouse gas (GHG) emissions by at least half compared to gasoline vehicles. Life-cycle emissions from BEVs would decrease even more with an increasing share of renewable energy in the electricity mix. Reducing carbon dioxide (CO₂) emissions from road transport through more rapid adoption of BEVs would help Indonesia meet its 2060 Net Zero Emission (NZE) target. Furthermore, electrification could help Indonesia reduce its dependence on fossil fuel imports, which have increased in recent years as the country struggled to increase its domestic fuel supply; reducing imports would enhance energy security and this is a key government priority.

Presidential Regulation (PR) No. 55/2019 provides a legal framework for electrifying the road transport sector in Indonesia. It aims to accelerate the adoption of electric vehicles (EVs), turn Indonesia into a base for BEV production and export, and build more charging infrastructure. In 2021, Indonesia introduced the National Grand Energy Strategy (GSEN) and it projected 2 million electric passenger cars on the roads by 2030. PR No. 55/2019 mandates that Perusahaan Listrik Negara (PLN), the state-owned electricity company, to build more charging infrastructure.

Acknowledgments: This work was generously supported by the ClimateWorks Foundation. Thanks to Marie Rajon Bernard, Jeanly Syahputri, and Arijit Sen for their review and help.
owned electricity company, plan for and deploy charging infrastructure across the country. It also allows the Ministry of Energy and Mineral Resources (MEMR) to regulate electricity tariffs and detail requirements for charging infrastructure.7

MEMR’s 2030 charging infrastructure roadmap, which is based on the GSEN, projects that 31,859 charging stations will be needed to support electric passenger cars.8 PLN projected 24,720 charging stations by 2030 in its charging infrastructure roadmap, based on a business-as-usual (BAU) scenario in which EV uptake follows current market trends without government policy interventions or targets.9 However, the methodologies MEMR and PLN used to make their respective projections are unclear. Moreover, neither roadmap provided detailed information on charger locations, types, or capacities.

**Background and objective**

From 2013 to 2018, sales of electric passenger cars, including BEVs and plug-in hybrid electric vehicles (PHEVs), were below 50 units annually in Indonesia.10 In 2021, only 1,321 electric passenger cars were sold. In 2022, however, 10,559 BEVs and 79 PHEVs were sold, bringing the EV share to 1% of total passenger car sales in 2022.11 By the end of 2022, the total stock of electric passenger cars (BEVs and PHEVs) on the road in Indonesia was 11,959.12

Charging stations are critical to EV deployment. These differ from gasoline fueling infrastructure because they can be found in a variety of locations and come with different charging capacities.13 Charging infrastructure also requires different upfront investment, comes with different maintenance costs, and different entities are responsible for installation.

This study analyzes Indonesia’s unique charging infrastructure needs by exploring two categories of charging stations, private and public. Private chargers are home chargers in single and multi-family dwellings and depot chargers that serve EV fleets (e.g., ride-hailing service vehicles) in centralized locations.14 Investment costs for private chargers are borne by individuals or companies (e.g., Bluebird, the national taxi service provider, and Grab Indonesia, a ride-hailing service). Public chargers are mostly accessible to the general public, but potentially come with some access restrictions; for example, restaurants or other businesses might restrict the use of their public chargers to customers.15 In this study, public destinations include, but are not limited to, shopping malls, restaurants, hotels, coffee shops, gas stations, office buildings,16 and airports; there are also public en-route locations, including along toll roads and national roads. In some cases, such as en-route charging, investment costs for public chargers

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10 PR No. 55/2019 refers to a broad range of road transport modes as BEVs. However, in this study, BEVs are only battery electric passenger cars.
12 Ibid.
14 EV Fleets, “Depot Charging. Phase 1: Planning,” accessed December 12, 2023, https://evfleets.electricautonomy.ca/topics/depot-charging/#:~:text=This%20is%20called%20Depot%20charging%20or%20when%20your%20employees%20arrive.
15 Ibid.
16 This study, unlike previous ICCT studies, considers workplaces public. In Indonesia, while located in private buildings, workplace chargers are accessible to the public.
are borne by government; in other cases, private companies that sell the electricity for EVs bear the investment costs. In the latter case, companies may need to collaborate with retailers or workplaces.

By the end of 2022, there were 1,114 public and private chargers across Indonesia and 80% of those were in three provinces: Bali, Jawa Barat, and DKI Jakarta. There are two primary charger types in Indonesia, Level 2 (also known as Type 2) and direct current fast charging (DCFC). Level 2 chargers are high-rate alternating current (AC) chargers that can fully charge a BEV in under 10 hours. DCFC chargers are rapid chargers that can fully charge a BEV in 20–60 minutes.

In Indonesia, around 48% of chargers are Level 2 and they have power output capacities ranging from 7 kW–22 kW (the higher the power output, the faster the charging). The other 52% are DCFC chargers with capacities from 25 kW–150 kW. From 2026-2030, the national government plans to focus only on deploying ultra-fast DC chargers with capacity above 100 kW and charging time under 30 minutes.

Researchers in the United States assessed how charging infrastructure could best be deployed based on a survey of electric car users that considered both how those cars were used and charger costs, and Figure 1 is an illustration of the results. EV charging is easiest when vehicles sit in place for a long period; the survey showed electric passenger cars are parked most at residences. Thus, home chargers are most critical for charging infrastructure.

![Figure 1. EV charging infrastructure categories ranked from least (top) to most important. Source: Adapted from Transportation Research Board and National Research Council, 2015.](image-url)
The housing situation in Indonesia supports the deployment of home chargers because 99% of Indonesian housing is single-family houses rather than apartment complexes.\(^{23}\) Even in metropolitan areas like Jakarta, single-family houses comprise about 95% of housing. It is easier to charge vehicles in single-family homes rather than apartments, because it is easier to install and access wall chargers (in garages, for example).

In its roadmap, MEMR assumed 80% of electric passenger car owners charge their vehicles at home. PLN also assumed 80% of electric passenger car owners charge at home overnight and that vehicle batteries are full before work commutes.\(^ {24}\)

To support home charging, PLN offers incentives such as special prices for electricity system upgrade costs and discount tariffs for overnight charging. PLN’s discount tariff is 30% off the normal electricity tariff when EV owners charge vehicles overnight between 10 pm and 5 am.\(^ {25}\) Electricity system upgrades might be needed for EV owners who want to install home chargers because they require more power output than is typically provided in their homes. PLN lowered the price for adding new electricity capacity for EV owners by 75–90%.\(^ {26}\) Alternatively, EV owners could secure a new electricity connection for home chargers that is separate from the rest of their household electricity.

It is not surprising that workplaces were found to be second in importance for charger installation, as vehicles sit in those locations for extended periods. Workplaces could also be attractive charging locations for people without access to home charging. Interprovince DCFC charging locations (e.g., along highways) were least important even though they facilitate regional travel.

This study estimates the number and type of chargers that will be needed for electric passenger cars in Indonesia in 2030 by using country-specific data to analyze four questions:

1. How many chargers will be needed, assuming 2 million electric passenger cars in Indonesia in 2030?
2. In which kinds of locations will public chargers be needed?
3. Which charger types and capacities are best suited for public chargers in Indonesia?
4. How much investment in public chargers will be needed by 2030 to support 2 million electric passenger cars?

This study could help improve charging infrastructure planning and thereby support the government’s 2030 electrification target. Our results could also complement the 2030 roadmaps from MEMR and PLN, particularly regarding needed charger types, capacities, and locations. Moreover, since ultra-fast chargers cost more than Level 1 and Level 2 chargers, this study could also help planners and policymakers in Indonesia minimize costs.


\(^{26}\) Perusahaan Listrik Negara (PLN), “Nge-Charge Mobil Listrik di Rumah Lebih Hemat, ada Promo Sambung Listrik dari PLN [Charging Electric Car at Home is Cheaper, There is a Promotion to Connect Electricity from PLN],” (January 2023), https://web.pln.co.id/media/siaran-pers/2023/01/nge-charge-mobil-listrik-di-rumah-lebih-hemat-ada-promo-sambung-listrik-dari-pln.”
Methodology

This study uses the International Council on Clean Transportation’s (ICCT) EV CHARGE model. The model has two primary categories—private and public chargers—and employs two methodologies, an energy-based approach and a minimum-coverage approach. The energy-based approach calculates the number of chargers by the annual energy delivery needed to support a certain number of EVs, while the minimum-coverage approach is based on factors such as distance between stations, the number of vehicles, or the population.

We incorporated Indonesia-specific data into the EV CHARGE model where available and used the model’s default global data for the rest. We also used Indonesia-specific key assumptions. For example, we categorized workplace chargers as public chargers and did not include public overnight chargers. This is because in Indonesia, single-family homes are dominant and street parking is rare.

We also assumed Indonesians use portable chargers for home charging because free portable chargers are provided by car manufacturers to electric passenger car buyers at purchase. A portable charger consists of a simple cable connected to an electricity converter; while easy to travel with, it has a power output below 3 kW. This study assumed portable chargers in Indonesia have a 2.2 kW capacity, given 71% of Indonesians travel around 60 km/day and could meet that daily energy demand with a 2.2 kW capacity. Another type of home charger is a wall charger, usually an AC Level 2 charger with a 7 kW capacity installed in a home’s garage. Based on PLN data, around 20% of EV owners use wall chargers.

Table 1 shows additional Indonesia-specific data inputs and key assumptions that we applied to the EV CHARGE model and there are more details of data sources in the Appendix.


Charger age was calculated based on its installation year

EV stock projection
EV stock in 2022 was used as a baseline and we project EV growth based on ICE percentage (%) share until government targets are met (400,000 units in 2025, 2,000,000 units in 2030).

EV stock per province (EV distribution)
For 2022–2025, we assumed the percentage share of BEVs out of the national total in each province matches the share of chargers in each province out of the national total. For 2025–2030, we assumed the share of EVs in each province matches the share of conventional cars currently in each province.

Home charging access share
In our baseline, assumed 80% of EV owners have home chargers; for a sensitivity analysis, assumed 60%, 70%, and 75%

Depot charging access
The share of EVs with access to depot charging was calculated by using the ratio of total chargers to total vehicles at the depot, as found in available sources.

Charger capacity
A charger’s power output. Level 2 chargers are 7 kW, 11 kW, or 22 kW; DCFC chargers are 25 kW, 50 kW, or 150 kW. We assume only these six capacities even though there are more, for example, Level 2 43 kW and DCFC 200 kW. The DCFC 150 kW falls under the ultra-fast charger category.

Charger investment cost
Capital or upfront costs, including hardware and installation costs.

Methodology to calculate the total number of chargers
The energy-based approach was used to calculate the total chargers in workplaces and public destinations; road length was used to calculate the total chargers in public en-route; and the number of EVs was used to calculate the total chargers for homes and depots.

Vehicle kilometers traveled
The average yearly mileage per vehicle in Indonesia. The private passenger car average is 13,650 km/ year, taxis average 140,000 km/year, and ride-hailing vehicles average 70,000 km/year.
This study uses different approach than previous ICCT studies, which generally based EV stock projections on BAU scenarios. This study calculates the total chargers that would be needed in 2030 if the Indonesian government’s EV targets of 400,000 units by 2025 and 2 million units by 2030 are met.

**Results and discussion**

Figure 2 shows the projection of Indonesia’s EV stock in 2030 in each province, based on a trajectory that meets the government’s 2030 EV targets. The five provinces with the highest EV concentrations are DKI Jakarta, Jawa Barat, Jawa Timur, Jawa Tengah, and Bali.

Additionally, we estimate the country will need 25,600 public chargers by 2030 to support the 2 million EVs (see Table 2). This falls between the MEMR (31,859 units) and PLN (24,720 units) roadmap estimates. Public destinations will account for around 72% of total public chargers. For public en-route locations, 7,100 units of chargers will cover all national roads, including toll roads. Provincial and local roads are covered by public destination chargers in this analysis. The total chargers needed at workplaces are estimated to be approximately 2,000 units due to the small share of passenger cars used for commutes (commuters predominately use public transport or two-wheelers).³³

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Results show that Indonesia would need 1,585,300 private chargers, with a small number of these located at a depot. Recall that we assumed home chargers are mainly portable rather than wall chargers. Depot chargers are mainly installed by Bluebird and Grab Indonesia.

<table>
<thead>
<tr>
<th>Category</th>
<th>Charger location</th>
<th>Number of chargers (units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Private</td>
<td>Home</td>
<td>1,581,700</td>
</tr>
<tr>
<td></td>
<td>Depot</td>
<td>3,600</td>
</tr>
<tr>
<td></td>
<td>Total private chargers</td>
<td>1,585,300</td>
</tr>
<tr>
<td>Public</td>
<td>Public destination</td>
<td>16,500</td>
</tr>
<tr>
<td></td>
<td>Public en-route</td>
<td>7,100</td>
</tr>
<tr>
<td></td>
<td>Workplace</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>Total public chargers</td>
<td>25,600</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1,610,900</td>
</tr>
</tbody>
</table>

When considering public and depot chargers combined, 29,200 are estimated to be needed by 2030, and Figure 3 shows these chargers by charger type (Level 2 and DCFC) in each province. As was the case for EV stock, five provinces—DKI Jakarta, Jawa Barat, Jawa Timur, Jawa Tengah, and Bali—will have the most (58%) public and depot chargers.

![Figure 3. Estimated need for public and depot chargers by 2030 per province (units) and by charger type.](image-url)
As Figure 3 shows, the shares of Level 2 and DCFC chargers are similar. This result suggests a different potential focus than the government’s plan, which at present only supports DCFC charging infrastructure after 2025. Based on our modeling results, more than 50% of chargers needed in 2030 will be Level 2, and these will be located in all locations. Figure 4 illustrates charger locations and capacities. Public en-route charging needs are served mainly by DCFC and there is only a small fraction of Level 2 (this is too small to be visible in Figure 4).

Though some may believe that charging an EV should be as fast as filling a tank of gas at a petrol station, our study found that a private charging station company installed several Level 2 chargers at a shopping mall. Visitors typically spend 1–3 hours at such a mall and this duration is well-suited to Level 2 charging, especially if EVs spent some time charging at home earlier.

Figure 4 shows that 7 kW and 22 kW capacity Level 2 chargers are needed most. DCFC chargers with 25 kW and 50 kW capacities account for 41% of total chargers needed and there is only a small share of the highest capacity 150 kW DCFC chargers; this suggests that Indonesia need not install many ultra-fast public chargers and that Level 2 and lower capacity DCFC chargers can meet the expected demand. The investment cost of a Level 2 charger is three to five times lower than the cost of a DCFC charger: a 22 kW Level 2 charger costs US$13,000 upfront, while a 150 kW DCFC charger costs US$70,000. There would be less government spending if fewer high-capacity DCFC chargers are purchased.

We estimate that the total investment cost for 25,600 charger units in public destinations, public en-route locations, and workplaces would be US$597 million (IDR 8.86 trillion), and this could be covered by a combination of public and private spending. The cost projection is based on PLN’s upfront cost for investing in different types and capacities of charging infrastructure (see Appendix for details). Figure 4 shows the projected investment cost for public chargers by province. DKI Jakarta and Jawa Barat would need to invest the most, around IDR 1.30 trillion each. However, 85%

34 Personal communication with Rexy Gunawan, Shell Indonesia, January 29, 2023.
of provinces, including Bali, which had many chargers already installed in 2022, would need less than IDR 300 billion.

Figure 5. Estimated cost to support public charging infrastructure per province in 2030.

PLN indicated that only a small portion of the state budget is allocated to support charging infrastructure.35 Further, PLN will prioritize the deployment of public en-route chargers to help address range anxiety, one of the biggest challenges in achieving electrification goals in Indonesia and other countries.36 Other countries, meanwhile, have dedicated substantial funding to public charging infrastructure. For example, in the United States, the federal National Electric Vehicle Infrastructure (NEVI) program is to provide US$5 billion in grant funding over 5 years to support the creation of a coast-to-coast network of EV chargers focused on major highways to support long-distance trips.37

35 Personal communication with PLN representatives Kevin Gausultan (PUSLITBANG) and Nugroho Adi (Divisi BKI), May 23, 2023.
In a potential scenario of limited government funding, it will be critical for private investors to support public charging infrastructure in Indonesia. The government could complement its own investment with fiscal and non-fiscal incentives designed to attract and private investment. In 2023, MEMR issued Ministerial Decree No. 182.K/TL.04/MEM.S/2023, which regulates electricity tariffs for fast and ultra-fast charging. The tariffs give a profit guarantee, which could help ensure investment in charging infrastructure. The government also eased the charger-permitting process through MEMR Regulation No 5/2021.

However, the Ministry of Finance shared that there are few tax incentives for charging infrastructure compared with EV purchase incentives. Meanwhile, neighboring Thailand has expanded incentives for EVs, and these include support for charging infrastructure. Thailand has a 5-year corporate income tax exemption and on the top of it, an extra 3 years of tax benefits for businesses that intend to invest in charging stations and meet certain requirements.

**Sensitivity analysis**

Though stakeholders in Indonesia indicated in private communications that 80% home charging access share is likely to be met, this section nonetheless explores the impact of a lower home charging access share on the number of public chargers needed and on total government investment costs. This sensitivity analysis addresses scenarios with home charging access shares of 60%, 70%, and 75%. Figure 5 shows the total number of public and depot chargers by location for each scenario alongside the 80% share scenario.

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Results in Figure 6 show that as home charging access increases, the need for public chargers in 2030 decreases. This helps clarify that Indonesia does not need the same number of charging stations as there are gas stations currently. The total chargers needed, excluding home chargers, is about 33% higher under the 60% home charger access share scenario than under the 80% scenario. The total depot and public en-route chargers needed are the same for all scenarios, because those results are calculated using the total number of vehicles (for depot) and the length of road (public en-route). The total chargers needed for public destinations and workplaces is based on total energy demand, which relates to the amount of energy that is being delivered to homes.

Figure 7 provides the total investment cost for public charging infrastructure under all scenarios. If home charging access is below 80%, the total investment cost for public chargers would be above IDR 9 trillion. Public charging investment for the 60% scenario would cost IDR 3 trillion more than the 80% scenario, a difference of 34%. This highlights the importance of promoting home charging in Indonesia.

Based on communications with stakeholders, we assumed portable chargers are used as home chargers; EV owners, therefore, would not need to pay additional costs to buy wall chargers. The only investment cost is the installation fee and any necessary upgrades of home electricity capacity. However, many EV dealerships, including Hyundai, DFSK, Kia, and Toyota dealerships, also offer bundle packages at additional cost where EV buyers can purchase wall chargers, service to install them, and upgrades to their electricity service in collaboration with PLN.41

In private communications, PLN representatives also noted that few Indonesians are aware of the benefits offered by PLN for home charging or how much money they could save on charging by taking advantage of the discounted tariff and electricity upgrade program. The government, PLN, car manufacturers, and home charger companies could work together to better promote the adoption of home chargers.

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DKI Jakarta results

DKI Jakarta is estimated to have the highest number of EVs among Indonesian provinces. At the end of 2022, there were 186 chargers located in public destinations, workplaces, and depots across DKI Jakarta.⁴² Based on the chargers installed, we assumed there are 2,240 EVs on the road at present. As seen in Figure 2, by 2030, we project 448,680 EVs (22% of the national total) will be in DKI Jakarta.

Here we calculate the total charging infrastructure needed in DKI Jakarta by 2030 using a 3% commuter share specific for the province, to compare it with the 10% share we assumed nationwide. Figure 8 shows the total charging infrastructure needed by 2030 when applying the baseline assumption that 80% of EV owners have home chargers and charge at home. Results show that as commuter share increases, the need for public charger infrastructure for 2030 decreases. Under the 3% commuter share scenario, 6,700 charger units will be needed in public destinations, public en-route locations, and workplaces by 2030. Meanwhile, under the 10% scenario, 5,900 units will be needed (a 12% decrease).

Figure 8 shows that approximately 1,800 depot chargers will be needed for taxis and ride-hailing services by 2030; this number does not change under the 3% and 10% commuter share scenarios because commuter share only affects chargers in workplaces and public destinations. By 2030, DKI Jakarta will have around 50% of all depot chargers in Indonesia due to the high adoption of EVs for taxis and ride-hailing services compared to other provinces.⁴³ Assuming 80% home charging access, DKI Jakarta will need only 9 public en-route charger units by 2030; this is because national road length in Jakarta is shorter than in other provinces. Finally, under the 10% commuter share scenario, DKI Jakarta will have around 400 workplace chargers—21% of total chargers nationally—by 2030.

![Figure 8. Total chargers needed by 2030 in DKI Jakarta under the 3% and 10% commuter share scenarios.](https://www.icct.org/file/8066131611/fig8.png)

⁴² See the Methodology section for sources of charging station distributions per province.
Figure 9 shows the total investment from either government or private funding needed in DKI Jakarta for public chargers under the 3% and 10% commuter share scenarios. At 3% commuter share, the total investment cost is estimated to be IDR 1.4 trillion. At 10%, the total investment cost is estimated at IDR 1.3 trillion.

![Diagram showing total investment cost in DKI Jakarta for public chargers under 3% and 10% commuter share scenarios.]

The Ministry of Transport asked the DKI Jakarta government to install more public chargers. The DKI Jakarta government plans to add a requirement for new building in Jakarta need to have charging station installed. Further, the DKI Jakarta government also open to collaborate with private sector to build public charging infrastructure to help minimize public spending.

**Conclusion**

This study used the ICCT’s EV CHARGE model to estimate the number of chargers that would be needed to meet the Indonesian government’s target of 2 million units of electric passenger cars by 2030. With an 80% home charging access share, results show that Indonesia would need to install 25,600 charging units in public destinations, public en-route locations, and workplaces by 2030. Including depot chargers needed for taxi and ride-hailing services brings the total chargers needed to 29,200 units. While MEMR and PLN public charger assume to be public, our results are similar to their assessments for 2030. Our modeling provides more detail than the roadmaps from MEMR and PLN, as we show where public and private chargers would be best located and the types and capacities of chargers needed. Specifically, we found that Level 2 chargers will be needed just as much as DCFC chargers in 2030. Moreover, few of the highest-cost ultra-fast DCFC chargers will be needed, contrary to existing charging infrastructure deployment plans for 2025 and beyond.

The share of private chargers, specifically home chargers, directly affects the need for public charging infrastructure. The commitments to home charging that the government, EV manufacturers, PLN, and the charging industry have shown are


45 Ibid.
important for encouraging home charging adoption, which lowers the investment costs necessary for public infrastructure. In particular, portable chargers are cost-effective and feasible in Indonesia, as most EV owners live in single-family homes and can meet most, if not all, of their vehicle energy demands through this charging. With 80% home charging access, public charging infrastructure investment cost will be around IDR 9 trillion; at 60% access, this would increase to IDR 12 trillion. With a high share of EV owners charging at home, public charging stations will not be needed on a large scale.

Private investment will be critical to help limit the total cost for public charging investment that is borne by the government. Currently, a small amount of the state budget goes to public charger infrastructure. To minimize spending, the government could issue charging-related regulations and offer tax incentives to attract private investment.
## Appendix. Details of Indonesia-specific data sources used in the EV CHARGE model.

<table>
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<th>Input</th>
<th>Sources</th>
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<td></td>
<td>• Information presented by Hyundai Motors Indonesia during a June 24, 2021, webinar entitled “Prospek dan Tantangan Industri Baterai Nasional [Prospects and Challenges of the National Battery Industry],” hosted by Universitas Indonesia (see <a href="https://kerjasama.ui.ac.id/webinar-prospek-dan-tantangan-industri-baterai-nasional/">https://kerjasama.ui.ac.id/webinar-prospek-dan-tantangan-industri-baterai-nasional/</a>).</td>
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<tr>
<td><strong>Charger age distribution and Charger capacity</strong></td>
<td>• Shell Indonesia, “Shell Recharge,” accessed July 6, 2023, <a href="https://www.shell.co.id/in_id/pengendara-bermotor/shell-recharge.html">https://www.shell.co.id/in_id/pengendara-bermotor/shell-recharge.html</a>.</td>
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<td></td>
<td>• PlugShare, “Indonesia,” accessed July 6, 2023, <a href="https://www.plugshare.com/">https://www.plugshare.com/</a>.</td>
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