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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.[1] 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.[2] Life-cycle emissions from BEVs would decrease even more with an increasing share of renewable energy in the electricity mix. Reducing carbon dioxide (CO_2) emissions from road transport through more rapid adoption of BEVs would help Indonesia meet its 2060 Net Zero Emission (NZE) target.[3] 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.[4]

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.[5] In 2021, Indonesia introduced the National Grand Energy Strategy (GSEN) and it projected 2 million electric passenger cars on the roads by 2030.[6] PR No. 55/2019 mandates that Perusahaan Listrik Negara (PLN), the state-

1 Zhenying Shao, Josh Miller, and Lingzhi Jin, *Soot-Free Road Transport in Indonesia: A Cost-Benefit Analysis and Implications for Fuel Policy*, (Washington, DC: ICCT, 2020), https://theicct.org/sites/default/files/publications/Indonesia-sootfree-CBA-02182020.pdf.

2 Zamir Mera and Georg Bieker, *Comparison of the Life-Cycle Greenhouse Gas Emissions of Combustion Engine and Electric Passenger Cars and Two-Wheelers in Indonesia*, (Washington, DC: ICCT, 2023), https://theicct.org/publication/comparison-life-cycle-ghg-emissions-combustion-engine-and-electric-pv-and-2w-indonesia-sept23/.

3 Ibid.

4 Yihao Xie and Marietta Harjono, *A Review of Motor Vehicle Fuel Demand and Supply in Indonesia*, (Washington, DC: ICCT, 2020), https://theicct.org/wp-content/uploads/2021/06/Indonesia-fuel-supply-demand-sept2020.pdf.

5 Baker McKenzie, "Charging Up Indonesia's Regime on Battery Electric Vehicles," (September 2019), https://insightplus.bakermckenzie.com/bm/attachment_dw.action?attkey=FRbANEucS95NMLRN47z%2BeeOgEFCt8EGQJsWJiCH2WAWHb%2FPDBPVvgk%2BCMu6Ekwvf&nav=FRbANEucS95NMLRN47z%2BeeOgEFCt8EGQbuwypnpZjc4%3D&attdocparam=pB7HEsg%2FZ312Bk8OluOIH1c%2BY4beLEAe9qYSaOn3zks%3D&fromContentView=1.

6 Ministry of Energy and Mineral Resources, Republic of Indonesia, "Tren Kendaraan Listrik ke Depan, Telah Disiapkan Sejak Dini [In the Future Trend of Electric Vehicles, Need to Get Prepared Early]," (December 2021), https://www.esdm.go.id/id/media-center/arsip-berita/tren-kendaraan-listrik-ke-depan-telah-disiapkan-sejak-dini.

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THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

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

7 Ministry of Energy and Mineral Resources, Republic of Indonesia, "Peraturan Menteri ESDM No.1/2023 [MEMR Regulation No.1/2023]," (2023), https://jdih.esdm.go.id/storage/document/Permen%20ESDM%20Nomor%201%20Tahun%202023.pdf.

8 Ministry of Energy and Mineral Resources, Republic of Indonesia, "Percepatan Pembangunan Infrastruktur SPKLU, Pemerintah Bakal Beri Insentif dan Kemudahan Perizinan [Accelerating Charging Infrastructure Development, Government Will Provide Incentives and Facilitate Licensing]," (September 2021), https://www.esdm.go.id/id/berita-unit/direktorat-jenderal-ketenagalistrikan/percepat-pembangunan-infrastruktur-spklu-pemerintah-berikan-insentif-dan-kemudahan-perizinan.

9 Ministry of Energy and Mineral Resources, Republic of Indonesia, "Indonesian Govt Supports EV Charging Application," (February 2021), https://www.esdm.go.id/en/media-center/news-archives/indonesian-govt-supports-ev-charging-application.

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.

11 EV-Volumes.com, "EV Data Center," accessed March 8, 2023, https://www.ev-volumes.com/datacenter/.

12 Ibid.

13 Transportation Research Board and National Research Council, *Overcoming Barriers to Deployment of Plug-in Electric Vehicles*, (Washington, DC: The National Academies Press, 2015), https://doi.org/10.17226/21725.

14 EV Fleets, "Depot Charging. Phase 1: Planning," accessed December 12, 2023, https://evfleets.electricautonomy.ca/topics/depot-charging/#:~:text=This%20is%20called%20depot%20or,go%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.[17] 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.[18] DCFC chargers are rapid chargers that can fully charge a BEV in 20–60 minutes.[19] 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).[20] 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.[21]

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.[22] 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.

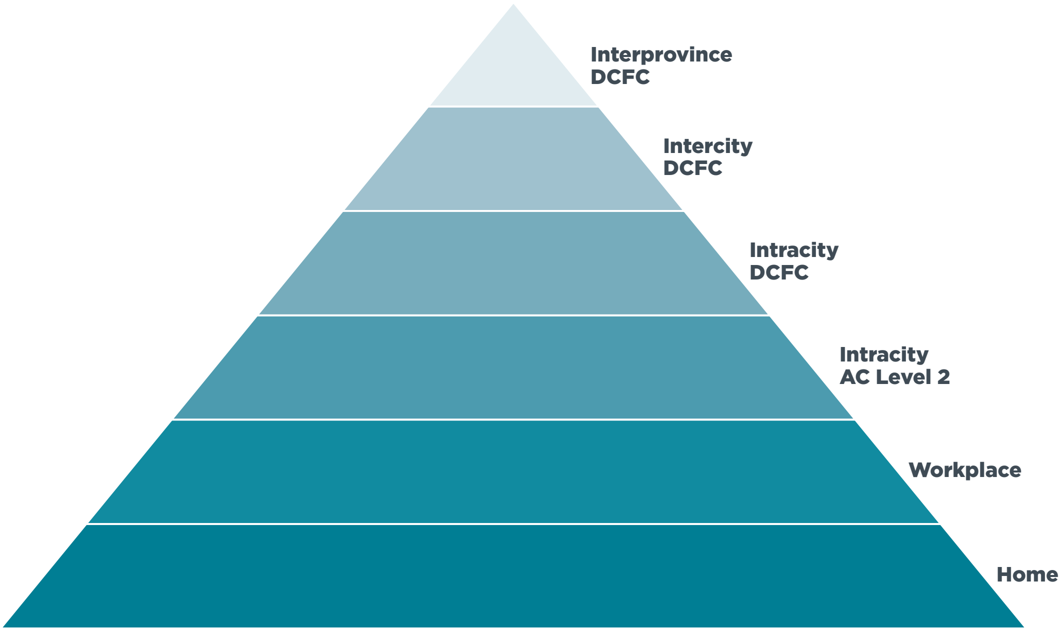

Figure 1. EV charging infrastructure categories ranked from least (top) to most important.
Source: Adapted from Transportation Research Board and National Research Council, 2015.

17 For sources, see Appendix for details.

18 U.S. Department of Transportation, "Charger Types and Speeds," accessed December 12, 2023, https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds#:~:text=Direct%20current%20fast%20charging%20(DCFC)%20equipment%20offers%20rapid%20charging%20along,not%20work%20with%20fast%20chargers.

19 Ibid.

20 EVESCO, "The Comprehensive Guide to Level 2 EV Charging," accessed December 12, 2023, https://www.power-sonic.com/blog/guide-to-level-2-ev-charging/.

21 Ministry of Finance, Republic of Indonesia, 2022, Dukungan Pemerintah Untuk Pengembangan Industry KBLBB [Government Supports for Battery Electric Vehicles Industry Development], presentation slides; Raka Lestari, "Kendaraan Listrik Makin Marak, Berapa Jumlah SPKLU di Indonesia? [Electric Vehicles are Becoming More Common, How Many Charging Stations in Indonesia?]" *SEVA*, May 19, 2023, https://www.seva.id/blog/kendaraan-listrik-makin-marak-berapa-jumlah-spklu-di-indonesia-052023-bu/.

22 Transportation Research Board and National Research Council, 2015.

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.

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23 Badan Pusat Statistik, *Statistik Perumahan Indonesia (Hasil Sensus Penduduk 2010) [Indonesian Housing Statistics (Population Census Results)*, (Jakarta, Indonesia: 2011), https://www.bps.go.id/publication/2011/03/14/15f934e423d963c57dd91fdf/statistik-perumahan-indonesia-hasil-sensus-penduduk-2010-.html.

24 Suci Sedya Utami, "PLN Ramal 80% Pemilik Kendaraan Listrik Bakal Ngecas di Rumah [PLN Predicts 80% of Electric Vehicle Owners Will Charge at Home]," *Medcom.id*, February 2, 2021, https://www.medcom.id/ekonomi/bisnis/lKYw9Qob-pln-ramal-80-pemilik-kendaraan-listrik-bakal-ngecas-di-rumah.

25 Faustina Prima Martha, "Mau Ngecas Mobil Listrik di Rumah? PLN Bikin Promo Home Charging [Want to Charge Your Electric Car at Home? PLN Gives Discount on Home Charging]," *Otomitif*, March 22, 2022, https://otomotif.bisnis.com/read/20220322/46/1513620/mau-ngecas-mobil-listrik-di-rumah-pln-bikin-promo-home-charging.

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.[27] 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.[28] 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.[29] 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.[30] 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.[31] Based on PLN data, around 20% of EV owners use wall chargers.[32] 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.

27 International Council on Clean Transportation, "EV CHARGE Model Documentation," accessed July 11, 2023, https://theicct.github.io/EVCHARGE-doc/.

28 Detailed model-default global data is available at https://theicct.github.io/EVCHARGE-doc/versions/v1.1/#default-modeling-assumptions.

29 AR Muhammad, "Punya mobil listrik tapi terkendala karena SPKLU jauh, install wall charger dong [You Have Electric Car but the Charging Station is Located Far Away, Try Install a Wall Charger]," *Sahitya.id*, May 23, 2023, https://sahitya.id/punya-mobil-listrik-tapi-terkendala-karena-spklu-jauh-instal-wall-charger-dong/.

30 Badan Pusat Statistik, *Statistik komuter jabodetabek: Hasil survei komuter jabodetabek 2019* [Jabodetabek Commuter Statistics: 2019 Jabodetabek Commuter Statistic Survey Result], (Jakarta, Indonesia: Badan Pusat Statistik, 2019), https://www.bps.go.id/id/publication/2019/12/04/eab87d14d99459f4016bb057/statistik-komuter-jabodetabek-2019.html; Badan Pusat Statistik, *Statistik komuter bandung raya (Hasil survei komuter Bandung Raya dan Gerbangkertosusila 2017*) [Greater Bandung Commuter Statistics (2017 Greater Bandung and Gerbangkertosusila Commuter Survey Result)], (Jakarta, Indonesia: Badan Pusat Statistik, 2017), https://www.bps.go.id/publication/2017/12/25/20170000000000000102367/statistik-komuter-bandung-raya-hasil-survei-komuter-bandung-raya-dan-gerbangkertosusila-2017-.html.

31 ACC One, "Charger mobil listrik: Jenis, cara pakai, dan biayanya [Electric Car Charger: Types, How to Use, and Cost]," November 6, 2022, https://www.acc.co.id/accone/InfoTerkini_Detail?Id=4749&title=Charger-Mobil-Listrik-Jenis-Cara-Pakai-dan-Biayanya.

32 Khoirul Anam, "EV makin diminati, pelanggan home charging PLN naik 119,4% [Increasing Demand in EVs, PLN Home Charging Customers Increase 119.4%]," *CNBC Indonesia*, July 28, 2023, https://www.cnbcindonesia.com/news/20230728091627-4-458050/ev-makin-diminati-pelanggan-home-charging-pln-naik-1194.

Table 1. Indonesia-specific data input and assumptions for the EV CHARGE model.

Input parameter	Details and assumptions	Data sources
Charging station distribution per province	Based on 2022 charging stations installed across Indonesia[a]	Various, see Appendix for details
Charger age distribution	Charger age was calculated based on its installation year	Various, see Appendix for details
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-Volumes, accessed March 8, 2023
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.	Badan Pusat Statistik [Central Bureau of Statistics], 2023
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.	Herdianto, 2019;[c] Grab, 2020[d]
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.[b] 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.	Various, see Appendix for details
Charger investment cost	Capital or upfront costs, including hardware and installation costs.	Various, see Appendix for details
Housing share	Per-province percentage of vehicle owners living in single-family or multi-family homes[e]	Badan Pusat Statistik [Central Bureau of Statistics], 2011
Commuter share	Share of passenger cars used to commute to work. We applied the Jabodetabek commuter share of 10% across Indonesia.[f]	Badan Pusat Statistik [Central Bureau of Statistics], 2019
Population	Number of people in the province.	Badan Pusat Statistik [Central Bureau of Statistics], 2021
Road length	Length of national roads, including toll roads, in the province.	Badan Pusat Statistik [Central Bureau of Statistics], 2022
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.	Asaad, 2020;[g] Ainurrofiq, 2020;[h] Bluebird, 2022[i]

[a] Estimates for Bali's charging infrastructure for 2025 may be inflated. While Bali had the most chargers installed across Indonesia in 2022, it hosted the G-20 summit that year. EVs were the summit's official transport mode, and that resulted in large-scale installation of charging infrastructure at a rate that may have decreased afterward. In any case, charging infrastructure needs for 2030 are aligned with EV stock per province, not current infrastructure.

[b] The capacity of 2.2 kW is for a portable charger being used as home charger.

[c] Radityo Herdianto, "Jangan Kaget, Besarnya Daya Charger Mobil Listrik Taksi BlueBird [Don't be Shocked, Here is Charging Capacity for Bluebird Taxi Electric Car]," *GridOto.com*, August 15, 2019, https://www.gridoto.com/read/221817595/jangan-kaget-besarnya-daya-charger-mobil-listrik-taksi-blue-bird.

d Grab, "Grab dan Hyundai Luncurkan GrabCar Elektrik, Dorong Pengembangan Ekosistem Kendaraan Listrik di Indonesia [Grab and Hyundai Launch Electric GrabCar, Encourage Development of the Electric Vehicle Ecosystem in Indonesia]," news release, January 27, 2020, https://www.grab.com/id/press/tech-product/grab-dan-hyundai-luncurkan-grabcar-elektrik-dorong-pengembangan-ekosistem-kendaraan-listrik-di-indonesia/.

[e] Kalimantan Utara was separated from Kalimantan Timur and became a province in 2012. We used 2020 census data to estimate that Kalimantan Timur retained 85% of its housing share with 15% going to Kalimantan Utara.

[f] In DKI Jakarta province, the commuter share is only 3% due to high use of public transport. Regardless, we used the highest commuter share from our data, 10%, across all of Indonesia. Compared with ICCT studies of other countries, 10% is low.

[g] M. Ikhsan Asaad, "Road map Pengembangan Infrastruktur Kendaraan Listrik 2020-2024 [Roadmap 2020-2024 Electric Vehicles Infrastructure Development]," September 1, 2020, https://gatrik.esdm.go.id/assets/uploads/download_index/files/ab04d-road-map-pengembangan-infrastruktur-kendaraan-listrik-pln-.pdf.

h Uun Ainurrofiq, "Kolaborasi Mewujudkan Ekosistem Kendaraan Listrik Untuk Masa Depan [Collaboration to Create Electric Vehicle Ecosystem in the Future]," (webinar from Sosialisasi Permen ESDM & SPBKLU, September 2021), https://gatrik.esdm.go.id/assets/uploads/download_index/files/a70c2-webinar-ev-ecosystem-esdm.pptx.pdf.

i Bluebird, "Perintis Mobil Listrik [Electric Car Pioneers]," (presentation, National Workshop Accelerating Battery Electric Vehicle, September 21, 2022), https://theicct.org/wp-content/uploads/2022/11/Bluebird.pdf.

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.

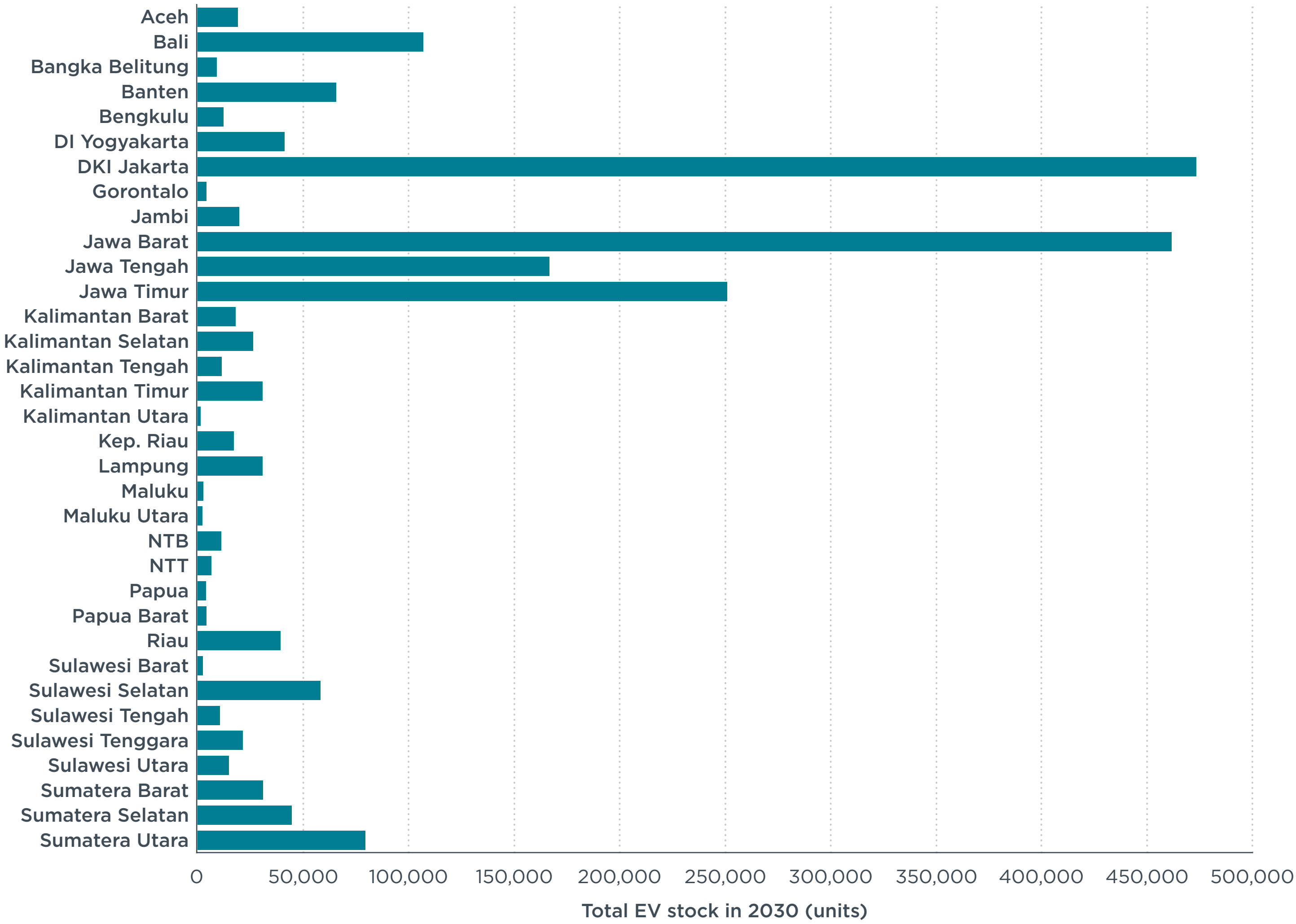

Figure 2. Projection of Indonesia's 2030 EV stock (units) based on 2025 and 2030 government targets.

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]

33 Badan Pusat Statistik [Central Bureau of Statistics], 2019, https://www.bps.go.id/id/publication/2019/12/04/eab87d14d99459f4016bb057/statistik-komuter-jabodetabek-2019.html .

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 2. Estimated number of chargers needed in Indonesia by 2030.

Category	Charger location	Number of chargers (units)
Private	Home	1,581,700
	Depot	3,600
	Total private chargers	**1,585,300**
Public	Public destination	16,500
	Public en-route	7,100
	Workplace	2,000
	Total public chargers	**25,600**
Total		**1,610,900**

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.

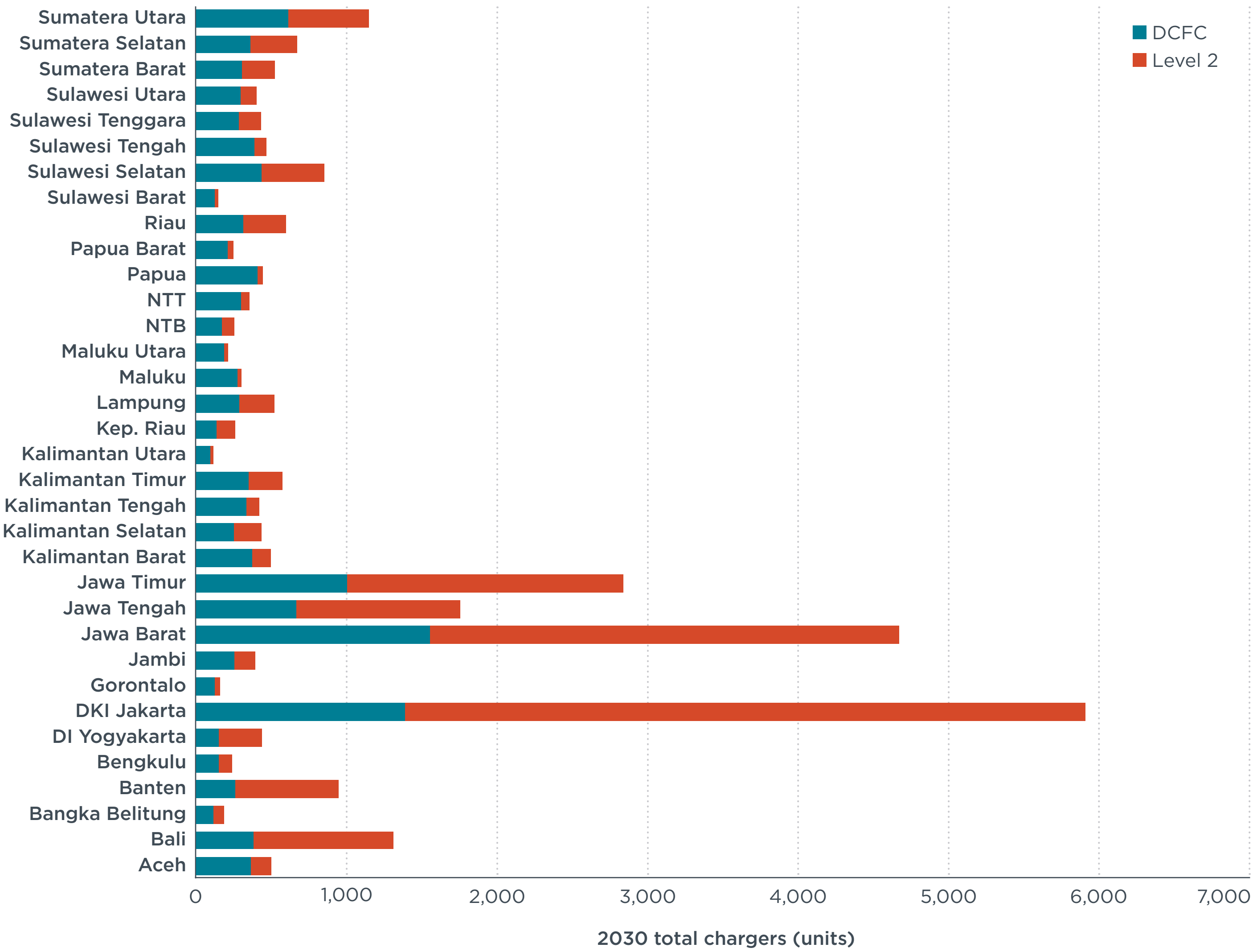

Figure 3. Estimated need for public and depot chargers by 2030 per province (units) and by charger type.

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.[34] 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.

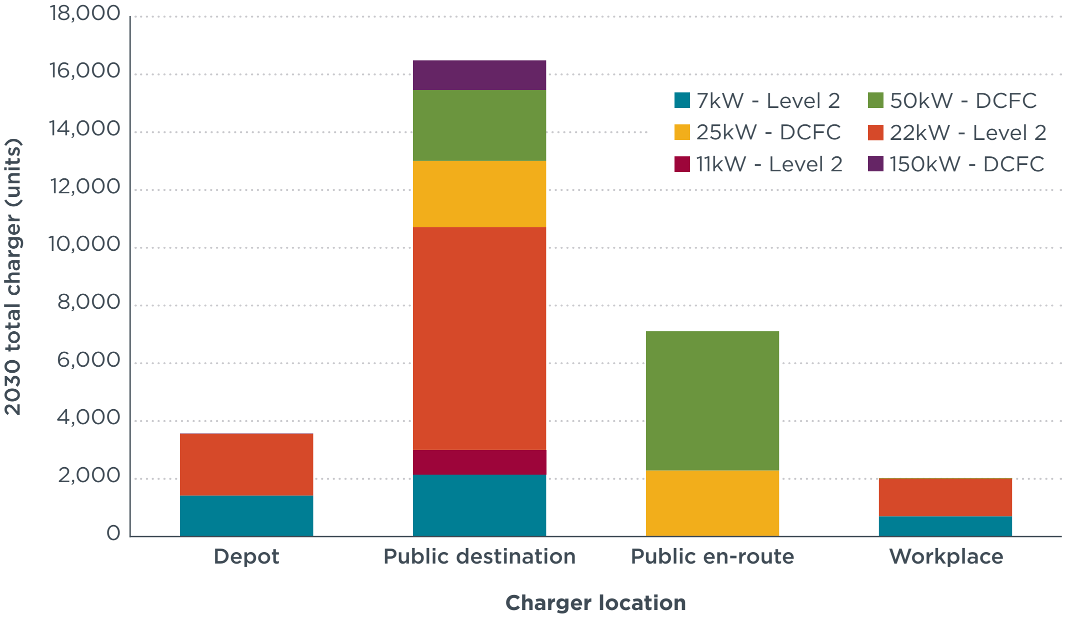

Figure 4. Estimated number of Level 2 and DCFC chargers (public and depot) in 2030, by location and capacity.

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.

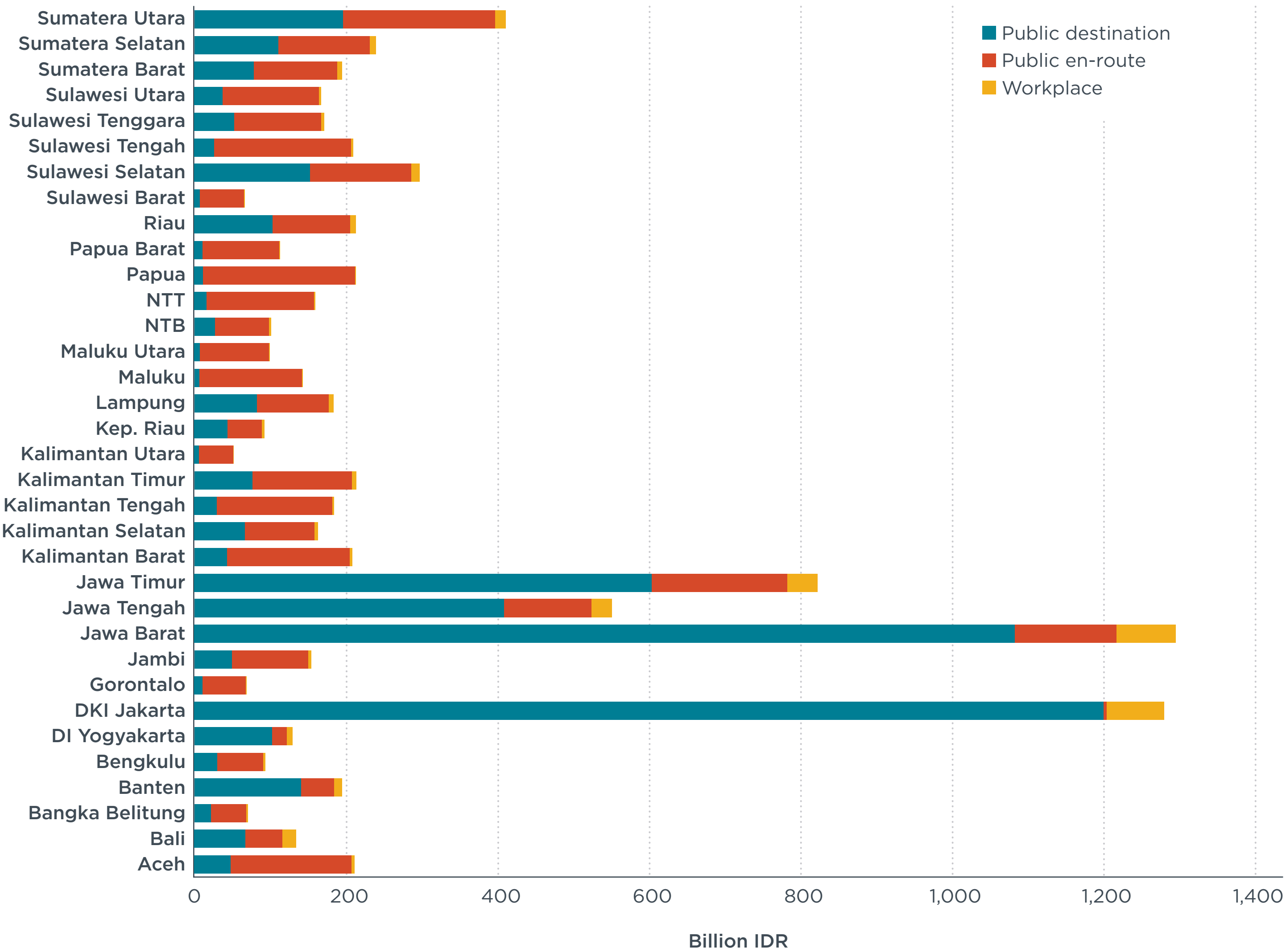

Figure 5. Estimated cost to support public charging infrastructure per province in 2030.

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.

36 Kristantyo Wisnubroto, "Mudik Pakai Mobil Listrik, Siapa Takut?! [Going to Hometown Using Electric Car, No Need to Worry]," *Indonesia.go.id*, April 17, 2023, https://indonesia.go.id/kategori/editorial/7005/mudik-pakai-mobil-listrik-siapa-takut?lang=1.

37 The White House, "Fact Sheet: Biden-Harris Administration Announces New Standards and Major Progress for a Made-in-America National Network of Electric Vehicle Chargers," February 15, 2023, https://www.whitehouse.gov/briefing-room/statements-releases/2023/02/15/fact-sheet-biden-harris-administration-announces-new-standards-and-major-progress-for-a-made-in-america-national-network-of-electric-vehicle-chargers/.

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.[38] The government also eased the charger-permitting process through MEMR Regulation No 5/2021.[39]

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.[40]

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.

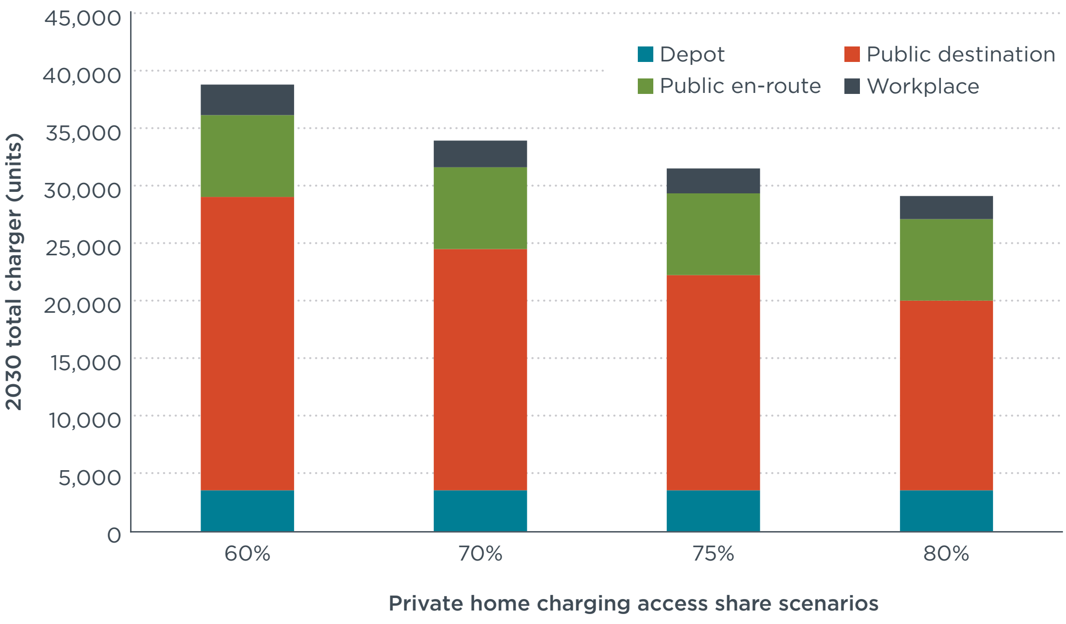

Figure 6. Total chargers needed (excluding home) in Indonesia by 2030 assuming different home charging access share scenarios.

38 Ministry of Energy and Mineral Resources, Republic of Indonesia, "Percepat Ekosistem Kendaraan Listrik, Pemerintah Resmi Terbitkan Tarif dan Biaya Layanan Pengisian Listrik Pada SPKLU [Accelerating the Electric Vehicle Ecosystem, Government Officially Issues Tariffs and Fees for Electric Charging Services for Charging Stations]," (2023), https://www.esdm.go.id/id/media-center/arsip-berita/percepat-ekosistem-kendaraan-listrik-pemerintah-resmi-terbitkan-tarif-dan-biaya-layanan-pengisian-listrik-pada-spklu.

39 Ministry of Energy and Mineral Resources, Republic of Indonesia, "Pemerintah Apresiasi Badan Usaha dan Produsen Peralatan SPKLU Dalam Pengembangan Ekosistem Kendaraan Listrik di Indonesia [Government Appreciates Business Entities and Charging Station Equipment Manufacturers in Developing the Electric Vehicle Ecosystem in Indonesia]," (2021), https://www.esdm.go.id/id/berita-unit/direktorat-jenderal-ketenagalistrikan/pemerintah-apresiasi-badan-usaha-dan-produsen-peralatan-spklu-dalam-pengembangan-ekosistem-kendaraan-listrik-di-indonesia.

40 "Thailand Approves Enhanced Incentives to Boost EV Use," *Reuters*, April 7, 2022, https://www.reuters.com/world/asia-pacific/thailand-approves-enhanced-incentives-boost-ev-use-2022-04-07/.

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.

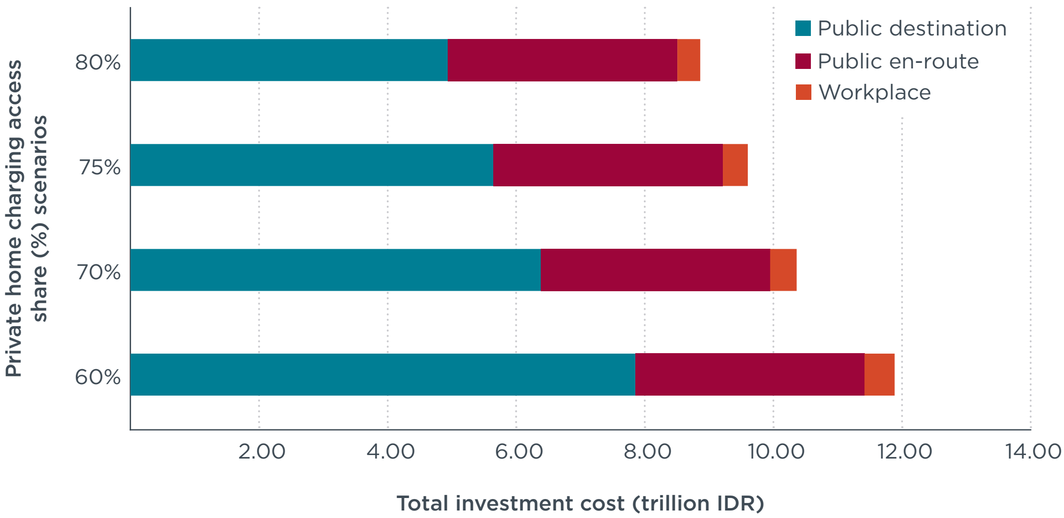

Figure 7. Comparison of total investment cost (trillion IDR) for public chargers under 60%, 70%, 75%, and 80% private home charging share scenarios.

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.

41 Sigit, "Bagaimana Prosedur Pemasangan Home Charging Mobil Listrik? [What is the Procedure for Installing Home Charging for an Electric Car?]," *Kabaroto*, March 23, 2023, https://kabaroto.com/post/read/bagaimana-prosedur-pemasangan-home-charging-mobil-listrik.

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.

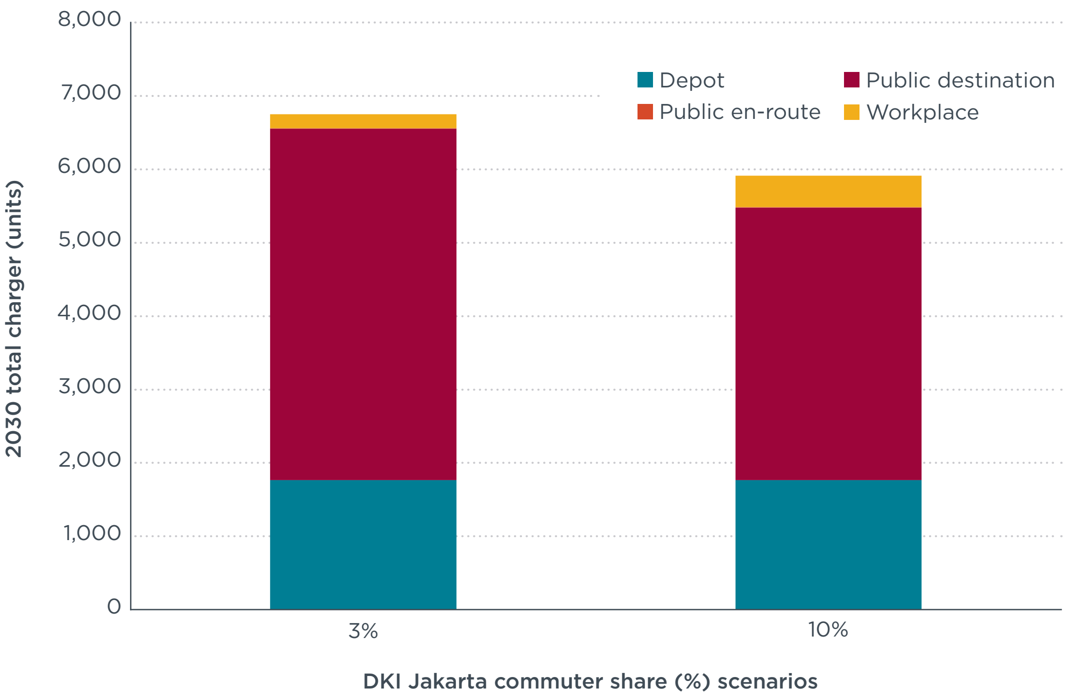

Figure 8. Total chargers needed by 2030 in DKI Jakarta under the 3% and 10% commuter share scenarios.

42 See the Methodology section for sources of charging station distributions per province.

43 Septian Farhan Nurhuda, "BlueBird Sudah Punya Ratusan Taksi Listrik di Indonesia, Bakal Nambah [BlueBird Already Has Hundreds of Electric Taxis in Indonesia, Will Add More]," *DetikOto*, August 30, 2023, https://oto.detik.com/mobil-listrik/d-6904074/bluebird-sudah-punya-ratusan-taksi-listrik-di-indonesia-bakal-nambah.

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.

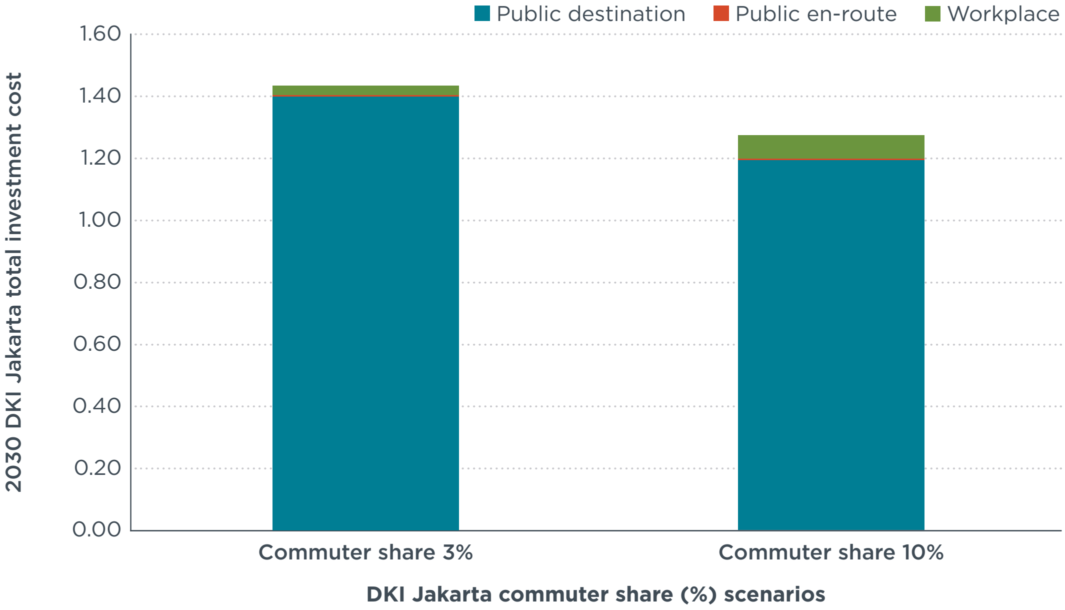

Figure 9. Total investment cost (trillion IDR) needed by 2030 in DKI Jakarta for public chargers under the 3% and 10% commuter share scenarios.

The Ministry of Transport asked the DKI Jakarta government to install more public chargers.[44] The DKI Jakarta government plans to add a requirement for new building in Jakarta need to have charging station installed.[45] 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

44 "Pj Gubernur DKI Jakarta: Izin Baru Gedung Wajib Punya SPKLU [Acting Governor of DKI Jakarta: New Building Permits Must Add Charging Stations]," *DetikOto*, October 25, 2022, https://oto.detik.com/berita/d-6368448/pj-gubernur-dki-jakarta-izin-baru-gedung-wajib-punya-spklu.

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.

Input	Sources
Charging station distribution per province **and** **Charger age distribution** **and** **Charger capacity**	• Perusahaan Listrik Negara (PLN), "Realisasi & Rencana Pengembangan Infrastruktur Pendukung Kendaraan Listrik di Jawa dan Nasional [Realization & Plan to Support Electric Vehicle Infrastructure Development in Java and National]," (September 2022), https://theicct.org/wp-content/uploads/2022/11/PLN.pdf. • 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 https://kerjasama.ui.ac.id/webinar-prospek-dan-tantangan-industri-baterai-nasional/). • Mitsubishi Motors, "Mitsubishi Sediakan Pengisian Daya Cepat Bagi Mobil Listrik di Plaza Senayan [Mitsubishi Provides Fast Charging for Electric Cars at Plaza Senayan]," news release, December 6, 2019, https://www.mitsubishi-motors.co.id/news-events/mitsubishi-sediakan-pengisian-daya-cepat-bagi-mobil-listrik-di-plaza-senayan. • EVCuzz, "Dukung Ekosistem KBLBB di Indonesia, EVCuzz Siap Perbanyak SPKLU [Support Electric Vehicle Ecosystem in Indonesia, EVCuzz Plans to Add More Charging Stations]," accessed July 6, 2023, https://evcuzz.com/dukung-ekosistem-kblbb-di-indonesia-evcuzz-siap-perbanyak-spklu/. • Shell Indonesia, "Shell Recharge," accessed July 6, 2023, https://www.shell.co.id/in_id/pengendara-bermotor/shell-recharge.html. • Dio Dananjaya and Agung Kurniawan, "Ini 11 Lokasi SPKLU Milik PLN dan Pertamina di Jakarta [11 Locations of Charging Stations Owned by PLN and Pertamina in Jakarta]," *Kompas.com*, October 12, 2021, https://otomotif.kompas.com/read/2021/10/12/084200615/ini-11-lokasi-spklu-milik-pln-dan-pertamina-di-jakarta. • PlugShare, "Indonesia," accessed July 6, 2023, https://www.plugshare.com/. • Wuling, "SPKLU: Pengertian, Lokasi, Hingga Perbedaan Dengan SPLU [Charging Station: Definition, Location, the Comparison with SPLU]," (November 20, 2023), https://wuling.id/id/blog/lifestyle/pemilik-mobil-listrik-wajib-tahu-spklu-stasiun-pengisian-kendaraan-listrik-umum. • Starvo, "Tentang Starvo [About Starvo]," (n.d.), https://starvo.co.id/wp-content/uploads/2023/08/Starvo.pdf. • Otopods, "Guide to EV Charging," accessed July 6, 2023, https://otopods.id/ev-charger/. • Ministry of Energy and Mineral Resources, Republic of Indonesia, "Penyediaan Infrastruktur Pengisian Listrik dan Tarif Tenaga Listrik Untuk Kendaraan Bermotor Listrik Berbasis Baterai [Provision of Electricity Charging Infrastructure and Electricity Tariffs for Battery Electric Vehicles]," (2020), https://gatrik.esdm.go.id/assets/uploads/download_index/files/683a2-bahan-presentasi-pak-hendra-1-.pdf.
Charger investment cost	• M. Ikhsan Asaad, "Road Map Pengembangan Infrastruktur Kendaraan Listrik 2020-2024 [2020-2024 Roadmap Electric Vehicle Infrastructure]," September 1, 2020, https://gatrik.esdm.go.id/assets/uploads/download_index/files/ab04d-road-map-pengembangan-infrastruktur-kendaraan-listrik-pln-.pdf. • Radityo Herdianto, "Punya Mobil Listrik, Segini Harga Buat Bikin Wall Charger di Rumah [You have Electric Vehicle, Here is the Cost of Installing a Wall Charger at Home]," *GridOto.com*, May 17, 2022, https://www.gridoto.com/read/223279235/punya-mobil-listrik-segini-harga-buat-bikin-wall-charger-di-rumah. • Muslimin Trisyuliono, "Enggak Perlu Modal Terlalu Banyak, Satu Unit Stasiun cas Mobil Listrik EVCuzz Paling Murah Mulai Rp 150 jutaan [You Don't Need to Spend a lot of Capital, One Unit of EVCuzz Charging Station Starts from IDR 150 Million]," *GridOto.com*, April 20, 2022, https://www.gridoto.com/read/223245011/enggak-perlu-modal-terlalu-banyak-satu-unit-stasiun-cas-mobil-listrik-evcuzz-paling-murah-mulai-rp-150-jutaan. • "Pasang Charger Mobil Listrik di Rumah, Berapa Biayanya? [Install Charger at Home, How Much it Cost?]," *SEVA*, October 11, 2022, https://www.seva.id/blog/pasang-charger-mobil-listrik-di-rumah-berapa-biayanya-102022-tr/. • Exchange Rates, "US Dollar to Indonesian Rupiah Spot Exchange Rates for 2022," accessed September 13, 2023, https://www.exchangerates.org.uk/USD-IDR-spot-exchange-rates-history-2022.html.