BRIEFING

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Policy roadmap for accelerating public transit bus electrification in Indonesia

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INTRODUCTION

Indonesia is the world's fourth most populous country and the tenth-largest economy.[1] Close to 60% of the population lives in urban areas.[2] Continued urbanization and economic development have increased the demand for fuel and mobility solutions, driving up greenhouse gas (GHG) emissions and private vehicle ownership and worsening air quality in cities.[3]

In 2019, Indonesia's GHG emissions totaled 1,845,113 gigatons of carbon dioxide (CO_2).[4] The nation was the fifth-largest contributor to global CO_2 emissions that year.[5] Transport has been the most energy-intensive sector of the Indonesian economy since 2012 and accounted for around 9% of total national GHG emissions in 2019.

1 "The World Bank In Indonesia," World Bank, 2022, https://www.worldbank.org/en/country/indonesia/overview.

2 "World Urbanization Prospects: 2018 Revision, Urban population (% of total population)—Indonesia," United Nations Population Division, The World Bank, https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS?locations=ID.

3 Retno Suni Astuti, Zainal Hidayat, Kushandayani Kushandayani, and Aden Nurul Huda, *Public Value of Public Transportation Mode for Urban Communities in Indonesia*, (Proceedings of the 5th International Conference on Indonesian Social and Political Enquiries, ICISPE 2020: Semarang, Indonesia, 9-10 October 2020), https://doi.org/10.4108/eai.9-10-2020.2304712.

4 Laksmi Dewanthi, "Indonesia Third Biennial Update Report under the United Nations Framework Convention on Climate Change"(Director General for Climate Change, Ministry of Environment and Forestry, December 2021), https://unfccc.int/documents/403577.

5 "Indonesia Climate Change Data and Policies," Climate Watch, https://www.climatewatchdata.org/countries/IDN?end_year=2019&start_year=1990.

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Ambient ozone and fine particulate matter ($PM_{2.5}$) pollution were linked to more than 110,000 premature deaths in Indonesia in 2019.[6] Poor air quality subtracts about 1.2 years of life expectancy— showing serious air pollution challenges.[7] In 2021, Indonesia's monitored annual mean $PM_{2.5}$ concentration was consistently multiple times higher than the 10 µg/m³ World Health Organization guideline.

Transportation is a major source of Indonesia's ambient air pollution. Nationally, on-road diesel vehicles caused 34% of transportation-related $PM_{2.5}$ and ozone pollution deaths in 2015. Because of outdated vehicle emission standards and poor fuel quality, emissions from diesel-powered transport caused an estimated 7,100 premature deaths in Indonesia in 2015, equivalent to $4.2 billion of economic costs, or 0.47% of Indonesia's gross national income.[8] In the capital city, Jakarta, vehicles contribute up to 41% of $PM_{2.5}$ emissions during the wet season and 57% during the dry season (Eighty-five percent of all vehicles in Jakarta are privately owned, most of them motorcycles).[9]

The government of Indonesia seeks to ensure that economic growth, driven largely by the transport sector, will not harm the quality of life or health of hundreds of millions of Indonesians. President Joko Widodo identified electric vehicles (EVs) as a key technology to address that challenge and instructed government ministries to incentivize EV and component manufacturing and adoption.[10] At the subnational level, Jakarta's government has made commitments and provided incentives to accelerate the transition to zero-emission vehicles (ZEVs) during this decade to meet GHG reduction targets.

Zero-emission buses offer a clear opportunity to develop cleaner and wider public transit services. Both battery-electric and hydrogen fuel-cell electric power trains are zero-emission technologies. This briefing focuses on battery-electric buses (BEB), which cost less and are more readily available. In public transport, BEBs can meet mobility needs, alleviate traffic congestion, improve economic opportunities, and avoid the pitfalls of car-centric transportation and development. Furthermore, BEBs emit no tailpipe pollutants like $PM_{2.5}$, nitrogen oxides (NO_x), black carbon, or CO_2 from the combustion of diesel or compressed natural gas (CNG). A transition to zero-emission transit buses in Indonesian cities holds the promise to control air pollution, mitigate climate change, and achieve socioeconomic goals.

Like Indonesia, nations worldwide are renewing public transit systems with BEBs to meet growing urban mobility demands. The lower costs and reliable performance of BEB technology make it the leading zero-emission choice to replace aging diesel and CNG bus fleets and provide modern transit services.

6 "State of Global Air 2020," IHME, 2020, https://www.stateofglobalair.org/data/#/health/plot.

7 Michael Greenstone and Qing (Claire) Fan, "Indonesia's Worsening Air Quality and its Impact on Life Expectancy," *Air Quality Life Index*, March 2019, https://aqli.epic.uchicago.edu/wp-content/uploads/2019/03/Indonesia-Report.pdf.

8 Susan Anenberg, Josh Miller, Daven Henze, and Ray Minjares, "A global snapshot of the air pollution-related health impacts of transportation sector emissions in 2010 and 2015" (ICCT: Washington, D.C., 2019), https://theicct.org/sites/default/files/publications/Global_health_impacts_transport_emissions_2010-2015_20190226.pdf.

9 Driejana Driejana, "Fixing Jakarta's commuter pollution problem," *Eco-Business*, August 10, 2022, https://www.eco-business.com/opinion/fixing-jakartas-commuter-pollution-problem/;

10 in some contexts, EV also includes plug-in hybrid vehicles, which are not 100% zero-emission. In this briefing paper we use EVs refer exclusively to battery-electric and hydrogen fuel cell electric vehicles.

OBJECTIVE AND SCOPE

This briefing outlines the policies Indonesia's government could enact to accelerate the adoption of BEBs. First, we review institutions and policies relevant to urban BEBs in Indonesia, and the state of BEB adoption in the country, then benchmark Indonesia against the most robust urban transit fleet electrification policies globally to identify areas to strengthen.

Most of the policies reviewed here fall under the purview of the national government. But urban transit is also a local matter, involving operations planning, procurement, and infrastructure. Therefore, we address some policies commonly adopted by municipal governments and transit operators, but we approach those from the perspective of how the national government can support local entities.

We also discuss vehicle electrification policies for heavy-duty vehicles (HDVs), including trucks and buses. Some HDV policies are primarily meant to spur zero-emission truck development (which lags zero-emission bus development); we assess these policies because they indirectly affect the entire HDV industry and regulatory structure.

We recognize the complexity of developing an actionable playbook of policies to promote e-buses. Each policy area features multiple stakeholders and priorities. This briefing kick-starts the conversation for key institutional stakeholders in Indonesia. Future research will be needed to fill in important details for government and industry.

INSTITUTIONAL AND REGULATORY FRAMEWORK IN INDONESIA

In Indonesia, public transport electrification is driven by government policies and regulations. The flagship EV policy is Presidential Regulation (PR) No. 55/2019, issued in August 2019. It offers top-level guidance to the automotive industry on battery electric vehicle (BEV) development and provides opportunities for involvement by local governments and universities. This regulation has four objectives: identify the ministries/agencies responsible for implementation; develop technical specifications for BEVs; create a BEV manufacturing capacity; and facilitate the market transition from internal combustion engine (ICE) vehicles to BEVs.

A group of ministries led by the Coordinating Ministry for Maritime and Investment Affairs is developing regulations to realize the vision laid out in PR No.55/2019. Table 1 outlines these national-level institutions, the scope of their jurisdictions, and the roles they play in public transport electrification.

Table 1. Key national institutions for BEB adoption

Institution	Jurisdiction	Roles in public transport electrification
Coordinating Ministry for Maritime and Investment Affairs	Ministerial coordinator	• Coordinate regulatory EV agenda across ministries • Attract foreign investment for battery and EV supply chain
Ministry of Transport (MoT)	Vehicles	• Promote urban transit buses (Buy the Service program) • Develop EV technical regulations for buses • Issue type approval for BEBs
Ministry of Energy and Mineral Resources (MEMR)	Charging infrastructure and electricity	• Oversee technical, legal aspects of charging infrastructure development • Coordinate infrastructure development with the national electricity company PLN • Convert ICEs vehicles to EVs • Develop electricity policies, including grid decarbonization • Set electricity pricing for EV charging
Ministry of Industry (MoI)	Industrial development and manufacturing of vehicles and charging equipment	• Design industrial policies for manufacturing EVs and components • Draft regulations on EV manufacturing • Require domestic production content levels on EVs
Ministry of Finance (MoF)	Fiscal instruments, financing mechanisms, and loans for: vehicles, charging infrastructure, and industrial development	• Determine fiscal incentives for EV manufacturing, imports, and development of infrastructure • Determine fiscal incentives for fleet operators that own and operate BEBs
Ministry of Home Affairs (MoHA)	Government-owned vehicles, provincial EV fiscal instruments	• Provide regulatory framework for provincial governments to define vehicle transfer fees and circulation taxes
Ministry of Environment and Forestry (MoEF)	EV batteries	• Regulate environmental impact of EVs, including raw material extraction and battery end-of-life disposal • Monitoring, Reporting, and Verification (MRV) of transportation GHG emissions
Ministry of National Development Planning/ National Development and Planning Agency (Bappenas)	Policy integration	• Oversee policies and ensure their alignment with the national development plan • Develop and evaluate net-zero plans
Ministry of State-Owned Enterprises (BUMN)	State-owned enterprises	• Coordinate adoption of zero-emission fleet mandates for public transit bus operators under its supervision • Identify readiness and develop plans for participation of industrial State-Owned Enterprises (SOEs) into bus electrification plans (e.g., INKA)
Ministry of Trade	Private sector engagement	• Organize private operators that will use e-buses
National Research and Innovation Agency	Vehicle and transport system research and development	• Encourage domestic development of e-bus technologies • Conduct transportation system research
National electricity company (PT Perusahaan Listrik Negara, PLN)	Charging infrastructure and electricity	• Sell electricity to final users • Plan public charging infrastructure development • Coordinate with MEMR on electricity sales for EV applications

INDONESIA'S BEB MARKET

Government efforts to accelerate BEB uptake have done little to boost the market. Only 51 BEBs ranging from 8 m to 12 m were registered in the country in 2021, concentrated in Java and Bali, including in Jakarta.[11] Indonesia's BEB production capacity is limited; only two domestic bus manufacturers – Mobil Anak Bangsa (MAB) and Industri Kereta Api (INKA) – operate in the country.

BEB ADOPTION AND GROWTH TARGETS IN JAKARTA

Regionally owned PT Transportasi Jakarta (Transjakarta) manages and operates the bus rapid transit system, feeder bus routes, and microbuses in the Greater Jakarta area. That encompasses 248 routes with 13 corridors of dedicated bus lanes. Transjakarta has been testing several e-bus models in recent years. In 2022, BEVs from several Chinese manufacturers and MAB were being piloted on Transjakarta routes.

Figure 1. Transjakarta BYD K9 BEB operating in non-bus rapid transit routes (photo credit: Adhi Triatmojo)

Currently, 30 low-floor 12 m BEBs operate on four Transjakarta routes. Transjakarta aims to deploy 220 BEBs by the end of 2023. The company has an ambitious timeline to transform its more than 4,400 ICE buses to 10,407 BEBs by 2030, a more than 100-fold fleet size increase from 2020 (Figure 2).[12] This would create strong demand for BEBs in the next decade by Transjakarta alone.

11 Data shared by Ministry of Transport at the National Workshop on Accelerating Battery-Electric Vehicle Adoption in Indonesia, ICCT, September 21, 2022, https://theicct.org/event/indonesia-workshop-sep22/.

12 "Connecting the Life of Jakarta," Transjakarta, presented at the National Workshop on Accelerating Battery-Electric Vehicle Adoption in Indonesia, ICCT, September 21, 2022, https://theicct.org/event/indonesia-workshop-sep22/.

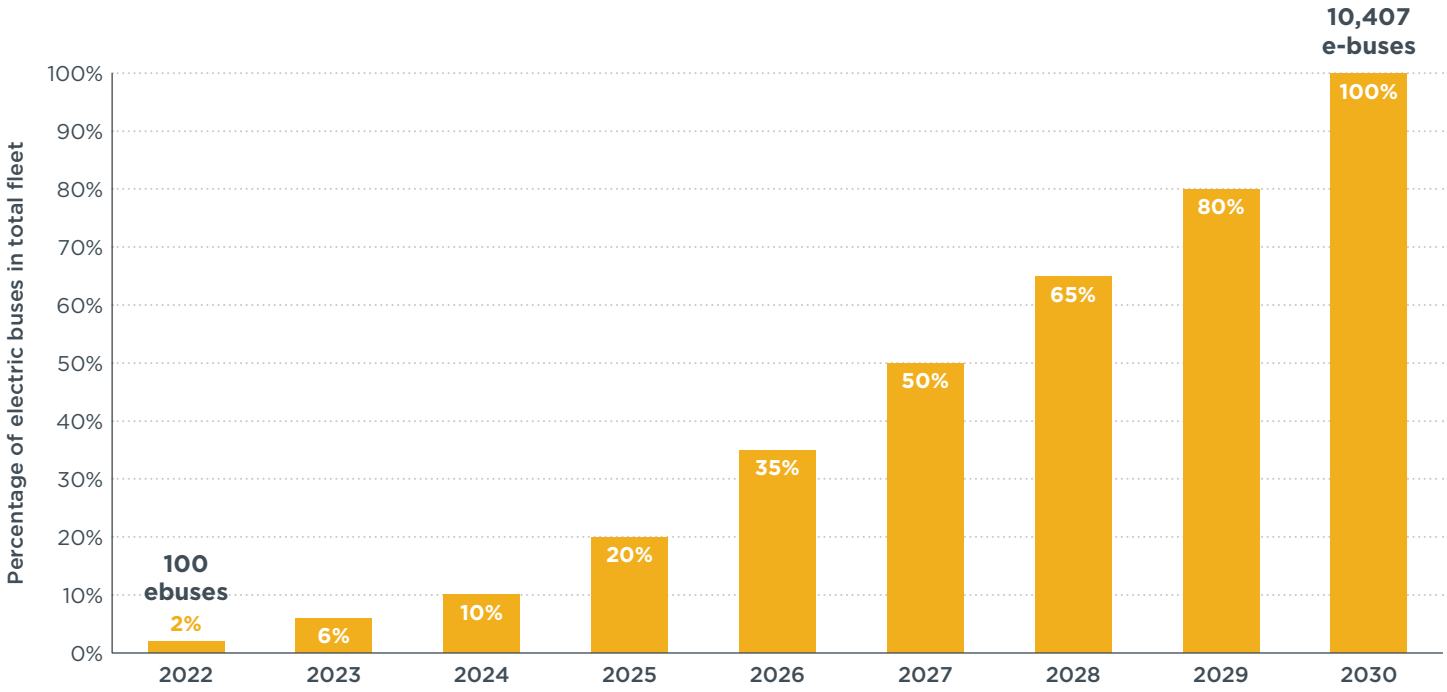


Figure 2. Transjakarta BEB target from 2022 to 2030 (source: Transjakarta, 2022)

BALI'S G20 BEB PROGRAM

Indonesia's government planned to put 53 BEBs in service in Bali for the G20 Summit in November 2022 to service diplomatic attendees.[13] By the end of the summit, 24 units INKA e-buses were in service.[14] After the summit, the buses were to be given to the municipal governments of Bandung and Surabaya to bolster their public transit bus fleets. However, the operation of BEBs in Surabaya and Bandung was halted because of a problem with their contract agreement, highlighting the institutional challenges that need to be addressed to accelerate BEB deployments in the country.[15]

13 Dicky Kurniawan, "53 Bus Listrik Untuk Transportasi KTT G20 Bali Akan Diproduksi di PT INKA," Tempo.co, May 27, 2022, https://otomotif.tempo.co/read/1595513/53-bus-listrik-untuk-transportasi-ktt-g20-bali-akan-diproduksi-di-pt-inka (In Indonesian).

14 "E-Inobus INKA, Sukses di Bali, Sekarang Sudah di Jakarta," INKA, Nov. 26, 2022, https://www.inka.co.id/berita/904 (In Indonesian).

15 Dhimas Ginanjar, "17 Bus Listrik di Surabaya Berhenti Beroperasi Tiga Bulan," Jawapos.com, March 30, 2023, https://www.jawapos.com/surabaya-raya/01445124/17-bus-listrik-di-surabaya-berhenti-beroperasi-tiga-bulan (In Indonesian); Tita Salsabila, "Bus Listrik di Kota Bandung Berhenti Beroperasi Sementara," Pikiranrakyat.com, January 6, 2023, https://www.pikiran-rakyat.com/bandung-raya/pr-016074952/bus-listrik-di-kota-bandung-berhenti-beroperasi-sementara (In Indonesian).

Figure 3. INKA BEB for the G20 Bali event (photo credit: Adhi Triatmojo, 2022)

BEB SUPPLY VIA PRODUCTION AND IMPORTS

Domestic production of BEBs in Indonesia is still in its early stages. The state-owned railway rolling stock company INKA entered the bus market in 2011, first producing CNG buses. In 2020, INKA began prototyping BEBs. Through a collaboration with the Ministry of Education, Culture, Research, and Technology (Kemdikbud), and a higher education consortium involving Universitas Gadjah Mada, Institut Teknologi Sepuluh Nopember, Universitas Airlangga, and Institut Seni Indonesia, INKA designed the 8-meter Merahputih BEB model, which debuted for the Bali G20 Summit.[16] According to INKA's own assessment, the local content of the Merahputih bus is 77%. Through the Buy The Service (BTS) scheme, which is the MoT's subsidy program to support public transit, INKA plans to produce 53 BEBs and cooperate with state-owned airport shuttle bus operator Djawatan Angkoetan Motor Repoeblik Indonesia (DAMRI) for the operation and maintenance of INKA BEBs in cities across Indonesia.[17]

MAB, founded in 2017, sold its first commercial 12-meter BEB to PT Paiton Energy in November 2019.[18] As of early 2023, customers included private companies PT Riau Andalan Pulp and Paper, PT Chandra Asri Petrochemicals, PT Kaltim Parna Industri, and the Semarang city government. MAB reported selling 40 BEBs through 2022. The local content for MAB's BEBs is 35%.[19]

BEBs from Chinese manufacturer Build Your Dreams (BYD) are imported to Indonesia as completely built units (CBUs). BYD is one of the largest BEB producers worldwide and is represented by Bakrie Autoparts in Indonesia. Thirty units of BYD's 12-meter

16 Yanuar R Yovanda, "PT INKA Siapkan 53 Bus Listrik Buat Operasional DAMRI di Dua Kota," *Tribun Bisnis*, September 30, 2022, https://www.tribunnews.com/bisnis/2022/09/30/pt-inka-siapkan-53-bus-listrik-buat-operasional-damri-di-dua-kota (In Indonesian).

17 "BEB INKA Development," INKA, 2022, presented at Transformative Urban Mobility Initiative Indonesia Workshop Presentation.

18 "PT MAB Gandeng Perusahaan Asuransi untuk Proteksi Armada Bus Listriknya," PT Mobil Anak Bangsa Indonesia, December 29, 2021, https://www.mabindonesia.com/?page=news-15 (In Indonesian).

19 Ruly Kurniawan, "Sudah 40 Unit Bus Listrik MAB Terjual di Indonesia," Kompas.com, July 26, 2022, https://otomotif.kompas.com/read/2022/07/26/180100715/sudah-40-unit-bus-listrik-mab-terjual-di-indonesia (In Indonesian).

K9 BEBs have been launched in Jakarta and operate on Transjakarta's non-bus rapid transit routes.[20] An additional 22 BYD K9 units are expected to operate in 2023.[21]

Several other Chinese manufacturers, including Higer in 2021, along with Zhongtong, Skywell, and Golden Dragon in 2022, have participated in Transjakarta's BEB pilot testing.[22] They neither sell BEBs in large volumes nor have they set up local BEB manufacturing facilities.

POLICIES FOR ACCELERATING TRANSIT BUS ELECTRIFICATION

Other governments have utilized several policy tools to promote demand for and supply of battery-electric transit buses These policies include targets to phase out sales of ICE buses; fleet purchase requirements; monetary incentives; industrial policies; infrastructure planning, standards, and subsidies; privileges and preferential treatment for BEBs; and zero-emission vehicle regulations/fuel consumption, $CO_{2,}$ and GHG standards. This section discusses the best practices associated with each policy tool and how the Indonesian government can learn from them.

PHASE-OUT TARGETS

The most important first step for BEB adoption is an official target to end sales of ICE buses. The national governments of Austria, Cape Verde, Chile, Colombia, Denmark, Israel, the Netherlands, and New Zealand, and the state government of the U.S. state of California, have committed to deploying only zero-emission technologies for their new urban buses. California, Cape Verde, Denmark, Ireland, Israel, the Netherlands, and New Zealand have also set targets to operate 100% zero-emission urban bus fleets by certain dates. U.S. and multinational memoranda of understanding (MoU) also address the phaseout of ICE buses.[23]

While some targets are political and nonbinding, overarching political statements show the direction of government policy and help industry and fleet operators make investment, planning, and purchasing decisions.

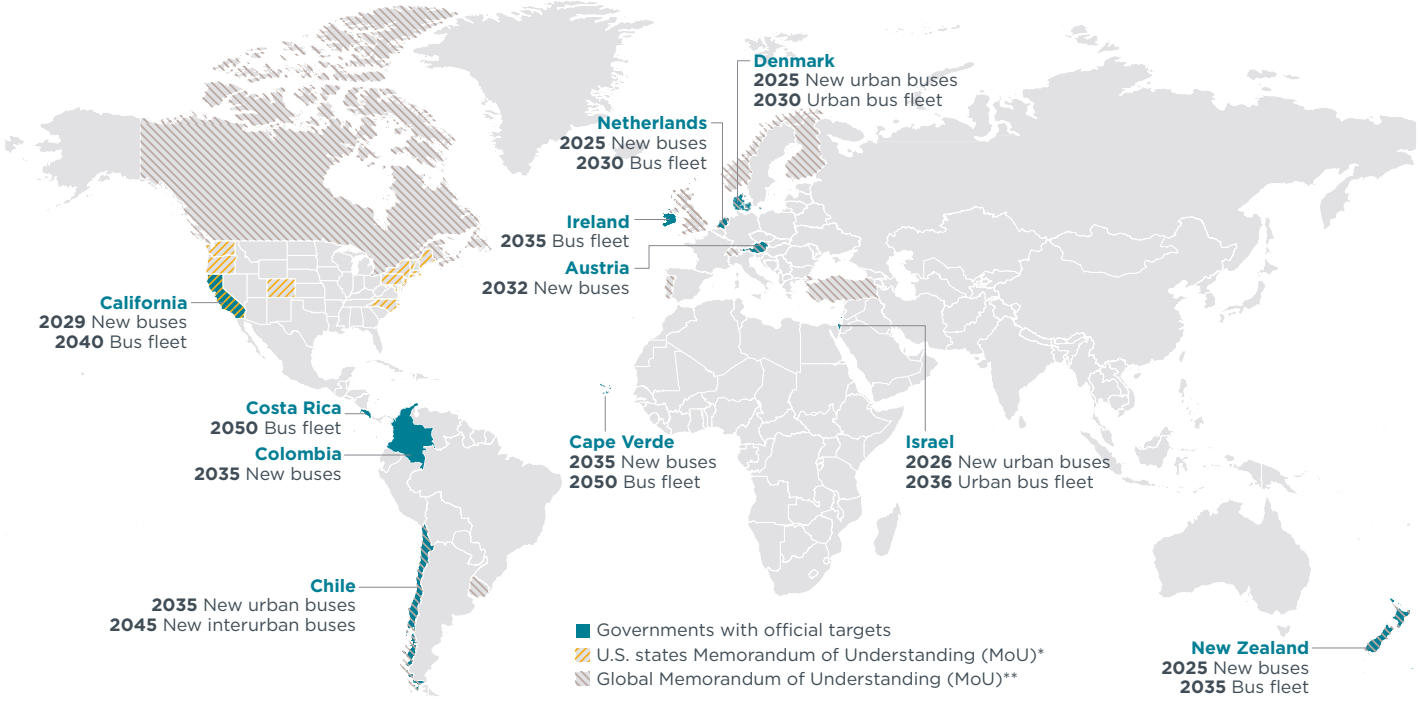
20 Janlika Putri Indah Sari, "Transjakarta Resmi Operasikan 30 Unit Bus Listrik," Kompas.com, March 8, 2022, https://otomotif.kompas.com/read/2022/03/08/194626015/Transjakarta-resmi-operasikan-30-unit-bus-listrik (In Indonesian).

21 Isna Rifka Sri Rahayu, "Mayasari Bakti Terima 22 Unit Bus Listrik," Kompas.com, March 13, 2023, https://money.kompas.com/read/2023/03/14/190819026/mayasari-bakti-terima-22-unit-bus-listrik (In Indonesian).

22 Muhammad Fathan Radityasani, "Transjakarta Uji Coba Tiga Merek Bus Listrik Sekaligus," Kompas.com, June 8, 2022, https://otomotif.kompas.com/read/2022/06/08/130100915/transjakarta-uji-coba-tiga-merek-bus-listrik-sekaligus (In Indonesian).

23 At COP26 in Glasgow, a global MoU was signed to accelerate the zero-emission medium- and heavy-duty vehicles market by setting a 100% zero-emission target including new bus sales by 2040. Signatories include Austria, Canada, Chile, Denmark, Finland, Luxembourg, the Netherlands, New Zealand, Norway, Scotland, Switzerland, Turkey, the United Kingdom, Uruguay, and Wales. In the United States, governors from 15 U.S. states and the mayor of Washington, D.C. signed an MoU that aspires to have all sales of new medium- and heavy-duty vehicles in their jurisdictions be zero-emission by 2050.

Governments with official targets to 100% phase out sales of internal combustion engine buses by a certain date (Status: Through February 2023)



* New medium- and heavy-duty vehicles at least 30% zero-emission in 2030 and 100% no later than 2050. Not necessarily reflected yet in an official state policy document such as a climate or transport strategy/plan, in a law, or in a similar framework.
** New medium- and heavy-duty vehicles 30% zero-emission in 2030 and 100% by 2040. Not necessarily reflected yet in an official national policy document such as a climate or transport strategy/plan, in a law, or in a similar framework.

Figure 4. Global ICE bus phase-out targets as of February 2023

National targets are often complemented by municipal and regional ones. Forward-looking cities, states, and provinces have been early BEB adopters (as shown clearly in Latin America, where there is a strong correlation between zero-emission bus targets and their adoption).[24] Successful commercial, technological, and operational experiences can spread from pioneering cities and regions.

Through the National General Energy Plan (RUEN) enacted under Presidential Regulation No. 22/2017, Indonesia targets 10% of public transport fleets to be electric or hybrid by 2025.[25] The MoT's stated electrification goals culminate with 90% electrification of public transit fleets by 2030 (Figure 5) – although this target is not a formal governmental regulation or decree.[26] At the subnational level, Transjakarta has targeted electrifying its entire fleet by 2030.

24 "E-Bus RADAR: Electric buses in Latin America," Danmarks Tekniske Universitet, ZEBRA, C40 Cities, International Council on Clean Transportation, & Partners for Growth, August 2022, https://www.ebusradar.org/en/.

25 President of the Republic of Indonesia Regulation No. 22/2017, "Peraturan Presiden Republik Indonesia Nomor 22 Tahun 2017 Tentang Rencana Umum Energi Nasional," [Presidential Regulation of the Republic of Indonesia Number 22 of 2017 concerning the General National Energy Plan], 2017, https://jdih.esdm.go.id/storage/document/Perpres%2022%20Tahun%202017.pdf (In Indonesian).

26 "Electric Mobility Transport Future Indonesia toward Zero Emission Buses," Directorate of General of Land Transportation, Ministry of Transport, 2022, presented at the Transformative Urban Mobility Initiative Workshop.

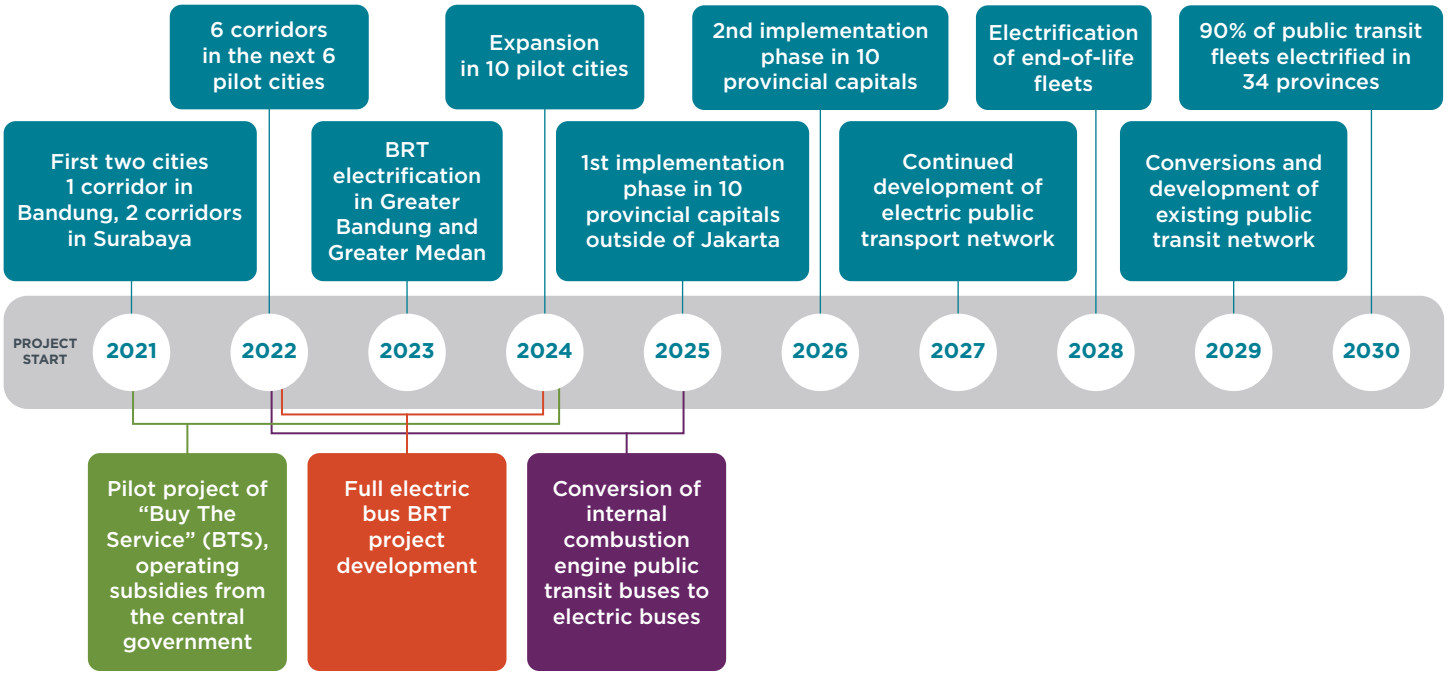


Figure 5. Public transport electrification timeline in Indonesia (source: MoT, 2022)

Phase-out targets from the past few years across other countries provide Indonesian policymakers with lessons for modelling BEB targets. For example:

- Targets enshrined by law or regulation convey political importance and certainty, enabling regulators, industry, and fleet owners to make investment decisions regarding BEVs. Confidence from BEB manufacturers and lending institutions can reduce the perceived risks of investing in manufacturing and help accelerate BEB production.
- Progressive timelines with incremental milestones allow the entire transit bus value chain's capacity to build gradually to accommodate zero-emission technologies.31 For example, Transjakarta has committed to deploy increasing numbers of BEBs each year before fully electrifying its fleet by 2030.[27]
- Targets that specify zero-emission technologies are preferable to ambiguous targets that include language like "low carbon" and "clean transport," which can promote ICE variants without meaningfully reducing emissions.[28]

With ambitious and unequivocal official targets, effective policies can advance BEB adoption. And policies that support both supply and demand are needed. While Presidential Regulation No. 55/2019 did not include phase-out dates for ICE buses or quantified BEB adoption targets, it did galvanize ministries to issue strategy documents and regulations to support EV acceleration. An ICE bus phase-out target could lead to even stronger policy and industry responses.

27 DKI Jakarta Province Governor's Decree No. 1053/2022, "Guidelines for the Acceleration of Battery-Based Electric Motorized Vehicles in Transjakarta Transportation Services", 2022, https://jdih.jakarta.go.id/dokumen/detail/5368.

28 Marissa Moultak, Nic Lutsey, and Dale Hall, *Transitioning to zero-emission heavy-duty freight vehicles*, (ICCT: Washington, DC, 2017), https://theicct.org/publication/transitioning-to-zero-emission-heavy-duty-freight-vehicles/.

FLEET PURCHASE REQUIREMENTS

To create demand for BEBs, governments sometimes mandate the purchase of zero-emission products for public transit fleets. As the world's largest consumer and producer of BEBs, China accelerated its new energy vehicle (NEV)[29] campaign through purchase requirements, including for its transit bus fleets. This created a sizeable market for a nascent technology and incentivized the bus industry to invest in research and development. The Chinese government's 2015 New Energy Public Transit Bus Promotion Policy targeted having 30% of bus purchases by transit operators be NEVs and for the national fleet of NEV transit buses to reach 200,000 by 2020.[30] Many cities like Shenzhen surpassed their targets.

More recently, the central government required 100% of urban buses be NEVs in key polluting cities under the Clean Diesel Action Plan in 2018–2020.[31] As of 2020, the central government's Green Mobility Action Plan targets at least 80% of new urban bus purchases to be NEVs nationwide.[32]

In California, the Innovative Clean Transit regulation requires that transit agencies buy only zero-emission buses from 2029 onward.[33] This regulation was adopted by the California Air Resources Board (CARB) in 2018 and is binding on all publicly funded transit agencies in California. The pathway to 100% requires that zero-emission buses comprise 25% of all new bus purchases by 2023 and 50% by 2026. CARB is allowing a slower transition timeline for transit agencies with fewer than 100 buses.

The MoF regulates the equivalent purchase requirement for public fleets in Indonesia. Its decree No. 72/2020 covers the procurement of government-operated BEVs. The decree releases BEVs from previous MoF provisions on maximum price limits for government fleets; it applies to all provinces in Indonesia and all types of four-wheeled operational vehicles. However, the decree does not set BEB procurement targets for public fleets. In 2022, President Widodo issued Instruction No. 7/2022 on the government fleet's transition to BEVs but left out public transit buses.[34] Through the MoHA, the government can still implement purchase requirements for its transit bus fleets and update the regulation to require BEV adoption in other vehicle segments. Another possibility is exploring policy synergy with the Ministries of State-Owned Enterprises and Industry, which oversee the supply of buses.

Two key points are relevant to Indonesia for formulating fleet purchase requirements:

» Purchase requirements normally begin with public fleets. The government has direct funding control over these vehicles; its experience can give private fleet owners and operators confidence and pave the way for broader purchase requirements.

29 NEV is a term used in China that includes battery electric and fuel-cell electric vehicles, as well as plug-in hybrid vehicles.

30 "交通运输部关于加快推进新能源汽车在交通运输行业推广应用的实施意见", [Ministry of Transport Guidance on accelerating the application of new energy vehicles in the transport sector], Ministry of Transport of the People's Republic of China, 2015, http://www.gov.cn/gongbao/content/2015/content_2883248.htm (In Chinese).

31 Hui He, *China's Clean Diesel Action Plan: 2018–2020*, (ICCT: Washington, DC, 2019), https://theicct.org/sites/default/files/publications/ICCT_China_Clean_Clean_Diesel_2018_2020_20190529.pdf.

32 "交通运输部国家发展改革委关于印发《绿色出行创建行动方案》的通知," [Ministry of Transport and National Development and Reform Council's notice on the publication of Green Mobility Action Plan], Ministry of Transport and National Development and Reform Council, 2020, http://www.gov.cn/zhengce/zhengceku/2020-07/26/content_5530095.htm (In Chinese).

33 "Innovative Clean Transit (ICT) Regulation Fact Sheet," California Air Resources Board, May 16, 2019, https://ww2.arb.ca.gov/resources/fact-sheets/innovative-clean-transit-ict-regulation-fact-sheet.

34 President of the Republic of Indonesia Instruction No 7/2022, "Tentang Penggunaan Kendaraan Bermotor Listrik Berbasis Baterai (Battery Electric Vehicle) Sebagai Kendaraan Dinas Operasional Dan/Atau Kendaraan Perorangan Dinas Instansi Pemerintah Pusat Dan Pemerintahan Daerah, [Concerning the use of battery-based electric motor vehicles (battery electric vehicles) as service operational vehicles and/or personal vehicles for services of central government and local government agency], September 13, 2022, https://peraturan.bpk.go.id/Home/Details/225262/inpres-no-7-tahun-2022 (In Indonesian).

» Like targets, fleet purchase requirements can sometimes be local or regional undertakings. While many cities and regions, including Jakarta, have their own procurement targets and timelines, a national target helps lower levels of government design and align their BEB timelines and creates a bigger national market to attract manufacturers.

MONETARY INCENTIVES

Monetary incentives can make electric products more economically attractive than diesel or CNG buses. They include direct funding for bus customers to cover the price gap between battery-electric and diesel buses, as well as other fiscal tools such as tax exemptions to purchase and register BEVs.

In the early stages of adoption, before economies of scale lower costs, high purchase prices may discourage transit operators from choosing BEBs, despite their long-term cost advantages. This is when purchase subsidies are most useful. China heavily subsidized BEB production and consumption in the 2010s. BEBs received central purchase subsidies of up to ¥500,000 (~$75,000) per vehicle, and fuel-cell buses received up to ¥600,000 (~$90,000) per vehicle. Between 2009 and 2016, the Chinese central government spent at least ¥12.6 billion (~$1.9 billion) to subsidize NEVs, excluding local funding and other forms of support.[35] Direct national and local subsidies for BEB purchases together reached up to 60% of the cost of the bus during the early stages of BEB deployment in China in 2015-2017.[36] While subsidies went to vehicle manufacturers, discounted prices were passed on to consumers.

India in 2015 introduced the Faster Adoption and Manufacturing of Electric Vehicles (FAME) program, a comprehensive set of policies to reduce the upfront cost of EVs, establish charging stations and infrastructure, and raise consumer awareness of EVs. The government initiated the second phase of FAME (FAME-II) in April 2019, making available ₹86.0 billion (~$1.3 billion) for purchasing EVs and earmarking an additional ₹10 billion (~$150 million) to support deployment of charging infrastructure.[37] Purchase incentives for bus operators to buy BEBs are a prominent component of the FAME-II scheme. In August 2020, the Indian Ministry of Heavy Industries (MHI) approved subsidies for 5,595 BEBs in 64 cities under FAME-II. It funds up to 40% of the estimated cost of buses, up to ₹6.5 million (~$97,000) for standard buses, ₹4.5 million (~$67,000) for midi buses, and ₹3.5 million (~$52,000) for minibuses. However, regional transit authorities, which had to design and set up their tenders at a competitive cost, possessed limited capacity and experience for these deployments. The Indian government appointed state-owned Convergence Energy Services Limited to aggregate BEB demand from nine cities and coordinate procurement of 5,450 buses.[38] As of June 2022, more than 3,100 BEBs were registered in India.[39] National fiscal incentives create demand at a scale that municipalities and regions cannot match. BEB adoption in India accelerated after demand was aggregated at the national level.

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35 "关于2016年及以前年度新能源汽车推广应用补助资金初步审核情况公示," [Public announcement on the preliminary review of subsidies for the promotion and application of new energy vehicles in 2016 and previous years], Ministry of Industry and Information Technology of the People's Republic of China, 2019, http://www.caam.org.cn/chn/8/cate_79/con_5222055.html (In Chinese).

36 Yang Chen. et al, "Electrification of Public Transport: A Case Study of Shenzhen Bus Group," (World Bank, 2021), https://documents1.worldbank.org/curated/en/708531625052490238/pdf/Electrification-of-Public-Transport-A-Case-Study-of-the-Shenzhen-Bus-Group.pdf.

37 "Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) Scheme - Phase I & II," International Energy Agency, 2023, https://www.iea.org/policies/12517-faster-adoption-and-manufacturing-of-hybrid-and-electric-vehicles-fame-scheme-phase-i-ii.

38 Amber Banerjee, "World's Largest Electric Bus Tender for 5,450 Buses: How CESL Orchestrated This Deal," *The Times of India*, May 24, 2022, https://timesofindia.indiatimes.com/auto/worlds-largest-electric-bus-tenderfor-5450-buses-how-cesl-orchestrated-this-deal/articleshow/91760385.cms.

39 Anuj Dhole and Pramoda Gode, "Electric buses in Maharashtra: Lessons from interviews and recommendations for future rollout in India, (ICCT: Washington, D.C., 2022), https://theicct.org/publication/maharashtra-lessons-from-interviews-aug22/.

In China, electric transit buses also receive operating subsidies from the central government. The exact amount depends on the vehicles' technical specifications, and buses must meet mileage requirements to be eligible.[40] Operating incentives for BEBs are less common elsewhere, in part because of their superior energy efficiency, and, in many cases, because electricity is cheaper than diesel. Governments can set policies that help BEBs retain this advantage, especially in infrastructure and energy pricing.

In March 2023, the Coordinating Ministry for Maritime and Investment Affairs announced a package to support BEV development in Indonesia. The MoI proposed 149 billion IDR (~$9.9 million) to subsidize the purchase of 552 BEBs in 2023/2024.[41]. Buses only receive 1% of the total available fund, with the rest of the funds allocated for passenger cars and motorcycles. The subsidy is offered as a 11% to 1% discount in value-added tax for battery-powered four-wheeled vehicles, including BEBs, that meet a domestic content level of 40%.[42]

In addition to the two new announcements, Indonesia has other monetary incentive programs. PR No. 55/2019 lays out provisions for EVs, including tax and import duty exemptions. MoHA Decree No. 1/2021 also sets a lower transfer fee (Bea Balik Nama Kendaraan Bermotor/BBNKB) for BEBs than for ICE buses. PR No. 55/2019 provides the legal basis for regional governments to offer fiscal benefits for BEV purchases. The DKI Jakarta government completely waives vehicle taxes and transfer fees for BEVs.[43] The provinces of West Java, East Java, and East Kalimantan offer up to 5% discounts on vehicle transfer fees for BEVs.[44]

Here are key lessons for Indonesia related to monetary incentives for BEBs:

- Increase the allocated subsidies for BEBs. The current 1% share of buses in the new incentive package is too low. More substantial purchase subsidies for buses can help overcome BEBs' upfront price premium for a greater number of operators and cities and encourage a modal shift to public transportation. In the near term, government funding will sustain the BEB market until technology improvements and cost reductions lower prices.
- Build a BEB focus into existing schemes. The BTS scheme today has no special BEB provisions. The MoT could strengthen and complement the BTS program with incentives that cover any cost gaps between BEBs and ICE buses, especially during the trial and pilot periods of new bus technologies. Furthermore,

40 L. Xue, W. Wei, P. Liu, & D. Liu, "Overcoming the Operational Challenges of Electric Buses: Lessons Learnt from China," (World Resources Institute, 2019), http://www.wri.org.cn/Overcoming_the_operational_challenges_of_electric_buses%3A%20lessons_learnt_from_China_CN.

41 Adi Ahdiat, "Usulan Anggaran Insentif Kendaraan Listrik, Bus Hanya dapat Sedikit," katadata.id, March 14, 2023, https://databoks.katadata.co.id/datapublish/2023/03/14/usulan-anggaran-insentif-kendaraan-listrik-bus-hanya-dapat-sedikit (In Indonesian).

42 Ministry of Finance Regulation 38/2023, April 1, 2023, https://peraturan.bpk.go.id/Home/Details/246542/pmk-no-38-tahun-2023 (In Indonesian).

43 "Insentif Pajak Bea Balik Nama Kendaraan Bermotor Atas Kendaraan Bermotor Listrik Berbasis Baterai (Battery Electric Vehicle) Untuk Transportasi Jalan," [Tax Incentive for Motor Vehicle Tax on Battery Electric Vehicle for Road Transportation], DKI Jakarta Governor Regulation 03/2020, January 15, 2020, https://peraturan.bpk.go.id/Home/Details/131358/pergub-prov-dki-jakarta-no-3-tahun-2020 (In Indonesian).

44 "Perubahan atas Peraturan Daerah Provinsi Jawa Barat Nomor 13 Tahun 2011 tentang Pajak Daerah," [Regional Regulation (PERDA) Concerning Amendments to West Java Province Local Act 13/2011 Concerning Regional Taxes], West Java Local Act 09/2019, 2019, https://peraturan.bpk.go.id/Home/Details/121550/perda-prov-jawa-barat-no-9-tahun-2019, (In Indonesian); "Peraturan Gubernur Daerah Istimewa Yogyakarta Nomor 27 Tahun 2020 Tentang Penghitungan Dasar Pengenaan Pajak Kendaraan Bermotor Dan Bea Balik Nama Kendaraan Bermotor," [Regulation of the Governor of the Special Region of Yogyakarta 27/2020 Concerning Basic Calculation of the Imposition of Motorized Vehicle Tax and Transfer Fee of Motorized Vehicles], DI Yogyakarta Governor Regulation 27/2020, 2020, https://jdihn.go.id/search/daerah/detail/1167883, (In Indonesian); "Peraturan Gubernur (PERGUB) tentang Nilai Jual Kendaraan Bermotor dan Nilai Jual Ubah Bentuk Sebagai Dasar Pengenaan Pajak Kendaraan Bermotor dan Bea Balik Nama Kendaraan Bermotor," [Governor Regulation (PERGUB) concerning Motorized Vehicle Sales Value and Change of Sales Value as the Basis for Imposition of Motorized Vehicle Tax and Transfer Fee of Motorized Vehicles], East Kalimantan Governor Regulation 4/2021, 2021, https://peraturan.bpk.go.id/Home/Details/184449/pergub-prov-kalimantan-timur-no-4-tahun-2021 (In Indonesian).

subsidizing ICE buses could undermine the superior energy efficiency, environmental benefits, and potential operational savings of BEBs.

- Limit national monetary incentives, especially purchase subsidies, in scope and duration to generate sufficient demand during market ramp-up and phase them out as economies of scale decrease BEB costs. In China, the central government has gradually cut funding to support BEBs. In 2020, a slow-charging 12-meter BEB received a maximum of ¥90,000 (~$13,000) – 80% less than what it could receive in 2016.
- To minimize financial burdens, consider incentive programs that follow a revenue-neutral approach (or bonus-malus system); fund BEBs with revenues generated from high-polluting vehicles and activities. A malus component in subsidy schemes promotes long-term fiscal sustainability while disincentivizing polluting vehicles and activities. California's Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project[45] and Carl Moyer Memorial Air Quality Standards Attainment Program[46] are examples of the "polluter pays" principle in which funding streams for BEB purchase incentives come from the state's CO_2 emissions trading revenues and smog fee and registration surcharges. The Indonesian MoF's October 2021 Harmonization of Tax Regulation bill would tax carbon emissions at no less than 30 IDR (~$0.0019) per kg CO_2e.[47] However, implementation of the carbon tax has been postponed until 2025.[48]
- Fund BEBs that meet stringent safety, performance, and operation requirements. Over time, the Chinese government introduced stricter technical requirements for buses and applied more robust verification and enforcement measures for fleets to qualify for subsidies. These practices promote efficient BEB procurement and operations that can reduce costs, improve air quality, reduce GHG emissions, and enhance service.
- Use financing as an alternative and complementary funding method. State-owned banks can create low- or zero-interest loans to offset vehicle and infrastructure capital costs.

INFRASTRUCTURE PLANNING, STANDARDS, AND SUBSIDIES

Governments are central to ensuring the availability of charging and fueling infrastructure to support bus electrification. Compared with other vehicle types that do not always travel on fixed routes and have no dedicated charging and parking locations, transit buses are relatively captive and centralized in ownership and operation. As a result, BEBs generally do not rely on geographically dispersed public charging stations that require public funding. Nor do national governments normally plan for charging networks for BEBs; charging and refueling decisions are specific to routes and fleets.

Nevertheless, national governments can provide funding for capital investment in bus-specific infrastructure. The Buses and Bus Facilities Program and Low or No Emission Vehicle (Low-No) Program from the U.S. Department of Transportation (DOT) provided $1.6 billion in 2022 to transit agencies to build and retrofit infrastructure to support BEBs.[49]

45 "Implementation Manual for the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)", California Air Resources Board, 2020, https://californiahvip.org/wp-content/uploads/2020/09/HVIP-FY2019-20-Implementation-Manual-1.pdf.

46 "The Carl Moyer Program Guidelines 2017 Revisions," California Environmental Associates and California Air Resources Board, 2017, https://ww2.arb.ca.gov/sites/default/files/2020-06/2017_cmpgl.pdf.

47 Meeting with Bappenas's Low Carbon Development Initiative (LCDI), National Development Planning Agency (Bappenas), 2021.

48 Teti Purwanti, "Pajak Karbon Ditunda Sampai 2025," *CNBC Indonesia*, October 13, 2022, https://www.cnbcindonesia.com/news/20221013175437-4-379582/pajak-karbon-ditunda-sampai-2025 (In Indonesian).

49 "Biden-Harris Administration Announces Over $1.6 Billion in Bipartisan Infrastructure Law Funding to Nearly Double the Number of Clean Transit Buses on America's Roads," U.S. Department of Transportation, August 16,2022, https://www.transportation.gov/briefing-room/biden-harris-administration-announces-over-16-billion-bipartisan-infrastructure-law.

Governments can also help lower the cost to operate charging infrastructure. California's Low Carbon Fuel Standard (LCFS) is a market-based mechanism to increase the use of low-carbon transportation fuels. Fleets that invest in, own, and operate charging and hydrogen refueling infrastructure generate credits based on the amount of fuel they use. The credits can be sold for revenue to support the ownership and operation of BEBs.

Furthermore, governments can play a key role in charging planning and standards. In Indonesia, the national electricity company PLN and MEMR's Directorate General for Electricity have published an EV charging infrastructure development plan.[50] While the plan does not currently address BEB charging needs, specify technical requirements for charging equipment, or harmonize the charging equipment standards, updates to the plan and future enforceable regulations could include these features.

MEMR's electricity pricing structure also enables lower operating costs for BEBs. Under MEMR Regulation 28/2016, BEB charging belongs to "bulk electricity," electricity tariffs for BEB charging range from 565.6–1,414 IDR/kWh (compared to household electricity tariffs that range from 1,600–2,300 IDR/kWh).

One option to reduce energy costs and encourage off-peak charging that lowers demand on the electricity grid is temporal, or time-of-day (TOD), electricity pricing. The pricing structure requires advanced metering infrastructure and the necessary regulatory framework (neither of which is currently in place in Indonesia).

There are three important lessons on the role of the central government to support BEB infrastructure:

- Infrastructure incentives through crediting mechanisms, such as low-carbon fuel standards, can lower the energy costs of BEBs and improve total cost of ownership comparisons with ICE vehicles. In California, the LCFS not only subsidizes fleet owners that use electricity and hydrogen but also charges a premium on fossil fuels like diesel.
- In the next few years, BEB products in Indonesia will likely come from multiple brands and countries; the national government should lay out technical standards to ensure compatibility across buses and charging equipment.
- The government should maintain current industrial electricity prices for BEBs and explore TOD tariffs to drive down costs and manage the power demand for the grid.

INDUSTRIAL POLICIES

While few governments have made dedicated efforts to expand BEB production, industrial policies can attract manufacturers to invest in and facilitate the production of EVs. A burgeoning EV industry improves the affordability, accessibility, and selection of BEB models for transit operators.

China's status as the world's largest EV producer and consumer is primarily attributed to its forward-looking policy to develop the NEV industry as a strategically important economic sector. In 2009, China's State Council issued the Auto Industry Adjustment and Revitalization Plan and set the first official goal for massive NEV deployment.[51]

50 "Road Map Pengembangan Infrastruktur Kendaraan Listrik (2020-2024)", [Roadmap of the development of Electric Vehicle Infrastructure (2020-2024)], MEMR, 2020, https://gatrik.esdm.go.id/assets/uploads/download_index/files/ab04d-road-map-pengembangan-infrastruktur-kendaraan-listrik-pln-.pdf (In Indonesian).

51 Lingzhi Jin, Hui He, Hongyang Cui, Nic Lutsey, Chuqi Wu, Yidan Chu, Jin Zhu, Ying Xiong, and Xi Liu, "Driving a Green Future: A Retrospective Review of China's Electric Vehicle Development and Outlook for the Future" (ICCT, China EV100: Washington, D.C., 2021), https://theicct.org/sites/default/files/publications/China-green-future-ev-jan2021.pdf.

In contrast to China's approach, successful BEB adoption in countries such as Chile, Colombia, and Mexico relied less on industrial policies than other facilitating policy tools. For example, in Mexico, EVs (including BEBs) are exempt from import tariffs from 2020-2024. This facilitated the import of 165 BEBs by the end of 2022.

In recent years, several countries have adopted industrial policies intended to develop and strengthen EV battery supply chains, especially for upstream raw materials. With its abundant nickel ore reserves, Indonesia is exploring joint ventures with foreign battery and vehicle manufacturers to build up its EV value chain.[52]

Presidential Regulation No. 55/2019 requires domestic vehicle and component manufacturing and promises financial incentives for investments in capital goods and research and development activities. For BEBs specifically, Indonesia's MoI developed Ministerial Decree No. 27/2020, the Roadmap of Industry Development for BEVs, which included a timeline to import BEBs as complete knockdowns (CKD) from 2020 to mid-2022, followed by incomplete knockdowns (IKD) from mid-2022 to 2024. The decree also set annual targets for domestic content in EV manufacturing – 40% from 2022-2023, 60% from 2024-2029, and 80% thereafter. In the interim, MoI Decree No. 28/2020 allows the import of BEVs in the form of CKDs and IKDs and the import of individual components. Furthermore, MoF, through Regulation No. 150/PMK. 010/2018,[53] and the Indonesia Investment Coordinating Board, through Regulation No. 1/2019,[54] provide corporate income tax deductions of up to 100% to eligible vehicle or component manufacturers.

For a country still relatively new to EV production, Indonesian policymakers must balance developing a local manufacturing base in the mid- to long-term with the more immediate market demand for BEBs. Here are key lessons for industrial policy support:

- Requiring high local content and restricting imported CBU buses from receiving fiscal incentives (as is the norm) during the early stages of EV market development may slow the uptake of this technology. While Indonesia aspires to be a global player in the EV value chain, ultimately, local research and development and technology transfer will take time. Maintaining high local content requirements might derail electrification plans for cities like Jakarta because there may not be enough products available or the products may be too expensive.
- On the other hand, allowing a high number of CBU bus imports for a prolonged period may erode the national EV industry's early growth.
- Successful public-private partnerships between industry, government (for example, through the National Research and Innovation Agency and MoI), and academic and research institutions can support domestic design, prototyping, and full-scale production of BEBs. At the same time, Indonesia should be open to foreign investment to attract know-how and capital and help develop the national EV industry.

52 International Energy Agency, "Global Electric Vehicle Outlook 2022," (2022), https://www.iea.org/reports/global-ev-outlook-2022.

53 Ministry of Finance of the Republic of Indonesia, "Peraturan nteri Keuangan Republik Indonesia No. 150 Tahun 2018 Tentang Pemberian Fasilitas Pengurangan Pajak Penghasilan Badan", [Regulation of the Minister of Finance of the Republic of Indonesia No. 150 of 2018 concerning the Provision of Corporate Income Tax Reduction Facilities], 2018, https://peraturan.bpk.go.id/Home/Details/113460/pmk-no-150pmk0102018 (In Indonesian).

54 Indonesia Investment Coordinating Board, "Peraturan Badan Koordinasi Penanaman Modal Republik Indonesia Nomor 1 Tahun 2019 Tentang Rincian Bidang Usaha dan Jenis Produksi Industri Pionir yang Dapat Diberikan Fasilitas Pengurangan Pajak Penghasilan Badan Serta Pedoman dan Tata Cara Pemberian Fasilitas Pengurangan Pajak Penghasilan Badan", [Regulation of the Investment Coordinating Board of the Republic of Indonesia Number 1 of 2019 concerning Details of Business Fields and Types of Production of Pioneer Industries that Can Provide Corporate Income Tax Deduction Facilities as well as Guidelines and Procedures for Providing Corporate Income Tax Deduction Facilities], 2019, https://peraturan.bpk.go.id/Home/Details/169080/peraturan-bkpm-no-1-tahun-2019 (In Indonesian).

» The low number of BEBs in operation in Indonesia suggests that current regulations may require revisions to avoid stifling EV market growth. A study on the broader fiscal and economic benefits and challenges of temporarily relaxing domestic content levels and reducing import duties for CBUs, semi knockdowns (SKDs), or CKDs is recommended to ensure that early EV market growth does not depend only on domestic production.

PERFORMANCE STANDARDS: ZEV REGULATIONS/FUEL CONSUMPTION, CO_2, AND GHG STANDARDS

Legally binding vehicle regulations can accompany phase-out targets to cement manufacturers' shift to zero-emission bus production and overcome supply barriers. Regulations can take two forms: Requiring a certain share of a manufacturer's vehicles to be zero-emission, sometimes known as ZEV mandates, and stringent performance standards in fuel consumption, CO_2, and GHG emissions that can be achieved more economically with zero-emission drivetrains. Both policy instruments target vehicle producers and have been adopted by leading markets in other vehicle segments.

The most noteworthy example of zero-emission vehicle regulation is in California. The Advanced Clean Cars program adopted by the state in 2012 features several interlinked regulations intended to reduce light-duty vehicle (LDV) emissions, including a ZEV percentage credit requirement for auto manufacturers.[55] The efficacy of California's LDV ZEV mandate is demonstrated by the state's nearly 19% ZEV share of all new passenger vehicle sales in 2022, which was three times that of the rest of the United States.[56] In 2019, the California Air Resources Board passed the Advanced Clean Trucks regulation, the first binding regulation in the world to require manufacturers to sell increasing percentages of zero-emission trucks.

The European Union's (EU) 2020 LDV CO_2 regulations are credited with raising Europe's ZEV share of new passenger car registrations from 3 to 11%. In the HDV space, the EU's and the United States' current CO_2 and GHG standards provide extra incentives for manufacturers to produce ZEVs. As an incentive to manufacturers, zero-emission HDVs are counted more than once in the average CO_2 emissions of a manufacturer, which helps lower their fleet-average value for compliance.

To be clear, there is no ZEV sales requirement for buses in any market today. As its name suggests, California's Advanced Clean Trucks regulation concerns only trucks. Buses are also not yet covered under the current scope of the EU's HDV CO_2 emission standards. While the utility of these policy tools for BEB promotion is unclear, fuel consumption and CO_2 standards and/or ZEV regulations have far-reaching benefits for a country's automobile industry beyond just BEBs. To be effective, ZEV regulations and fuel consumption, CO_2, and GHG standards should be:

» Aligned with overarching phase-out targets and fleet purchase requirements.

» Implemented on a timetable that allows manufacturers to gradually increase the number and share of EVs, including BEBs, in production. At the same time, the long-term timetable must be forward-looking and drive technological innovation by setting high benchmarks.

» Developed to provide flexibilities (e.g., credits and credit multipliers) to facilitate manufacturer compliance in initial stages, but with limited scope and duration. Ideal flexibilities and incentives in GHG/fuel economy standards should strike a

55 Shikha Rokadiya and Zifei Yang, "Overview of global zero-emission vehicle mandate programs" (ICCT: Washington, D.C., 2019), https://theicct.org/publication/overview-of-global-zero-emission-vehicle-mandate-programs/.

56 "California ZEV Sales Near 19% of All New Car Sales in 2022," Office of Governor Gavin Newsom, January 20, 2023, https://www.gov.ca.gov/2023/01/20/california-zev-sales-near-19-of-all-new-car-sales-in-2022/.

balance between incentivizing ZE-HDVs and diluting the benefits from GHG and fuel economy standards.

- Stringent enough to compel manufacturers to improve the performance of their products, which has the added benefit of reducing fuel usage. This frees up financial resources devoted to subsidizing diesel consumption, which can then be used to support electric mobility initiatives.
- Designed with a framework of supply-side policies that could benefit the entire road transportation sector when extended to other vehicle classes and segments.

PRIVILEGES AND PREFERENTIAL TREATMENT

Privileges and benefits exclusive to the ownership and operation of BEBs can encourage transit operators to turn away from ICE vehicles. Leading cities are already implementing two forms of preferential treatments.

In tendering processes, cities including Bogotá, Kolkata, Mexico City, and Santiago award longer contracts to operators that submit BEB bids – sometimes twice as long as conventional diesel bus contracts. A longer contract helps recover the cities' higher upfront purchase costs and possible battery replacement costs, enabling BEBs to maintain a competitive cost per kilometer compared with ICE buses. Transjakarta's operating contracts with third-party BEB operators last 10 years, 3 years longer than diesel bus contracts.

Zero-emission zones are areas where only pedestrians, cyclists, and ZEVs are granted unrestricted access. Other vehicles are either prohibited from entering or permitted to enter upon payment of a fee. Zero-emission zones are often based on existing low-emission zones, which limit the access and operation of vehicles that do not meet certain environmental performance standards. For example, Amsterdam is progressively upgrading its low-emission zone (which allows only Euro IV buses) to a zero-emission zone that will cover the entire city by 2030.[57]

Privileges and favorable treatment for BEBs do not involve significant financial resources. Given their limited geographic scale, the design and implementation of such programs will be decided by cities and regions. However, to facilitate that work, the Indonesian government can:

- Enable longer contracts for public transit operation of BEBs (e.g., up to 15 years) while keeping ICE buses at current contract lengths (7 years maximum).
- Provide more and longer government support to the BTS scheme for BEBs.
- Create the legal framework for cities and regions to designate and implement zero-emission zones.

POLICY ROADMAP FOR INDONESIA

National policies that immediately and directly promote BEB adoption should be considered highest priority by the Indonesian government. Local governments will play important roles in adopting these policies, while SOEs, civil society, and other stakeholders can help secure a successful transition to zero-emission buses. Table 2 summarizes recommended policy actions for Indonesia and describes timelines and the roles various policymakers could play.

Table 2. Summary of recommended policies

57 Hongyang Cui, Pramoda Gode, and Sandra Wappelhorst, "A global overview of zero-emission zones in cities and their development progress" (ICCT: Washington, D.C., 2021), https://theicct.org/publication/a-global-overview-of-zero-emission-zones-in-cities-and-their-development-progress/.

Policy Action	Overview and Scope	Timeline	Policymaker Roles
Phase-out targets	National-level policy/regulation to ban sales and registrations of ICE buses by a certain year (100% phase-out target).	Short term	President's Office: Announce phase-out target. MoT: Announce targets for new buses along with an accompanying electrification target. MoE, MEMR, and BUMN (in coordination with PLN and Pertamina): Address charging infrastructure. MoI (in conjunction with MoT): Ensure national industry readiness, develop plans to fulfill the target, and set regulations for old bus retrofitting.
Fleet purchase requirements	A national level decree that would mandate an increased share of zero-emission buses under a predefined timeline that scales up over time. Different timelines can be defined by province to better reflect local public transit conditions. This would allow for local transit fleets to scale up (through a progressive design) BEB operations and recondition depots to accommodate new technology. Clarify national funding support to local authorities to finance purchases of vehicles and infrastructure. Encourage cities to electrify fleets and catalyze a nationwide BEB transition. Encourage investors by providing a better defined, lower risk market for manufacturing, assembly, and import of EV components and complete units.	Short term, following national ICE bus phase-out targets. Phased-in and scaled over time, enabling industry to answer to increasing demand and local authorities and bus operators to address technical and operational barriers. Timelines and targets can be stronger for larger operators and more flexible for smaller ones.[58]	MoT: Develop regulations allowing only the registration of BEBs for public transit fleets. MoF: Issue state budget allocations to fund purchases. MoHA: Synchronize regional governments' procurement of vehicles with national-level regulations. BUMN: Coordinate the response of SOEs (e.g., INKA, DAMRI), prioritizing responses from larger operators.
Monetary incentives	A necessary component of fleet purchase requirements to help transit operators overcome the cost barrier to buying BEBs. Nationally coordinated subsidies can pool bus orders and create demand to attract manufacturers and lower prices. Subsidizing hundreds, if not thousands, of BEB purchases yearly will be costly. Funding must be targeted, nimble, and sourced from other polluting activities. Funding could be generated by the future implementation of the carbon tax in Indonesia, or from reallocating a fraction of the state budget that subsidizes diesel to BEB purchases and infrastructure.	Short-term regulatory development for both fiscal and direct monetary subsidies. Implementation should be limited to the near future, as monetary incentives can be phased out in the long term as battery technology becomes less expensive. Tax incentives can be adopted and implemented in the short-term (the key challenge will be to find a sustainable subsidy funding source. In the near term, funding can be allocated from diesel subsidies revenue sources, while a more fiscally stable method is developed in the medium term.	MoF: Develop monetary incentives for BEB purchases. MoF and MEMR: Develop long-term funding support for BEB subsidies (MEMR oversees fuel pricing). MoF and MEMR: Develop mechanisms and regulations to simultaneously tax polluting fossil fuel usage and allocate funds for BEB subsidies. Parliament: Approve mechanisms and regulations to simultaneously tax polluting fossil fuel usage and allocate funds for BEB subsidies.

58 "Innovative Clean Transit (ICT) Regulation Fact Sheet," California Air Resources Board, May 16, 2019, https://ww2.arb.ca.gov/resources/fact-sheets/innovative-clean-transit-ict-regulation-fact-sheet.

Policy Action	Overview and Scope	Timeline	Policymaker Roles
Infrastructure planning, standards, and subsidies	BEBs face fewer infrastructural bottlenecks than electric long-haul trucks or passenger vehicles, which need more geographically widespread public charging stations. Nevertheless, the cost of investing in depot charging is not negligible. Insufficient charging infrastructure will impair vehicle operations and delay deployments. Government support can lower capital and operating costs of BEB charging infrastructure, at least during the early stages of the fleet deployment scale-up. Provisions for public transit fleet electrification must be developed and incorporated into PLN and MEMR's EV charging infrastructure development plan.[59] The plan should require technical standards, focusing on harmonizing charging equipment. Government vehicle subsidies should also cover charging infrastructure and grid connections and upgrades. Preferential electricity tariffs support the early adoption of BEBs and help reduce operating costs for those vehicles and should be maintained with further optimizations through TOD tariffs.	Short-term infrastructure planning and standards development, as well as technical standards for BEB charging infrastructure. Short- to medium-term for charging infrastructure and electricity price subsidies.	MEMR, PLN: Develop regulations and policies to secure the planning and development of BEB infrastructure. MoT: Coordinate planning timelines as BEBs are adopted locally. MEMR: Expand technical regulations for EV charging infrastructure to buses. MEMR and MoF: Define the level of national subsidies (through Parliament's approval for the sale of electricity for BEBs operating in public transit systems).
Industrial policies	Industrial policies will be important to ensure an adequate supply of BEBs and components at reasonable costs. BEBs should be part of the EV industrial development master plan. However, the more immediate supply may need to come from vehicle imports or CKDs/IKDs with components not manufactured in Indonesia. To address the shortage of BEB products, it is advisable to temporarily lower current domestic content requirements for manufacturers and sellers and reduce import tariffs for vehicle parts and assembled products. Moving forward, the priority should shift to attracting investment in the domestic EV value chain and acquiring the technical know-how to produce components and vehicles in Indonesia.	Short term, the government could temporarily relax domestic content requirements to access import tax incentives for EV components and complete units. The limited number of Indonesia-built BEBs operating in the country suggests that bolder industrial actions are needed soon. Medium- to long-term policy actions to spur investments in the EV value chain and local production of BEBs are needed to meet the long-term phase-out targets of ICE buses and the increased demand from public transit fleet mandates.	MoI: update domestic content requirements for BEBs in a progressive way that responds to immediate demand needs while securing long term viability for current domestic builders. Coordinating Ministry of Maritime and Investment Affairs: Address issues related to industrial investment schemes.
Performance standards	Indonesia will need to start designing fuel economy, CO_2 emission standards, or ZEV regulations for the entire road transport sector (a time and resource-intensive endeavor). To electrify public transit buses, demand-side policies have more immediate effects; supply-side tools stimulate the industrial development of a wide range of vehicle segments, including passenger cars and HDVs. For example, CO_2 emission standards for HDVs and engines, including those used in public transit buses, will compel manufacturers to improve the fuel efficiency of their products and provide an additional compliance avenue for electric powertrains to meet those standards.	Medium-term development of regulations and technical norms that govern performance standards (given these policies require significant technical analysis to support implementation). Implementation would require significant lead time to allow vehicle manufacturers and importers to respond to technological changes in their production and importing lines.	MoEF: Set vehicle emissions standards.[60]

59 MEMR 2020.

60 In other regions, fuel economy standards and ZEV mandates are often developed, implemented, and managed by the Ministry of Industry.

Policy Action	Overview and Scope	Timeline	Policymaker Roles
Privileges and preferential treatment	Implemented by cities and provinces and supported by the national government. By updating tendering and procurement processes to favor BEB purchases, offering longer contracts for public transit operators that commit to deploying BEBs, and adopting zero-emission zones in some areas of cities, preferential treatment and exclusive privileges to BEBs complete the demand-side policies. Zero-emission zones or longer BEB contracts cost less than fiscal subsidies and complement other policies that promote demand for BEBs. These are often designed and implemented locally and are, therefore, a lower priority for the national government.	Short-term implementation (given that some policies, like tendering and procurement practices to support BEBs, are easily adopted). Short- medium term design and implementation of zero-emission zone policy (given the time needed for studies and preparatory designs and for implementation on the ground).	Local governments: Manage bus tendering and procurement (although the experience from India's FAME-II scheme showed how procurement can also be centralized and supported nationally). Design and implement zero-emission zones. MoT: Potentially issue national-level guidelines for public transit bus procurement by cities and establish, through appropriate policy mechanisms, longer contracts for public transit operators of BEBs, centralized procurement systems, and other key aspects of public tendering and procurement of BEB services (e.g., access to purchase subsidies). MoEF: Potentially support low-emission and zero-emission zone implementation with funding for monitoring and enforcement technology (e.g., air quality monitoring stations, physical infrastructure, and cameras). MoHA: Supervise and synchronize regulations for tendering and procurement, to align low-emission zones implemented by local authorities with national policies and regulations.