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Indonesia Sustainable Mobility Outlook 2025

Driving Transport Decarbonization: Multi-pathways to Sustainable Mobility in Indonesia

Imprint

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Driving Transport Decarbonization: Multi-pathways to Sustainable Mobility in Indonesia

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Foreword

Motion for the Future: Indonesia Sustainable Mobility Blueprint

Indonesia is at a crucial point in building its sustainable future. As one of the world's largest economies and most populous countries, our decisions today will shape our economic prospects and significantly influence our role in global climate stability. The transportation sector, responsible for a large share of our national greenhouse gas emissions, presents both our biggest challenge and our best chance to reach net-zero emissions by 2050. CO_2 emissions from transportation reached approximately 202 million tonnes in 2024, accounting for roughly 25% of Indonesia's total emissions. Although growth has slowed to around 2% per year since the Paris Agreement, the overall trend continues upward, driven by rising mobility and vehicle ownership, highlighting the urgent need for transformational action.

This Indonesia Sustainable Mobility Outlook (ISMO) arrives at a time when urgent action is no longer optional—it is essential. Our transport sector has grown rapidly alongside our economic development, bringing improved connectivity and mobility to millions of Indonesians. However, this growth has come with environmental and economic costs that we can no longer ignore. Road transport alone accounts for approximately 28% of our national carbon emissions and contributes to worsening air quality in many cities, making it a priority area for immediate intervention.

The path to sustainable mobility requires a fundamental shift in how we approach transportation. This change cannot happen through market forces alone; it needs coordinated policy measures, effective regulations, and strategic investments. The government recognizes that reducing transport emissions requires a multifaceted approach that encompasses vehicle standards, fuel quality, infrastructure development, and behavioral change.

Our regulatory framework must evolve to support cleaner transportation options while ensuring economic growth continues. This includes implementing stricter emission standards for vehicles, promoting the use of cleaner fuels, creating incentives for sustainable transport choices, and creating demand for electric mobility. The Government of Indonesia is committed to developing policies that encourage innovation while providing clear guidelines for both industry and consumers.

Improvements in public transportation remain a key component of the strategy. By investing in efficient, accessible, and clean public transportation systems, we can reduce the number of private vehicles on our roads and improve mobility for all citizens. This involves expanding bus rapid transit networks, building integrated transportation systems, and making public transit a preferred choice rather than an option of last resort.

The acceleration of electric vehicle deployment is another key component of our strategy to reduce fuel subsidies and emissions, particularly through comprehensive supply-side policies in Indonesia. The government's plan to establish a robust local electric vehicle manufacturing system by offering targeted incentives for battery production, component manufacturing, and assembly must be continued with a strong commitment. By establishing attractive investment conditions, simplifying regulations for electric vehicle makers, and developing industrial zones dedicated to electric vehicle production, we aim to make Indonesia a regional center for sustainable mobility manufacturing. These supply-side actions, along with local content requirements and technology transfer agreements, will help ensure that our shift to electric mobility creates jobs, enhances technical skills, reduces reliance on imported vehicles, and makes electric vehicles more affordable and accessible for Indonesian consumers.

Infrastructure development is just as important. Again, the government must work to establish charging networks, increase grid capacity, and make sure the necessary infrastructure for sustainable mobility is available across our diverse archipelago. This includes both urban and rural areas, recognizing that sustainable mobility must be inclusive and accessible to all Indonesians.

The journey toward sustainable mobility is challenging, but it is a step we must take with resolve and a clear purpose. This report, grounded in evidence, best practices, and our specific national context, presents a comprehensive analysis and action agenda for all stakeholders. Together, we can develop a sustainable mobility that benefits our people while protecting our planet for future generations.

Jakarta, July 2025

Fabby Tumiwa

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Abbreviations

2W : Conventional two-wheelers
A-S-I : Avoid, shift, and improve
APBD : *Anggaran Pendapatan dan Belanja Daerah* (Regional Revenue and Expenditure Budget)
APC : Air pollution control
APILL : *Alat Pemberi Isyarat Lalu Lintas* (traffic light)
ASC : Alternative specific constant
ASEAN : Association of Southeast Asian Nations
ATP : Ability to pay
Bappenas : *Badan Perencanaan Pembangunan Nasional* (Ministry of National Development Planning)
BESS : Battery energy storage system
BEV : Battery electric vehicle
B100 : Biofuel blending of 100%
B30 : Biofuel blending of 30%
B35 : Biofuel blending of 35%
B40 : Biofuel blending of 40%
B60 : Biofuel blending of 60%
BKT : *Badan Kebijakan Transportasi* (National Transportation Policy Agency)
BMS : Battery management system
BoE : Barrel of oil equivalent
BPDPKS : *Badan Pengelola Dana Perkebunan Kelapa Sawit* (Indonesia Oil Palm Plantation Fund Management Agency)
BPJS : *Badan Penyelenggara Jaminan Sosial* (Social Security Agency)
BPTJ : *Badan Pengelola Transportasi Jabodetabek* (Jabodetabek Transportation Management Agency)
BRI : Belt and Road Initiative
BRT : Bus rapid transit
BTS : Buy the Service
CAGR : Compound annual growth rate
CAPEX : Capital expenditure
CBD : Central business district
CBU : Completely built-up
CKD : Completely knocked-down
CLD : Causal Loop Diagram
CN48 : Cetane number 48
CN51 : Cetane number 51
CO : Carbon monoxide
CO_2 : Carbon dioxide
CO_2e : Carbon dioxide equivalent
E2W : Electric two-wheelers
E4W : Electric four-wheelers
E5 : Ethanol blending of 5%
ENDC : Enhanced Nationally Determined Contribution
ESG : Environmental, Social, and Governance
ESS : Energy storage system
EU : European Union
EV : Electric vehicle
FAME : Fatty acid methyl ester
FBC : Final Business Case
FCEV : Fuel-cell electric vehicle
FeNi : Ferronickel

Abbreviations

GDP	:	Gross domestic product
GHG	:	Greenhouse gases
GR	:	Government regulation
GW	:	Gigawatt
GWh	:	Gigawatt-hour
HC	:	Hydrocarbon
HDV	:	Heavy-duty vehicle
HEV	:	Hybrid electric vehicle
HSR	:	High-speed rail
IBC	:	Indonesia Battery Corporation
ICE	:	Internal combustion engine
ICEV	:	Internal combustion engine vehicle
IDR	:	Indonesian rupiah
IDX	:	Indonesia Stock Exchange
INA	:	Indonesia Investment Authority
IRA	:	Inflation Reduction Act
IVO	:	Industrial vegetable oil
Jabodetabek	:	Jakarta, Bogor, Depok, Tangerang, and Bekasi
JAKI	:	Jakarta Kini (Jakarta smart city app)
JUTPI	:	Jabodetabek Urban Transportation Policy Integration
KA	:	*Kereta api* (train)
Km	:	Kilometer
km/h	:	Kilometer per hour
KRD	:	*Kereta rel diesel* (diesel commuter train)
KRL	:	*Kereta rel listrik* (commuter rail line)
kWh	:	Kilowatt-hour
LCR	:	Local content requirements
LCS	:	Limited concession schemes
LEZ	:	Low emission zones
LFP	:	Lithium iron phosphate
LiOH	:	Lithium hydroxide
LRT	:	Light rail transit
LULUCF	:	Land use, land-use change, and forestry
LVC	:	Land value capture
MEMR	:	Ministry of Energy and Mineral Resources (Republic of Indonesia)
MHP	:	Mixed hydroxide precipitate
MoEF	:	Ministry of Environment and Forestry (Republic of Indonesia)
MoF	:	Ministry of Finance (Republic of Indonesia)
MoHA	:	Ministry of Home Affairs (Republic of Indonesia)
MoI	:	Ministry of Industry (Republic of Indonesia)
MoInv	:	Ministry of Investment (Republic of Indonesia)
MoT	:	Ministry of Transportation (Republic of Indonesia)
MPV	:	Multi-purpose vehicle
MRT	:	Mass rapid transit
$MtCO_2$	:	Megatonne of carbon dioxide
NiMH	:	Nickel-metal hydride
NMC	:	Nickel manganese cobalt
NMT	:	Non-motorized transport
NOx	:	Nitrogen oxides
NZE	:	Net-zero emissions
OD	:	Origin-destination

Abbreviations

PDB	:	*Produk Domestik Bruto* (gross domestic product)
PHEV	:	Plug-in hybrid electric vehicle
PLI	:	Production-linked incentives
PLN	:	*Perusahaan Listrik Negara* (State Utility Company)
PM	:	Particulate matter
PPJ	:	*Perkeretaapian Perkotaan Jakarta* (Jakarta urban railways)
Ppm	:	Parts per million
PPP	:	Public-private partnership
PR	:	Presidential regulation
PSN	:	*Proyek Strategis Nasional* (National Strategic Project)
PSO	:	Public service obligation
PT:	:	Public transportation
Q1:	:	Quarter 1
RIPNAS	:	*Rencana Induk Perkeretaapian Nasiona*l (National Railways Master Plan)
RIPP	:	*Rencana Induk Perkeretaapian Provinsi* (Provincial Railways Master Plan)
RITJ	:	*Rencana Induk Transportasi Jabodetabek* (Jabodetabek Transportation Master Plan)
RPJMN	:	*Rencana Pembangunan Jangka Menengah Nasional* (National Medium-term Development Plan)
SCR	:	Selective catalytic reduction
SDG	:	Sustainable development goals
SLA	:	Sealed lead acid
SoE	:	State-owned enterprises
SOP	:	Standard operating procedures
SPBKLU	:	*Stasiun Penukaran Baterai Kendaraan Listrik Umum* (battery swapping station)
SPKLU	:	*Stasiun Pengisian Kendaraan Listrik Umum* (plug-in charging station)
SPM	:	*Standar pelayanan minimal (minimum service standard)*
SRUT	:	*Sertifikat Regisrasi Uji Tipe (*Type Test Registration Certificate*)*
SSR	:	Supply-side regulations
SUMP	:	Sustainable urban mobility plan
SUV	:	Sports utility vehicle
SWF	:	Sovereign Wealth Fund
TCO	:	Total cost of ownership
TDM	:	Travel demand management
TfL	:	Transport for London
TOD	:	Transit-oriented development
USD	:	United States Dollar
VAT	:	Value-added tax
VKM	:	Vehicle per kilometer
VRE	:	Variable renewable energy
VRLA	:	Valve-regulated lead-acid
WFH	:	Working from home
WHO	:	World Health Organization
WTP	:	Willingness to pay
xEV	:	Electrified vehicle (term covering HEV, PHEV, BEV, FCEV)

Executive summary

Urgency for sustainable mobility

- The transportation sector in Indonesia consumes more than 40% of all final oil, the majority of which is imported, making it the country's largest oil and second-largest energy consumer. Road and land transportation account for 90% of the transportation sector's energy consumption. Road transport also contributed over 80% of transport emissions, **which grew 1.56% annually to reach 202 MtCO_2** in 2024. Transport oil use exposes the country to global price shocks and pushed fuel subsidies to 17% of the state budget in 2022. Transport efficiency is key to 5% and 8% GDP growth by 2025 and 2029, respectively. Scaling **sustainable mobility efforts can reduce oil use by over 29 million BOE by 2030** while lowering logistics costs, boosting productivity and supporting clean industry growth.
- Road-based mobility imposes growing environmental and economic costs. **Motorized transport is a major source of urban air pollution, contributing 19% of PM2.5 concentrations in 11 cities and over 90% of transport-related deaths from PM2.5 and ozone exposure**. The national mode share is dominated by motorcycles, accounting for nearly 70%, while walking and cycling remain below 2%—a reflection of poor walkability, low-density development, and fragmented public transport networks. This imbalance, combined with **weak spatial planning, causes chronic congestion that costs at least USD 4 billion annually, or 0.5% of Gross Domestic Product (GDP), and wastes over 2.2 million liters of fuel each day in major cities**. Despite these systemic issues, **mitigation policies remain heavily focused on fuel and vehicle technology, with only 2 out of 17 measures in Minister of Transport Regulation 8/2023 addressing "Avoid" strategies** like land use and travel demand reduction.

"Avoid" strategies

- Urban density strongly correlates with lower vehicle ownership and emissions. In Indonesia, every additional car per 100 residents is associated with a 1.4% drop in urban density. Compact development reduces travel distances, vehicle use, and energy demand. In Indonesia, the most common transit-oriented development (TOD) spots are located in Jakarta**. Jakarta's current TOD facility index scores only 0.3, risking suboptimal outcomes**. However, a 2022 survey shows **TOD areas already reduce trip distances and shift mode choices—car use down by 27%, motorcycle use down by 25%, and cycling increased by 200%**.
- Travel demand management (TDM) tools like odd-even restrictions, low emission zones (LEZ), car-free days, and working from home (WFH) are emerging, but need stronger enforcement and integration. These policies have shown early gains in managing peak congestion, but long-term success depends on broader system reform. Remote work offers significant potential to reduce emissions from commuting, with **69% of Indonesian workers believing they can WFH**. A major post-pandemic working pattern has emerged: **in-office work dropped by 26%, hybrid arrangements increased by 27%, and 62% of respondents preferred to continue working hybrid.** The increased residential emissions from WFH are often offset by avoided travel. Global evidence suggests that one WFH day per week can generate net energy savings up to four times greater than the added residential consumption.

"Shift" strategies

- Bus, intercity rail, and urban rail serve as a public transport system. **Bus Rapid Transit (BRT) offers flexible routing and scalable coverage.** However, public interest to take public transport remains low in many cities due to poor travel time reliability, particularly when buses operate in mixed traffic (without dedicated lanes). Jakarta's Transjakarta, with 14 corridors spanning over 250 km, has inspired replication in six other metropolitan areas. **Three cities—Bandung, Medan, and Semarang—have begun construction of new BRT systems, each with budgets ranging from IDR 1-2 trillion.** Commuter rail systems in Jabodetabek and Yogyakarta–Surakarta have long operated over capacity, with peak load factors reaching up to 272%. Nationally, Indonesia is steadily **expanding its rail network,**

with 7,451 km of track completed toward the 2030 RIPNAS target of 10,524 km. This progress reflects alignment with long-term national goals, though current infrastructure remains heavily concentrated in Java.

- Teman Bus and BisKita, city bus services launched under the Indonesian government's Buy the Service (BTS) scheme, now operate in **8 cities.** Managed by the Ministry of Transport and Ministry of Finance, the scheme allows authorities to set minimum service standards and fare policies, regardless of distance traveled. **The programs have served over 81.8 million passengers to date—62% of whom are former motorcycle users.**
- Most railway projects in Indonesia are financed through state budgets and concessional loans, which offer low interest (0.1–0.3%) and long tenors (up to 40 years), making them more attractive than green bonds. Recent reforms under the Job Creation Law and GR 33/2021 have improved Public-Private Partnership readiness by easing permits and lowering entry barriers. However, private investment remains concentrated in the Jakarta–Bandung high-speed rail. Efforts to tap **green bond markets are also limited due to low project bankability, high issuance costs, and underdeveloped verifier services.**

"Improve" strategies

- **Eighty percent of E2Ws sold have used the incentives** since mid-2023. However, policy uncertainty following the suspension of incentives in 2025 has disrupted demand. **With no replacement scheme officially announced, sales dropped by over 80% year-on-year in Q1 2025.** For E4Ws, sales growth in the BEV segment reflects strong demand for **affordable models priced between IDR 250-300 million and IDR 350-400 million, each surpassing 10,000 units sold from 2022 to 2024.** E4W market saw a sharp increase in model variety and price competition, largely due to the entry of Chinese EV brands. **Between 2022 and 2024, 8 Chinese brands entered the Indonesian market, supported by tariff-free CBU imports and tax exemptions.** As a result, **available BEV models grew from just 11 in 2022 to over 50 by early 2025.** As a result, **the average price of the top 10 best-selling E4Ws fell from IDR 1 billion in 2023 to around IDR 450 million in 2024.**
- **Only 1% of fuel in Indonesia meets Euro 4 standards,** as most domestic refineries lack the capacity to produce low-sulfur fuel. Current regulations mandate 50 ppm sulfur only for high-performance fuels, while the majority of widely used fuel remains of lower quality. **Improving fuel quality would raise production costs by IDR 500 per liter.** Yet, improving fuel quality—especially in urban areas like Jabodetabek—**could cut PM emissions by 95% and reduce major pollution-related illnesses, saving up to IDR 550 billion annually in health costs.**

Just transition in mobility

- Indonesian commuters have no ideal commuting option, especially for lower-income groups. **Higher-income motorbike users travel 64% faster,** while car users get safer, more comfortable trips. Lower-income commuters rely on slower, riskier modes, and lose more time. **Once income exceeds IDR 4 million/month, most shift to cars, reflecting a strong preference for comfort and reliability.**

Outlook

- Road travel is projected to hit **3.2 trillion km by 2050**, with **vehicle ownership growing to 234 million—190 cars and 526 motorcycles per 1,000 people**—driven by nearly doubled per capita travel demand.
- Without stronger action, **road transport emissions will reach 561 MtCO2 by 2060.** Announced efforts scenario cut just 80 Mt, leaving 485 Mt. In contrast, **a combined strategy of biofuel usage, public transport shift, BEV adoption, and vehicle age limits can slash emissions to 117 Mt—reducing 2060 emissions by 76%.** Despite this progress, residual emissions remain, largely from heavy-duty vehicles and limitations in biofuel blending.

Ringkasan eksekutif

Urgensi mobilitas berkelanjutan

- *Sektor transportasi merupakan **konsumen minyak terbesar dan konsumen energi terbesar kedua di Indonesia,** menyumbang **lebih dari 40% dari total konsumsi akhir minyak**—sebagian besar berasal dari impor. Sekitar **90% konsumsi energi sektor ini berasal dari transportasi darat.** Transportasi jalan juga menyumbang lebih dari 80% emisi sektor transportasi, yang **tumbuh rata-rata 1,56% per tahun dan mencapai 202 juta ton CO_2 pada tahun 2024.** Ketergantungan terhadap minyak menyebabkan kerentanan terhadap fluktuasi harga global dan mendorong subsidi energi hingga 17% dari APBN tahun 2022. Di sisi lain, pencapaian target pertumbuhan ekonomi 5% pada 2025 dan 8% pada 2029 sangat bergantung pada efisiensi sektor transportasi. **Mobilitas berkelanjutan berpotensi menurunkan konsumsi minyak hingga lebih dari 29 juta BOE pada 2030**, sambil menekan biaya logistik, meningkatkan produktivitas, dan mendukung pertumbuhan industri bersih.*
- *Sistem mobilitas Indonesia yang didominasi oleh transportasi jalan membawa dampak lingkungan dan ekonomi yang semakin besar. **Transportasi bermotor menyumbang 19% konsentrasi PM2.5 di 11 kota besar, serta lebih dari 90% kematian terkait polusi transportasi akibat PM2.5 dan ozon.** Moda transportasi nasional didominasi sepeda motor (hampir 70%), sementara berjalan kaki dan bersepeda kurang dari 2%—menunjukkan rendahnya keterhubungan angkutan umum dan tata ruang yang tidak padat. **Kondisi ini menyebabkan kemacetan kronis yang merugikan ekonomi hingga USD 4 miliar per tahun (0,5% Produk Domestik Bruto/PDB), serta menghamburkan 2,2 juta liter bahan bakar per hari di kota-kota besar. Meski demikian, kebijakan mitigasi masih sangat fokus pada teknologi kendaraan dan bahan bakar, dengan hanya 2 dari 17 tindakan mitigasi dalam Permenhub No. 8/2023 yang tergolong strategi "Avoid" (pengurangan kebutuhan perjalanan).***

Strategi - strategi "avoid"

- *Kepadatan kota berkorelasi erat dengan kepemilikan kendaraan dan emisi yang lebih rendah. Di Indonesia, setiap tambahan 1 mobil per 100 penduduk berhubungan dengan penurunan kepadatan kota sebesar 1,4%. Pengembangan kota yang kompak memperpendek jarak perjalanan dan menurunkan permintaan energi. **Di Jakarta, indeks fasilitas TOD saat ini hanya sebesar 0,3, yang menunjukkan implementasi yang masih lemah.** Meski begitu, survei 2022 menunjukkan bahwa **lokasi TOD telah berhasil menurunkan jarak tempuh dan mendorong pergeseran moda: penggunaan mobil turun 27%, motor turun 25%, dan penggunaan sepeda naik 200%.***
- *Kebijakan manajemen permintaan perjalanan (TDM) seperti ganjil-genap, zona rendah emisi (LEZ), car free day, dan kerja dari rumah (WFH) mulai diterapkan tetapi masih belum terintegrasi secara sistematis. Survei menunjukkan **69% pekerja Indonesia merasa dapat bekerja dari rumah.** Setelah pandemi, tren kerja berubah: **kerja di kantor menurun 26%, dan 62% responden menyatakan ingin melanjutkan skema kerja hibrida.** Peningkatan emisi rumah tangga akibat WFH umumnya diimbangi oleh pengurangan emisi transportasi. Secara global, satu hari WFH per minggu dapat menghasilkan penghematan energi empat kali lipat dari peningkatan konsumsi energi rumah tangga.*

Strategi - strategi "shift"

- *Transportasi publik utama di Indonesia mencakup bus, kereta antarkota, dan kereta perkotaan. Sebagai angkutan berbasis jalan, BRT menawarkan **fleksibilitas rute dan jangkauan yang dapat ditambah.** Namun masih menghadapi tantangan dalam waktu tempuh akibat bercampur dengan lalu lintas umum (tanpa jalur khusus). Transjakarta, dengan 14 koridor sepanjang lebih dari 250 km, menjadi model BRT nasional yang kini direplikasi di enam metropolitan. **Tiga kota—Bandung, Medan, dan Semarang—telah memulai konstruksi BRT baru dengan anggaran IDR 1-2 triliun per sistem.** Di sisi lain, sistem kereta komuter seperti di Jakarta dan Yogyakarta–Solo telah lama beroperasi melebihi kapasitas, dengan beban puncak mencapai 272%. Secara nasional, pengembangan jalur kereta juga terus dilakukan. Hingga 2024, **Indonesia telah membangun 7.451 km jalur kereta, mendekati target 10.524 km pada 2030** dalam RIPNAS. Meskipun demikian, lebih dari 70% jaringan masih terkonsentrasi di Pulau Jawa.*

- *Program Teman Bus dan BisKita kini beroperasi di **13 kota menggunakan model kontrak melalui skema Buy the Service (BTS).** Dikelola oleh Kementerian Perhubungan dan Kementerian Keuangan, skema ini memungkinkan otoritas menetapkan standar layanan minimum dan tarif, terlepas dari jarak tempuh. **Program ini telah melayani lebih dari 81,8 juta penumpang—62% di antaranya adalah mantan pengguna sepeda motor.***

- *Sebagian besar proyek perkeretaapian di Indonesia dibiayai melalui anggaran negara dan pinjaman konsesional, yang menawarkan bunga rendah (0,1–0,3%) **dan tenor panjang (hingga 40 tahun),** sehingga lebih menarik dibanding obligasi hijau. Undang-Undang Cipta Kerja dan PP 33/2021 telah meningkatkan kesiapan Public Private Partnership dengan menyederhanakan izin dan menurunkan hambatan masuk. Namun, investasi swasta masih terbatas pada proyek unggulan seperti kereta cepat. **Upaya untuk mengakses pasar obligasi hijau juga masih terbatas karena rendahnya kelayakan proyek dan layanan verifikator yang belum berkembang.***

Strategi - strategi "improve"

- ***80% penjualan motor listrik memanfaatkan insentif sejak pertengahan 2023.** Namun, ketidakpastian kebijakan pasca penghentian insentif pada 2025 mengganggu permintaan. **Tanpa skema pengganti yang resmi diumumkan, penjualan turun lebih dari 80% pada Q1 2025 secara tahunan.** Penjualan mobil listrik baterai (BEV) menunjukkan pertumbuhan pesat dengan harga antara **Rp 250–300 juta dan Rp 350–400 juta,** masing-masing melampaui 10.000 unit dari 2022–2024. Permintaan BEV didorong oleh preferensi pasar dan persaingan harga, terutama akibat masuknya merek kendaraan listrik dari Tiongkok. **Antara 2022 dan 2024, delapan merek Tiongkok memasuki pasar Indonesia, menaikkan jumlah model BEV dari hanya 11 model pada 2022 menjadi lebih dari 50 model pada awal 2025. Akibatnya, harga rata-rata dari 10 mobil listrik terlaris turun dari Rp 1 miliar pada 2023 menjadi sekitar Rp 450 juta pada 2024.***

- ***Hanya 1% bahan bakar di Indonesia yang memenuhi standar Euro 4,** karena kapasitas produksi untuk bahan bakar sulfur rendah masih terbatas. Regulasi saat ini menetapkan batas sulfur 50 ppm hanya untuk bahan bakar performa tinggi, sedangkan mayoritas bahan bakar memiliki kualitas lebih rendah. **Meningkatkan kualitas bahan bakar akan meningkatkan ongkos produksi seharga IDR 500 per liter.** Akan tetapi, meningkatkan kualitas bahan bakar—terlebih di daerah perkotaan seperti Jabodetabek**—dapat memangkas emisi PM hingga 95% dan mengurangi penyakit akibat polusi secara signifikan, menghemat biaya kesehatan hingga Rp 550 miliar per tahun.***

Transisi yang adil dalam mobilitas

- *Komuter Indonesia tidak memiliki opsi perjalanan ideal, terutama bagi kelompok berpenghasilan rendah. **Pengguna motor dari kelompok berpenghasilan tinggi bepergian 64% lebih cepat,** sementara pengguna mobil mendapatkan perjalanan yang lebih aman dan nyaman. Komuter berpenghasilan rendah sering kali harus menempuh perjalanan lebih jauh, menggunakan moda yang kurang aman atau kurang andal. Begitu pendapatan melebihi **Rp 4 juta per bulan**, sebagian besar akan beralih ke mobil pribadi, **mencerminkan preferensi kuat terhadap kenyamanan dan keandalan.***

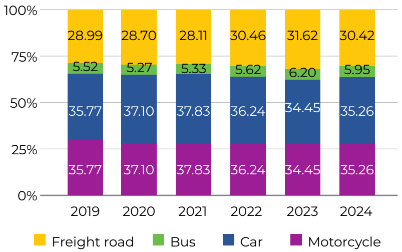
Outlook

- *Volume perjalanan darat diperkirakan mencapai **3,2 triliun km pada 2050,** dengan kepemilikan kendaraan meningkat menjadi **234 juta unit—190 mobil dan 526 motor per 1.000 penduduk**—didorong oleh permintaan perjalanan per kapita yang hampir dua kali lipat.*

- *Tanpa intervensi, **emisi transportasi jalan akan mencapai 561 juta ton CO2 pada 2060,** dengan upaya saat ini hanya mampu memangkas sekitar 80 juta ton. **Sebaliknya, strategi terpadu—menggabungkan biofuel, pergeseran ke transportasi umum, adopsi kendaraan listrik dan pembatasan usia kendaraan—dapat menurunkan emisi menjadi 117 juta ton (pengurangan emisi 76%).** Namun, **117 juta ton emisi sisa tetap ada,** terutama berasal dari kendaraan berat dan keterbatasan dalam pencampuran biofuel.*

Key Highlights

Urgency for sustainable mobility



35.26% (2024) — Share of **road transport emission from cars** (highest)

4 USD billion — Incurred **national costs due to congestion** annually

126.2% Total growth

3.82% CAGR

Growth of **Indonesia's road transport emissions** (2000-2022)

Potentials in "avoid" strategies

-27% Total growth

-25% CAGR

+200% in cycling

In **transit oriented development (TOD) areas in Jakarta** region

69% number of workers — Number of **workers that believe working from home (WFH) is feasible**

-26% Fully in-office work

+27% Hybrid work

Changes in **working pattern after COVID-19 pandemic**

↑ **Car ownership**
↓ **Urban density**

Each +1 car per 100 people linked to –1.4% urban density

313.61 kilometers — Total bike lanes in Jakarta

Potentials in "shift" strategies

251.4 Kilometer of length

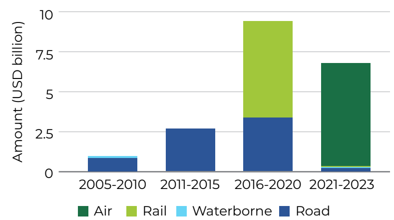
371.7 Million of passengers (2024)

Indonesia's **first BRT system** in Jakarta

7,451 Kilometer (2024)

10,524 Kilometer (2030)

Indonesia's **railway network and expansion targets** according to RIPNAS

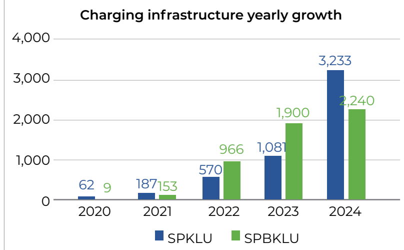


PPP investments for Indonesia's transport sector

1-2 USD Trillion — Budget allocation for **BRT masterplan in 3 cities** (Bandung, Medan, and Semarang)

62% (50+ million passengers) — City bus (from Buy the Service scheme) **passengers that were motorcycle users** previously

Potentials in "improve" strategy



Source: IESR, 2024a; PLN, 2025

Yearly **growth of charging stations (SPKLU) and battery-swapping stations (SPBKLU)**

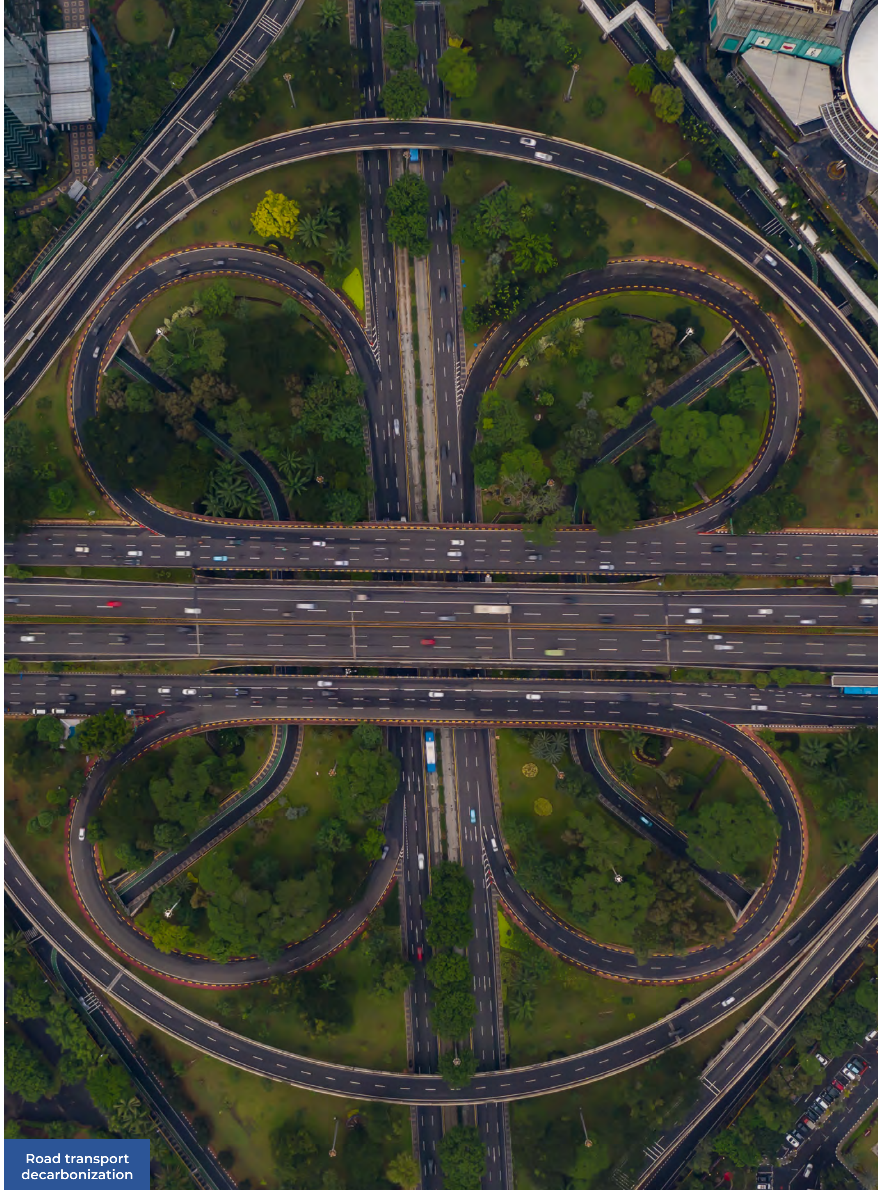
3x growth — 1 year **growth of charging stations** (2023-2024)

1/2 the price — Average **price of best selling E4W halved** from 2023-2024

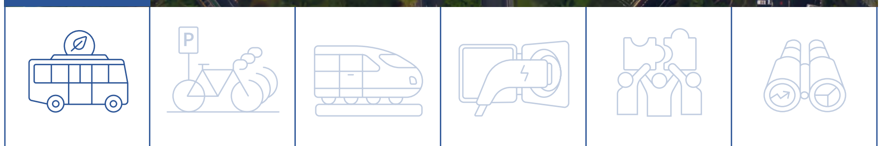
96% (41,400+ units)

84% (62,800+ units)

E4W and E2W **sales made with incentives** in 2024



Road transport decarbonization



Chapter 1.

The urgency of road transport decarbonization

Contents:

Indonesia's energy security and economic growth goal would need to be supported with sustainable mobility

Sustainable mobility enables people to move efficiently with transport system that are clean and inclusive

Sustainable mobility combines efficient mobility demand through compact cities and good urban design with clean and equitable mobility supply through shifting to low-emission modes like public transport and electric vehicles.

Continued oil use from transportation risks energy security

Transport is Indonesia's top oil consumer, which mainly imported, making the country vulnerable to global price shocks and draining foreign reserves. Fuel subsidies reached 17% of the state budget in 2022, driven by growing fuel use. At the same time, oil production is declining. Accelerating sustainable transport could reduce oil use by over 29 million barrel of oil equivalent (BOE) by 2030, easing fiscal burdens and strengthening energy resilience.

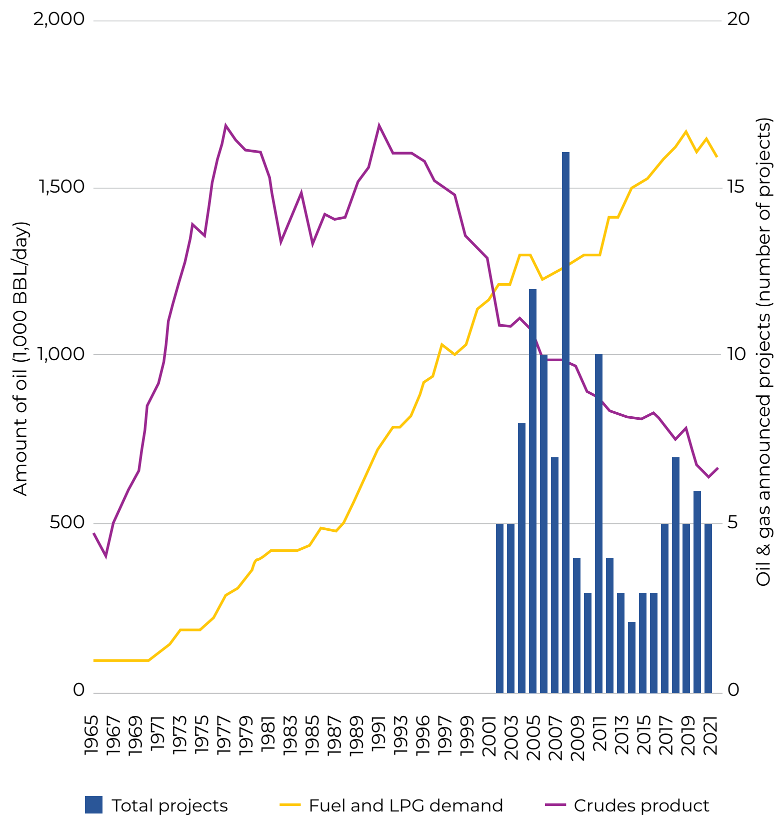
Sustainable mobility to enable economic growth

Indonesia is targeting a GDP growth rate of around 5% in 2025, and increasing to 8% by 2029. Achieving these targets requires reliable infrastructure, especially in transportation. Sustainable mobility helps to reduce travel time, lower logistics costs, increase productivity hours, improve access to markets, and create a new supply chain for clean vehicles—directly supporting economic growth.

Existing policies are strong enough to be the foundation

Many policies that support sustainable mobility already exist in Indonesia—from battery electric vehicle (BEV) acceleration to improved public transport and transit-oriented development. However, they are still underutilized or fragmented. Accelerating and streamlining these policies at the national level is crucial so Indonesia does not have to start from zero.

Depleting daily mean of national crude production vs. increasing fuel demand

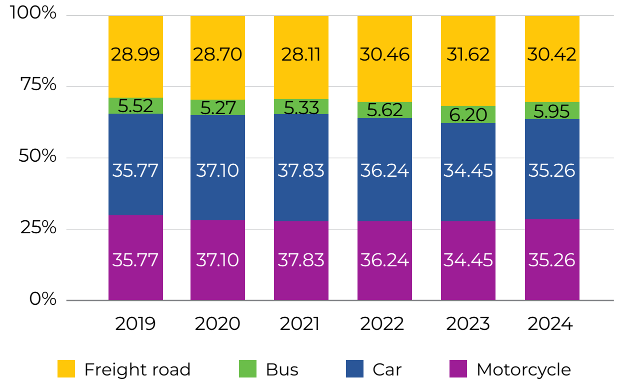


Source: IESR Analysis, 2024

Road transport emits biggest GHG and consumes most energy, yet government efforts focus mostly on fuel switching

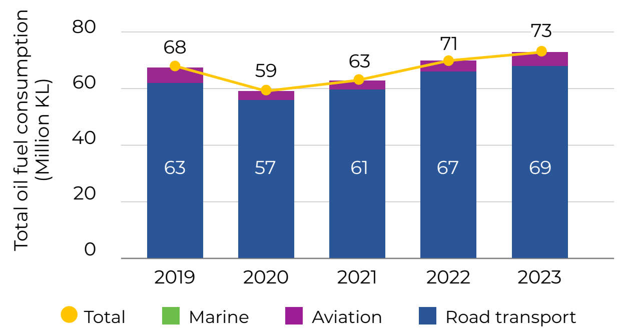
- The transport sector is one of the top three fossil fuel emission emitters in Indonesia, following the power generation sector and competing with the industrial sector. The transport sector emissions grew 1.56% annually and reached 202 million tonnes of CO_2 in 2024. Within that number, the road transport sector contributed at least 80% of the total transportation sector. Cars dominated the share of road transport emissions by around 35%, followed by freight roads at 30%, motorcycles at 28%, and buses at around 6%.
- Moreover, the transport sector places second in energy consumption, with a total of 449 million BOE or around 36% of final energy consumption (MEMR, 2024). More than 90% of yearly oil fuel consumption in the transport sector comes from the road transport sector. This condition is unfavorable since Indonesia has been a net importer of oil since 2004. Indonesia's net expenditure on fuel oil imports reached 22 billion USD to cover its domestic supply shortfall in 2023, which only represents the value of fuel oil imports minus exports and reflects the foreign exchange cost of bridging the gap between domestic production and consumption. (Tenggara Strategics, 2024).
- High energy consumption and CO_2 emissions of the road transport sector puts it as a priority in the transport sector decarbonization. In addition, the road transport sector also has many ready-to-implement options for decarbonization compared to other sectors, such as biofuels, electrification, and hydrogen.
- The government of Indonesia has been pushing fuel and technology shifts in the road transport sector for a long time. The government introduced biofuels in 2006, and it will be the focus in the near future as it has been stated in the new presidential campaign. However, biofuels has many drawbacks, such as the NO_x increase in the high blending biofuels (IESR, 2024), and it will need a total of 45 million hectares of energy plant or around 36% of total Indonesia forest area (Nugraha, 2023) to reach 100% blending (B100).
- Another approach that the government has been pushing is electrification. The use of electric vehicles (EVs) reduces the total energy needs by up to 82% compared to internal combustion engine vehicles (ICEVs), which will lead to the reduction of oil refineries needed to support Indonesia mobility. Although the use of EVs might solve oil import need, other road transportation sector problems still exist such as urban sprawl, congestion, safety and security of mobility and so on. Therefore, a sustainable transport systems needs to solve all of these other problems in the transport sector.

Share of road transport emission by mode



Source: IESR Model, 2025

Transport sector oil fuel consumption

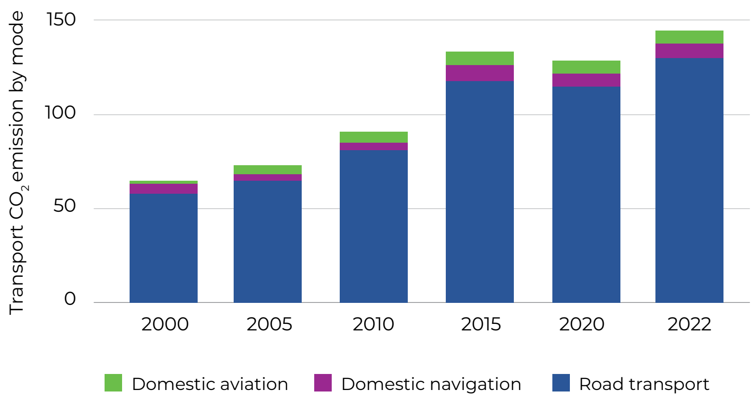


Source: HEESI, 2023

Pollution levels are going up along with rising emissions from vehicles, which makes the air quality even worse

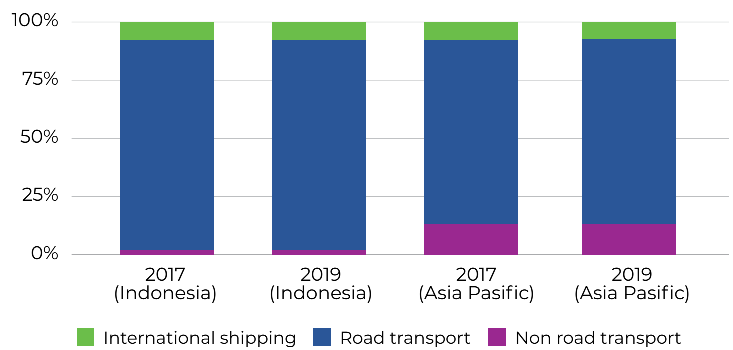
- Transport emission increases in Indonesia are largely driven by rapid growth in vehicle ownership and ongoing road expansion. When private motorized transport dominates mobility, it leads to congestion, inefficiency, and higher fuel consumption, ultimately resulting in increased emissions and air pollution. Between 2000 and 2022, road transport contributed over 90% of total transport emissions (EU, 2023).
- Motorized land transport also significantly influences air quality, primarily through the emission of pollutants such as nitrogen oxides (NO_x), carbon monoxide (CO), and particulate matter (PM). An analysis of air quality source apportionment across different seasons in 11 Indonesian cities found that vehicular sources contributed 19% of PM (Istiqomah & Marleni, 2020). Road transport is also responsible for over 90% of transport-related deaths from PM2.5 and ozone exposure in Indonesia—much higher than the Asia-Pacific average of 80% (McDuffie et al., 2021). As urban activity resumed after the pandemic, average PM2.5 levels in Indonesian cities rose sharply to 37.1 µg/m³ in 2023, over 20% higher than in 2022 and more than 7 times the WHO guideline (Greenpeace, 2024). Each 1 µg/m³ increase in PM2.5 exposure is associated with a 0.9–5% increase in mortality risk (Papadogeorgu et al., 2020).
- The negative consequences of pollution on labor supply and worker productivity are plenty (Kim et al., 2017). Air pollution significantly reduces factory worker productivity in Indonesia, where studies show a drop in worker productivity worth 6% of hourly wage for every 10 µg/m³ increase in PM2.5 above safe levels (Nafas Indonesia, 2022). Declines in individual health can also occur 3-10 years after exposure, damaging productivity in the long run. Samples from Jakarta and Tangerang show economic losses from missed work days due to own health can reach up to IDR 118-448 million per case (Duki et al., 2010). There are also economic losses from caretaking children due to air pollution-related illness. Nationally, one unit increase in pollution reduces weekly working hours by 2.46 hours for women and 1.17 hours for men in households with dependents (Kim et al., 2017).

Transport emission growth by mode in Indonesia



Source: EU, 2023

Health impacts from transportation tailpipe emissions due to PM2.5 and ozone air pollution



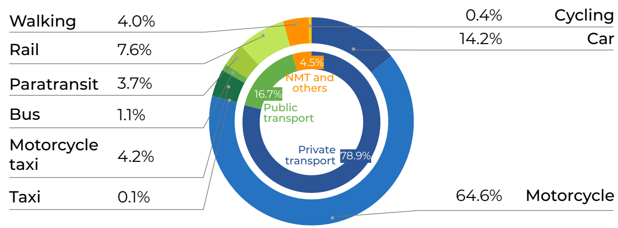
Source: McDuffie et al., 2021

Motorcycle domination signals deep reliance on two-wheelers, but highlights the urgency to develop alternatives

- The 2024 IESR mobility behavior survey examined passenger-kilometer modal share. Private transport dominates Indonesia's mobility landscape, accounting for 78.9% in Jabodetabek and 88.4% nationally. Across all modes, motorcycles largely dominated, with 64.6% in Jabodetabek and 69.2% at national level. Meanwhile, public transportation accounted for only 18.5% of trips in Jabodetabek and an even lower 10.4% at the national level. These figures fall significantly short of DKI Jakarta's modal share target of 60% by 2030. The modal share figures were even lower for non-motorized transport, which consisted of walking and cycling, at only 5% in Jabodetabek and 1.6% at national level (IESR Analysis, 2024).
- At the national level, there is a higher utilization of cars and a lower use of public and non-motorized transportations, with motorcycle modal share being approximately on the same level. Walking has a lower modal share compared to other modes of transport; it is found to be higher at Jakarta (4.0%) than in the national level (1.1%) (IESR Analysis, 2024), since low-density development usually results in low walkability (Wei et al, 2016). This aligns with the fact that Jakarta has a lower average trip distance (1.1 km) than the national level (2.0 km).
- The widespread reliance on private transport is often a response to gaps in public transport coverage, reliability, and affordability. As of 2020, the cost of traveling by motorcycle was IDR 546 per kilometer, compared to IDR 552-693 per kilometer for public transportation (Wisanggeni et al, 2020). They also occupy less space and produce lower per-passenger pollution than private cars (ITF, 2020). However, motorcycles are significantly more vulnerable to traffic accidents and account for the highest share of road fatalities in Indonesia, with 81% of deaths compared to just 8% for cars (Government of Indonesia, 2022). Conventional motorcycles emit significantly more pollutants, with median NO_x, CO, and HC levels up to 20, 6, and 8 times higher than those from gasoline passenger vehicles (e.g., bus) (ICCT, 2022)
- With motorcycles making up the vast majority of trips, any decarbonization strategy that overlooks them risks being ineffective. Policies must consider the advantages and user behavior of motorcycle use, especially when aiming to promote electrification, reduce car usage, or promote public transport. For example, public transport that cannot compete with motorcycle costs would risk not being utilized. Without serious consideration of the behavior, efforts will remain fragmented and fall short.

Modes of transport percentage in passenger-km in Jabodetabek and National Level

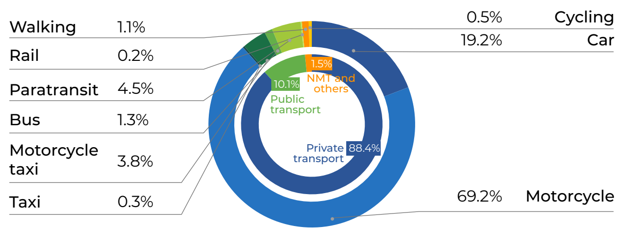
Jabodetabek Level



Modes	Distance per trip (km)
Car	22.5
Motorcycle	15.2
Taxi	9.7
Motorcycle taxi	8.2
Bus	9.1

Modes	Distance per trip (km)
Paratransit	17.9
Rail	10
Walking	1.1
Cycling	2.0
Others	0.0

National Level



Modes	Distance per trip (km)
Car	16.8
Motorcycle	9.3
Taxi	8.7
Motorcycle taxi	5.4
Bus	16.1

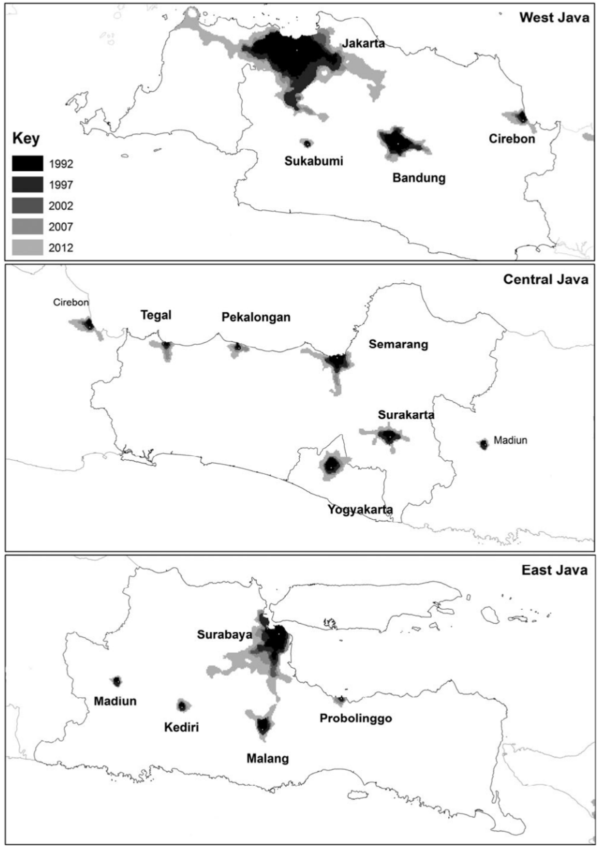
Modes	Distance per trip (km)
Paratransit	8.4
Rail	10.0
Walking	2.0
Cycling	2.0
Others	0.0

Source: IESR Analysis, 2024

As highways expand, urban sprawl pushes business hubs to be more dispersed—making people increasingly reliant on private vehicles

- Since 1990, over 150 km of highways have been built in Jakarta, Bogor, Depok, Tangerang & Bekasi (Jabodetabek) which indirectly play a key role in urban sprawling Indonesia's urban landscape (Pratama et al., 2022). Studies show that improving access to highway ramps by just 1 km increases urban sprawl by 6.6% and expands the urban land in city suburbs by 1.6% in Jabodetabek area, leading to more scattered developments. Urban sprawling is common occurrence within Indonesia's urban landscape which linked to less binding spatial regulations, sharp differences in land prices and a monocentric city model, where people move outward to access cheaper land.
- While some urban expansion is expected, sprawl reflects mismanaged growth. Between 1992 and 2012, 41 Indonesian cities—including Semarang, Surabaya, Bandung, Makassar, and Medan—experienced an average urban expansion rate of 2% per year, moderate by global standards and comparable to India, but one-third the rate of China (Olivia et al., 2018). However, Indonesia's rural-to-urban migration has been 3 times faster than India's, with the urban population growing from 17.2% in 1971 to 42.2% in 2000 (Civelli et al., 2023). At current rates, 71% of Indonesians are expected to live in urban areas by 2050 (United Nations, 2018), adding big demand on urban transport systems.
- In Java and Bali, agglomeration forces such as economic clustering, labor market concentration and infrastructure access raise land prices in urban cores and push development to the periphery (Civelli & Gaduh, 2018). The slow urban land convergence further intensifies the suburban sprawl trend (Pratama et al., 2022). As a result, employment hubs have emerged in suburban areas like Depok, Tangerang and Bekasi, shifting work activities away from the central business district (CBD) (Sadewo et al., 2022; Suharto et al., 2021; Civelli & Gaduh, 2018). This decentralization fuels inter-suburban commuting, shifting commuting flows of suburb-to-CBD travel patterns into suburb-to-suburb.
- Urban sprawl, rising transport demand, and shifting commuting flows pose serious challenges. Between 2014 and 2019, public transport reliability in Jabodetabek declined, with departure time variability increasing by 47% and arrival time variability by 17% (Sofiyandi & Siregar, 2020). Furthermore, the rise of online ride-hailing services contributed to a 6% decline in non-dedicated lane bus usage, from 11.6% (2014) to 5.2% (2019) (Sofiyandi & Siregar, 2020). In a situation where human activities scatter, infrastructure encourages private vehicle dependency and public transportation is unreliable. At the same time, other modes of transport like cycling and walking are even less attractive.

Urban area expansion in major cities (1992–2012)

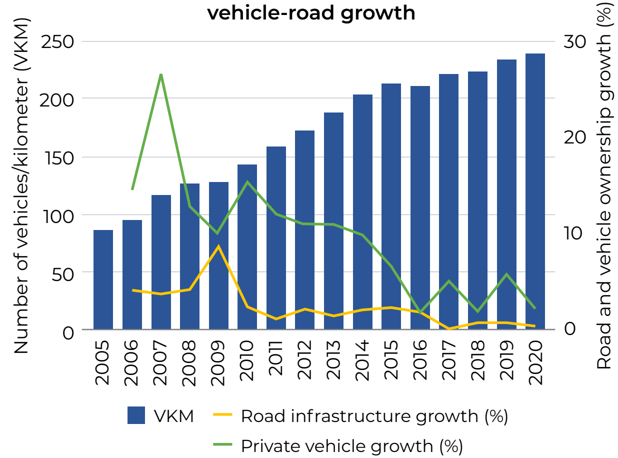


Source: Olivia et al., 2018

Road infrastructure growth has failed to keep pace with surging vehicle ownership, creating severe urban congestion that costs USD 4 billion annually

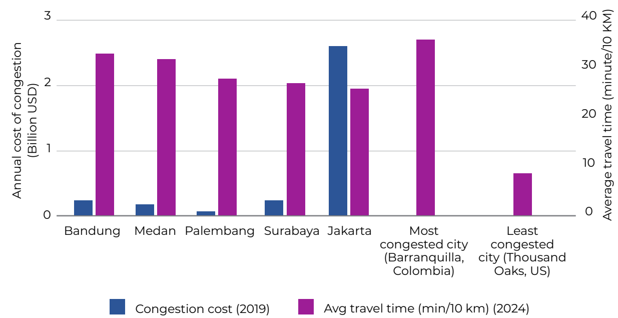
- Indonesian road infrastructure grew by over 2.5% annually between 2000 and 2015 (BPS, 2024). Since 2015, road expansion has slowed to below 1% annually. Private vehicle ownership has grown faster, averaging 3.6% per year. Between 2005 and 2020, road length increased 39% and vehicle numbers 290%. Due to this discrepancy, road vehicle concentration has increased significantly. Vehicle concentration on the road (VKM) rose from 86 in 2005 to 240 in 2020. In Indonesia, vehicle density remains higher than in India, which had only 20.4 vehicles per kilometer in 2005 and 51.3 in 2020. This 2.8X increase (about 179%) is comparable to India's 2.5X growth (151%).
- As road expansion is no longer keeping pace with urbanization and rising transport demand, road users take longer to commute as congestion worsens. In 2024, 5 Indonesian cities were ranked among the world's 100 most congested cities (TomTom, 2025). In those cities, the average travel time for every 10 km is between 26 - 33 minutes. When travel time is high, the average speed of vehicles reduces, especially for public transport. The daily average speed for road vehicles in Indonesian cities is 23-28 km/h (World Bank, 2022). In this situation, public transport becomes even less attractive when trapped in congestion with an average speed that could reach as low as 10 km/h, further reinforcing a cycle of high private vehicle dependence.
- Traffic congestion weakens mobility, draining productivity and increasing costs. According to The World Bank urban traffic congestion incurs a national cost of at least USD 4 billion per year, or 0.5% of Gross Domestic Product (GDP), due to excessive travel time, wasted fuel, and GHG emissions (World Bank, 2019). Further, congestion-driven speed fluctuations increase fuel consumption, with traffic jams in 6 major Indonesian cities causing daily fuel losses of 2.2 million liters of fuel per day in 2021 (VOI, 2021). Despite the massive economic costs of congestion, the response to alleviate congestion has often been to expand road infrastructure—but prioritizing private vehicles over walkability and public transport has only fueled more driving.
- Congestion reveals deeper structural issues in spatial planning and mobility systems. It highlights the complexity of transport governance, where cities, subnational agencies and national ministries operate with fragmented and uncoordinated authority, resulting in gaps in planning, regulation, and service provision. It also reflects unreliable public transport, pushing more people toward private vehicles. Undisciplined road behavior, such as lane hogging and lane jumping, exacerbates gridlock, while urban sprawl and poor land-use planning lead cities to become overly dependent on private vehicles.

Annual vehicle per kilometer (VKM) and vehicle-road growth



Source: IESR Analysis, 2025

Annual cost due to congestion and average travel time within Indonesia's most congested cities

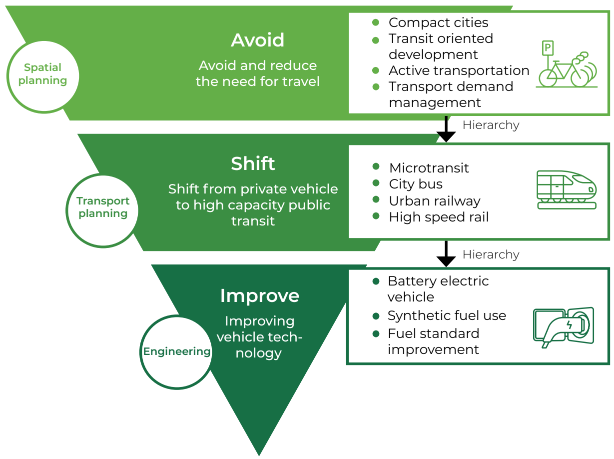


Source: TomTom, 2025; World Bank, 2019

Sustainable mobility relies on Avoid - Shift - Improve prioritization but "Avoid" measures remain largely underrepresented

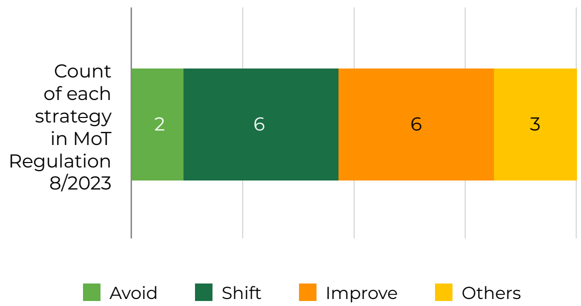
- Concepts such as *sustainable transport, sustainable transportation*, and *sustainable transport systems* are often used interchangeably with *sustainable mobility* (Holden et al., 2019). Both concepts encompass the idea of mobility, which includes revealed mobility (actual physical movement) and potential mobility (the attribute of being mobile). Sustainable mobility also includes measures to decarbonize the transport sector. Since they share common principles, objectives, and policy implications, therefore, for the entirety of this report, we consider them synonymous and use them interchangeably.
- The policy implications of sustainable mobility are structured around the Avoid, Shift, and Improve (A-S-I) strategies (Holden et al., 2020). This report outline core components analogous to the A–S–I strategies of reducing and managing travel demand, collective transport, and electromobility. Reducing and managing travel demand aim to reduce overall travel demand through compact cities, non-motorized transport, shorter trips, and transport demand management. Collective transport promotes shifting from private vehicle use to shared, high-capacity, and low-carbon transit such as city buses and rail-based transport. Electromobility focuses on improving vehicle technology through vehicles with electric powertrains, charging infrastructure expansion, and fuel improvement.
- The three core components must be prioritized in this order: (1) reducing and managing travel demand; (2) collective transport for situations where low mobility proves inadequate; and (3) electromobility as a last resort for cases where low mobility or collective transport is not feasible. This hierarchy emphasizes minimizing transport needs first, then optimizing shared solutions, before finally resorting to cleaner individual vehicles.
- According to Ministry of Transportation (MoT) Regulation 8/2023, which outlines climate mitigation strategies for Indonesia's transportation sector, sustainable mobility policies in Indonesia focus on "Improve" and "Shift" strategies. The "Avoid" strategy applies to only 2 of 17 mitigation measures in road transport. Indonesia's Enhanced Nationally-Determined Contribution (ENDC) transport decarbonization strategy, which only emphasizes EV adoption and fuel improvement ("Improve"), is too narrow.
- Indonesia's policy framework contradicts A-S-I's priorities. Since policy actions result in financial allocations, ignoring "Avoid" measures may indicate resource distribution inefficiencies and energy policy misdirection, which could raise costs or jeopardize the decarbonization target (Jarre et al., 2024). Despite their localized impact, "Avoid" and "Shift" strategies can reduce transport emissions by 60% and are cheaper than "Improve" measures (BCG, 2024).

Sustainable mobility framework

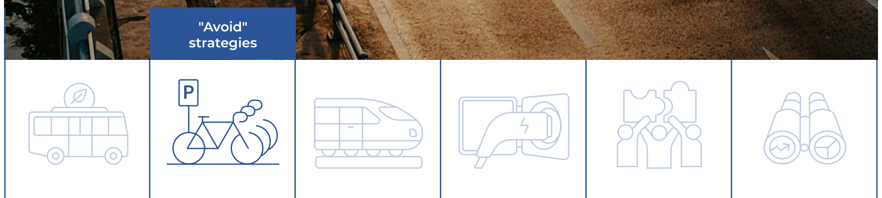


Source: Holden et al., 2020; EPA, 2020

A-S-I classification of climate mitigation measures for road transport in MoT Regulation 8/2023



Source: IESR Analysis, 2025



Chapter 2.

"Avoid" strategies to manage and reduce travel demand

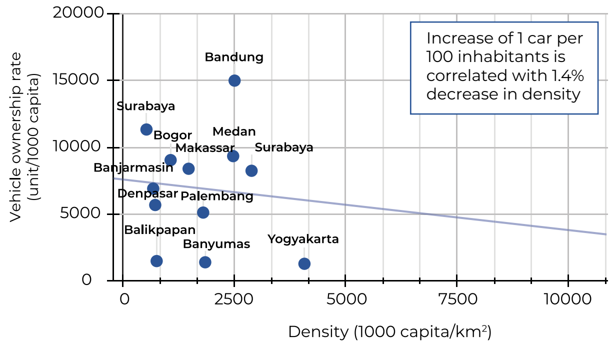
Contents:

- Transit-oriented development and compact cities
- Active mobility and non-motorized transport
- Transport demand management

Current TOD efforts have proven to reduce vehicle use and overall travel distance, but still miss key urban form elements

- Reducing car dependency in Indonesia is urgent, largely due to low-density urban expansion that separates homes from jobs and services, resulting in longer trip distances and increasing the need for private vehicles. Addressing this requires strategies based on the 5D framework (Density, Diversity, Design, Destination accessibility, and Distance to transit) (Ewing & Cervero, 2010). Density is especially impactful as it shortens travel distances by clustering activities, reducing vehicle use, energy demand, and emissions (Cervero & Kockelman, 1997).
- This is evident in Indonesia, where cities with higher densities tend to have lower vehicle ownership per capita, with each additional car per 100 inhabitants correlated with 1.4% decrease in urban density. These findings are consistent with Glaeser & Kahn (2004), although their study found a larger effect albeit with more comprehensive methodology.
- One widely recognized application of the 5D principles is transit-oriented development (TOD[1]). Jakarta is having eight major TOD hubs being planned across the city based on the Jakarta Transportation Master Plan (RITJ) (Coordinating Ministry of Economic Affairs, 2022). However, Jakarta TOD Grand Design only includes integration of public transport and activity centers (Government of Jakarta, 2022) and misses mixed land-use and residential provision elements, which are essential for bringing origin and destination closer and to ensure travel can be "avoided". The current TOD framework promotes a modal shift, which is a positive progress, but could be further enriched with these element to reduce travel altogether.
- Our analysis found that current TOD implementation in Jakarta scored only 0.3 on the TOD facility index[2] (IESR Analysis, 2023), which risks suboptimal results under current TOD efforts. However, even with the current implementation, based on our 2022 survey on current Jakarta TOD locations, TOD has significantly shifted mobility behavior for people with activity around TOD. It reduced overall trip distance across all modes, implying a more efficient trip. It also reduced private vehicle use (car use by 27% and motorcycle use by 25%) in terms of average travel distance and increased the use of cycling by 200%. Expanding TOD implementation with stronger adherence to its core principles could yield even greater impact.

Vehicle ownership and density in Indonesia in 2023



Source: IESR Analysis, 2025

Average travel distance survey before and after having activities around the designed TOD area in Jakarta

Category	Modes	Before TOD (km)	After TOD (km)	% Difference Average Distance
Private Transport	Passenger Car	16.8	12.3	- 27%
	Motorcycle	10.9	8.2	- 25%
	Motorcycle Taxi (Online/ Offline)	7.1	6.8	-4%
Public Transport	Bus	11.8	7.8	-34%
	Angkot/ Paratransit	12.2	4.6	-62%
	Train	15.0	11.2	-25%
Non Motorized Transport	Walking	1.5	1.1	-27%
	Cycling	0.0	2.0	+200%

Source: IESR Analysis, 2022

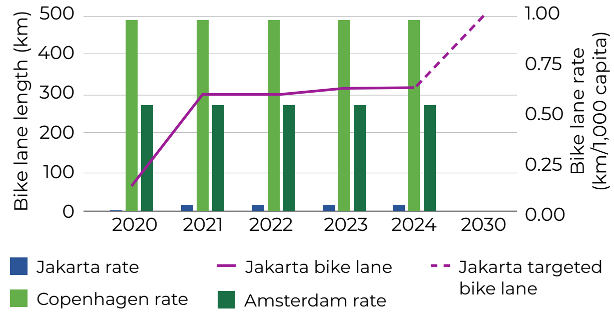
[1] *TOD, or transit-oriented development, refers to integrated urban places designed to bring people, activities, buildings, and public space together, with easy walking and cycling connection between them and near-excellent transit service to the rest of the city (ITDP, n.d.).*

[2] *TOD facility index is a framework developed by ITDP to calculate how aligned a TOD standard framework to the principles and objective of TOD (ITDP, n.a.)*

Non-motorized transport measures must be equally prioritized, but require political and resource commitment at all levels

- Jakarta, with 313.61 km of bike lanes serving its 10 million residents (as of 2024), has been experiencing significant growth since 2020 with an annual growth rate of approximately 95.37%, representing the fastest-growing bike lane infrastructure in Indonesia. However, this falls short when compared globally. Jakarta currently has 0.03 km bike lane per 1,000 capita. In comparison, two capitals of cyclists, Amsterdam with 0.54 km bike lane length per 1,000 capita and Copenhagen with 0.98 km bike lane length per 1,000 capita (IESR Analysis, 2024), both have completely separated bike paths. Both of these cities have the highest cycling modal shares of over 30%.
- Despite its health and environmental benefits, active mobility in Indonesia remains significantly underutilized. According to the 2023 IESR modal share survey (see pg. 10), only 4.5% of trips in Jakarta are made by walking. Nationally, this figure drops sharply to just 1.1% of total trip kilometers. Cycling fares even worse, with only a modal share of 1.1% at both the Jakarta and national levels.
- While rapid bike infrastructure development has occurred in Jakarta over the past five years, progress in non-motorized transport (NMT) at the national level has happened at a slower pace. There is currently no dedicated national plan, directive, or funding commitment for NMT infrastructure. The legal groundworks for NMT infrastructure are regulated through Law 22/2009 on Road Traffic and Transportation, that mentions pedestrian and cyclist infrastructure (Government of Indonesia, 2009), and Presidential Decree 59/2017, which emphasizes Sustainable Development Goals (SDG) 11 (sustainable cities) (Government of Indonesia, 2017) and, in turn, encourages walking and cycling. While the national government has laid the legal groundwork for the provision of cycling lanes, there is still a lack of proactive implementation at the regional level. Some provinces, such as Jambi, North Kalimantan, DKI Jakarta, and Bali, have enacted local regulations that demonstrate the dual legal principles of the obligation to fulfill (through the provision of infrastructure) and the obligation to protect (ensuring continued access and safety for cyclists and pedestrians) (Febriyana, 2024). For example, Jakarta's Regulation 128/2019 mandates the development of bike lanes (Jakarta Province Government, 2019), while Regulation 36/2022 supports integrated public bike rentals (Jakarta Province Government, 2022)
- NMT in Indonesia needs national-level policy commitments to maximize its potential. Integrating walking and cycling into national transport master plans, allocating dedicated budgets, and setting design standards that prioritize safety and accessibility are needed to promote widespread adoption and replication across provinces and alignment with global best practices.

Jakarta bike lane infrastructure length development



Source: IESR Analysis, 2024

Bike infrastructure regulation framework in several cities in Indonesia

No.	Provincial regulation	Obligation to fulfil	Obligation to protect
1	Jambi Province Regional Regulation No. 12 of 2021	Article 47 on the procurement of road equipment facilities (i.e., road signs, road marking; facilities for pedestrians, cyclist, and people with disabilities; street lighting; side safety fence; directional stakes, right-of-way stakes, and shades trees)	Article 52 regarding the provision of facilities for pedestrians, cyclists, and persons with disabilities cannot be contested by other parties
2	Regional Regulation of North Kalimantan Province No. 8 Year 2021	Article 12 on the provision of road equipment	Article 12 on the provision of road equipment
3	DKI Jakarta Provincial Regulation No. 8 Year 2018	Article 24 on the provision of cycling facilities	Article 26 on technical provisions for cycling facilities for infrastructure development
4	Bali Provincial Regulation No. 4 Year 2016	Article 6 on the provision of road equipment facilities	Article 12 on securing the use of road equipment

Source: Febriyana, 2024

Parking and vehicle restrictions as TDM tools show early progress, but limited long-term impact without broader reform

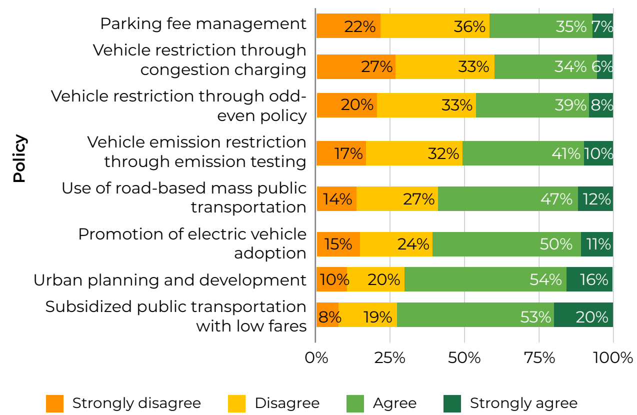
- Transportation demand management (TDM) refers to policies aimed at influencing travel behavior by managing travel demand. These policies typically fall into two categories: disincentives, such as vehicle restrictions (e.g., odd-even rules, low-emission zone (LEZ), car-free days), and incentives, such as public transport subsidies. According to the IESR Analysis (2024), incentive-based TDM measures are the most widely supported. Sixty-seven percent of respondents agreed with providing subsidies for public transport, while 59% supported the development of road-based mass public transport. These are followed by urban planning and development efforts (60% agreeing) and the promotion of electric vehicles (61% agreeing). In contrast, more regulatory measures, such as vehicle emission testing received a more neutral response, with 51% agreeing, indicating a nearly even split in public opinion.
- Furthermore, 55% respondent disagreed with the odd-even policy. The policy was introduced in 2018 to limit vehicles with certain plates in congested road segments and aimed to redirect traffic volume to other segments. However, another study found that this policy did not affect the travel time (Yudhistira, 2025) and is likely more effective in managing the demand in the short run. In contrast, the policy may be ineffective in the longer run, as drivers tend to adapt to the restrictions in place (Farda, 2018). Moreover, the cost of enforcing the measure is also a deterrent to its continuity in the longer run.
- Among TDM policies, disincentives like parking fees and congestion pricing (e.g., ERP) face the most negative public perception—58% and 60% disagree, respectively—despite their proven effectiveness. This often discourages implementation due to the political risks associated with the decision maker. However, Stockholm, where congestion pricing cut traffic volume by 20% and increase public transit use from 40% to 60%, also be able to improve public opinion from 55% has negative opinion to only 41% due to effectiveness (ICCT, 2021). Hong Kong's ERP similarly reduced congestion and pollution while delivering economic gains (ICCT, 2021). ERP revenues can also provide funding for public transport development, if designed to do so, which is essential. However, its effectiveness depends on pricing—if fees remain within the majority of the public's willingness-to-pay, traffic reduction effectiveness may be limited, despite still generating revenues for public transport. Additionally, it can also be integrated with other TDM measures, such as offering lower or zero charges for electric or low-emission vehicles.

Effort of TDM across cities in Indonesia

	Disincentives		Incentives	
	Vehicle Restriction	Parking Policy	Public Transport	Other Incentives Measures
Jakarta	Odd-even policy (permanent) LEZ, car free days	Progressive pricing, E-Parking	Fare subsidy, Integration	TOD, smart mobility apps (JAKI), WFH
Bandung	Odd-even policy (seasonal), car free days	Progressive pricing	Fare subsidy	None
Semarang	Odd-even policy (seasonal)	Progressive pricing	Fare subsidy	None
Surabaya	LEZ	None	Fare subsidy	None
Medan	None	None	Fare subsidy	None
Denpasar	None	E-Parking	Fare subsidy	None

Source: IESR Analysis, 2025

Public perceptions of various TDM policies in Jabodetabek area

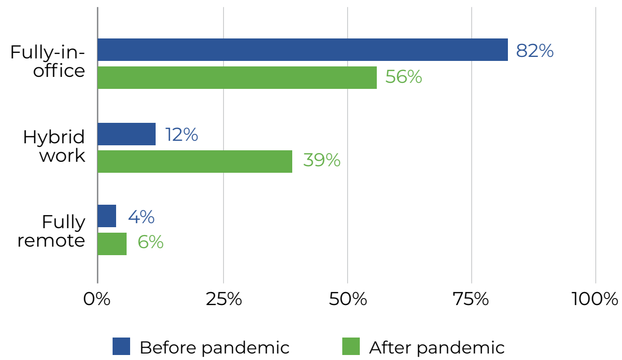


Source: IESR Analysis, 2024

Potential to capitalize the booming post-pandemic remote work to cut transport emissions

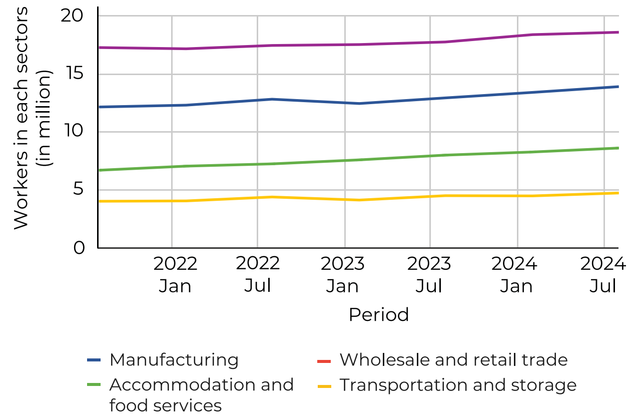
- Digital technology allows electrons to travel instead of people. Tools like telecommuting, video calls, and online information sharing can reduce the need for physical travel, enabling remote working or working from home (WFH) (Holden et al., 2020). Recent surveys show a growing preference among Indonesian workers for WFH. Among 1,000 surveyed workers, 69% believe they can work from home, which is far more than the global average of 54% (PwC, 2024). Another survey of 500 white-collar workers in Indonesia found a moderate shift in working patterns after the pandemic, with fully in-office work decreasing by 26%, hybrid arrangements increasing by 27%, and 62% of respondents expressing a preference for continuing to work in hybrid setups (Logitech, 2023).
- Indonesian workers prefer remote work because it saves on travel costs, reduces commuting stress, and offers flexible hours. As the use of computers and smartphones becomes more common, remote work has become easier and less dependent on advanced technological skills (Nugroho, 2024).
- WFH facilitates energy demand and emission trade-offs across the transport, residential, and office sectors. It typically increases household energy use by 7-23%, depending on factors such as climate, housing size, and appliance efficiency. However, for most car commuters traveling more than 3-6 km, this increase is offset by reduced transport emissions. A global simulation of one day of WFH per week for the whole year can save energy consumption four times higher than the additional residential energy consumption (IEA, 2020). In Aceh Besar, COVID-19 restrictions led to an average weekly travel reduction of 46 km per person, resulting in an estimated decrease of 5 tons in transport-related CO_2 emissions each week (Darma et al., 2022).
- Certain sectors in Indonesia show high potential for remote work, particularly among formal salaried employees, including manufacturing, transportation/logistics, trade, and hospitality (Qibthiyyah & Zen,, 2022). While these industries may appear unsuitable for remote work at first glance, they have demonstrated adaptability through digital solutions and hybrid arrangements. For example, in the transport sector, while drivers and delivery personnel cannot work remotely, back-office support roles such as dispatch coordination, customer service, and fleet management could. Furthermore, digital platforms like online taxis and online freight services enable some remote coordination. Notably, these sectors have also experienced consistent workforce growth over the past three years, further reinforcing the opportunity to expand remote work.

Shifts in work arrangements before and after pandemic among Indonesia's white-collar workers



Source: Logitech, 2023

Workforce growth in sectors with high remote work potential (urban Indonesia)



Source: LPEM UI, 2022; BPS, 2024

"Shift" strategies

Chapter 3.

Collective transport and shared mobility

Contents:

Chapter 3.1.

Penetration of public transportation

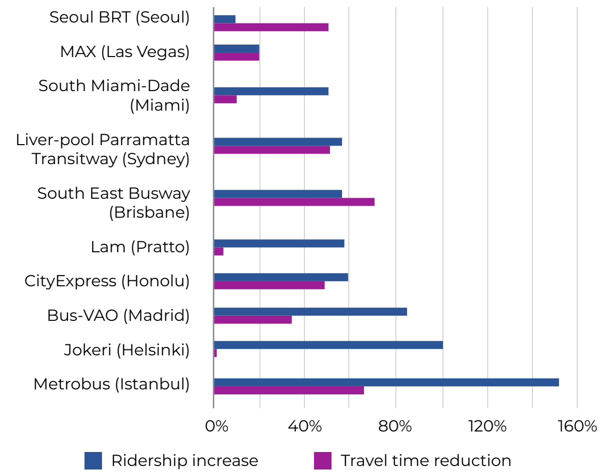
Penetration and progress of:

- BRT
- Intercity rail
- Urban rail

A road-based mass transit system offers a flexible mode option, while BRT development enhances bus service's attractiveness

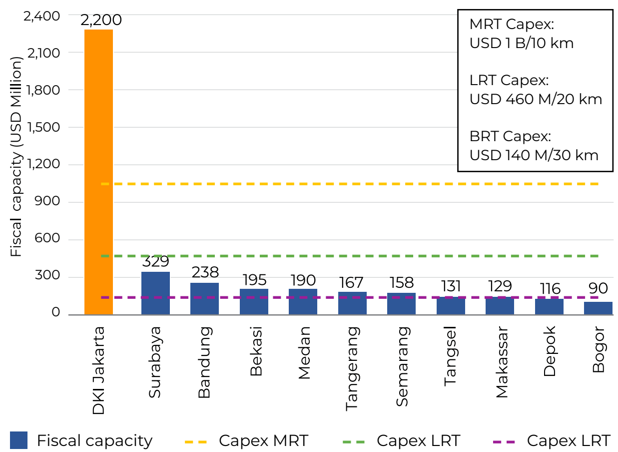
- Bus service offers a flexible mode option due to its nature as a road-based mass transit, making it easier for flexible routing adjustments. Yet, the public lately shows a lack of interest in using bus as it fails to satisfy travel time needs. It occurs due to its mixed traffic-based public transport—clogged whenever jammed. Meanwhile, developing mass rapid transit systems, such as Light Rail Transit (LRT) and Mass Rapid Transit (MRT), can be a huge problem for certain regions due to insufficient financial capacity and high investment risk, examining the potential demand and regional economics. Bus Rapid Transit (BRT), therefore, makes a breakthrough in urban mobility, offering an alternative for a dedicated lane mass transit system with more friendly investment (Kille, 2009).
- Transjakarta, with a total of 14 corridors and 251.4 km in length (Jakarta DoT, 2025), is the first BRT system implemented in Indonesia. Nominated as the longest BRT in the world (Harjadi, 2024), its separated lane allows smooth and quick mobility while offering an affordable price—IDR 3,500 regardless of how far miles the passenger travelled, saving up around 90% of fare per passenger on board (BPK RI, 2023). With IDR 3.9 trillion annual subsidy from the regional Jakarta Province APBD (Jakarta Provincial Government, 2024), Transjakarta managed to serve 371.74 million passengers in 2024 (Transjakarta, 2024).
- The success of Transjakarta inspires 6 other cities/metropolitans to prioritize the development of similar service, as per the 2020-2024 National Medium-Term Development Plan (RPJMN) (UGM, 2024). Corresponding to the master plan, three cities, i.e., Bandung (BRT Bandung Raya), Medan (BRT Trans Mebidang), and Semarang (BRT Trans Semarang), have even started the groundbreaking of BRT construction process (Fardianto, 2025; Melani, 2024; Mangontan, 2025), see Appendix 1. The total allocation budget for the development is in the range of IDR 1-2 trillion per BRT system (Laeis, 2024; Warsudi, 2024; Aldi, 2023). The cooperation between the Government of Indonesia, regional governments, international development banks, and other related private sectors (World Bank, 2022; Laeis, 2024) has enabled formalization of the operational service and promoted robust understanding of BRT system, including the institutional governance set up as well as feasibility and preliminary studies

BRT ridership association with travel time reduction (case study in international cities)



Source: WRI, 2017

Comparison between mass rapid transit cost development against fiscal capacity in Indonesia's regions



Source: Bappenas, 2025

Strong intercity rail progress in Java highlights urgency to implement RIPNAS nationally

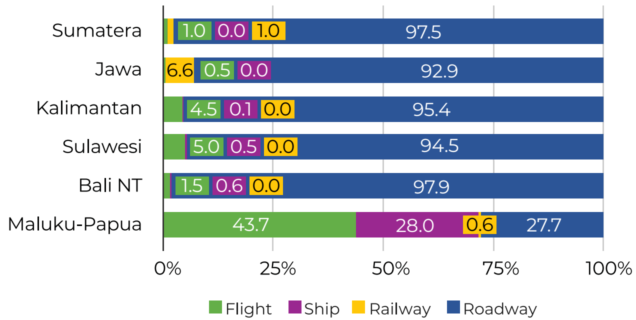
- Indonesia is steadily reinforcing its railway network under the 2030 National Railways Master Plan (RIPNAS), with a plan to build a total of 10,524 km of railway track by 2030—out of the necessary 12,100 km (Ministry of Transportation, 2011). Currently, it is meeting the 2024 target, which is 7,451 km. Railway progres is further emphasized by the public-private partnership (PPP) investment poured into railway projects, which comprised approximately 29-30% out of all transport PPP investment in 2023 (Asian Transport Observatory, 2024). Additionally, Indonesia's first high-speed intercity railway, the 186 km Jakarta–Bandung "Whoosh," began operations in October 2023 and transported over 6 million passengers during its first year of service (KCIC, 2025).
- The 2025–2029 RPJMN identifies railway development as a key priority under its third strategic objective: increasing access to quality employment. It also recognizes the lack of rail infrastructure across many provinces as a critical bottleneck for logistics and regional connectivity, particularly outside Java island (Government of Indonesia, 2025). As of 2022, approximately 70% of the rail track is located in Java, 28 % in Sumatra, 2.6% in Sulawesi, and 0.4% in Papua. This distribution remains far from meeting national infrastructure needs. RIPNAS projected a national rail network necessity by 2030, of which 44% of these needs are projected to be outside Java. The imbalance between actual supply and projected needs leads to rail accounts for less than 1% of national passenger transport production (Mulyono, 2019). Additionally, the railway production is also nonexistent in Kalimantan, Sulawesi, and Papua—regions where rail modal share is still almost 0%. Without proper railway expansion and investment in underserved areas, Indonesia risks failing to reach the target in RPJMN.
- Railway transportation is proven to significantly outperforms other modes on long-distance trip from cost, energy consumption, and environmental benefits. In a long-distance trip, diesel-based rail uses only energy consumption of 10% of similar trip by car and 16% compared to a bus per passenger kilometer (Ministry of Transportation, 2011), with electrified systems performing even better. Despite the promised carbon reduction, rail-based efforts are not explicitly featured as a core decarbonization strategy in Indonesia's ENDC. This oversight risks downplaying the significant role rail could play in achieving long-term emission reductions goals.

Current railway development indicators in the 2025–2029 RPJMN and the 2030 RIPNAS

Indicator	Unit	2024 - 2029 RPJMN Target			2030 RIPNAS Target
		2023 (Baseline)	2025	2029	2030
Railway passenger transport volume	Million passengers	501	519	601	-
Length of railway lines in operation (cumulative)	Kilometers	6,880	6,924	6,985	10,524
Electrified signaling usage on railway lines	Percent (%)	63%	65%	70%	-

Source: Ministry of Transportation, 2011

Modal share based on production according to region in Indonesia in 2018



Source: Mulyono, 2019

Urban railway capacity versus demand: increasing connectivity and proper route planning are urgently needed

- Railway is essential for reducing transport emissions. It has the lowest emissions per passenger-kilometer compared to other transport modes, with clear evidence of high demand in cities. However, most cities failed to meet the demand for the railway trip. Only 2.92% of Jakarta's demand is actually served, and this number is even lower in other cities with less railway infrastructure, such as Yogyakarta (0.18%) and Palembang (0.27%). Even with the highest demand served across cities, Jabodetabek Urban Transportation Policy Integration (JUTPI) report showed that the Jabodetabek mas transport system was operating far beyond its capacity, with some directions, such as Bekasi, reached 328% of its capacity (JICA, 2019). However, it should be noted that this capacity data is more than seven years old, and Jakarta has undergone numerous recent capacity expansions during this period, which may have reduced the actual volume per capacity ratio lower.
- Despite the high demand, several urban railway lines in Indonesia are currently underutilized, including major projects like JAKPRO's LRT and the Palembang LRT. These systems face similar issues: a low connectivity index (approximately 0.5)[1], limited integration with other modes, and planning based on short-term needs like the ASEAN Games, which no longer accurately reflect actual demand. The LRT Velodrome station currently handles approximately 2,000-4,000 passengers daily (BPS, 2024), out of its 80,000 daily ridership estimation if it is connected to Manggarai, which is planned to begin operation in 2027 (PwC, 2024). Other than that, LRT Jakarta is also expected to undergo a further 4.5 km expansion for Phase 2B, which extends from Velodrome to Klender and is expected to finish in 2026 (Jakarta Investment Center, 2023). MRT Phase 2 also has ongoing construction from Bundaran HI to Ancol Barat (MRT, n.d).
- Meanwhile, the Palembang LRT that represents a massive IDR 13.4 trillion investment (Climate Policy Initiatives, 2021), has yet to implement its expansion plan and risk being under capacity if it does not improve through other means, such as intermodal integration or TOD development.

Gaps in estimated demand and served demand in several cities in Indonesia

Cities	Trip numbers (Estimated demand)	Urban Rail Ridership (Served Demand)	Total served demand from the estimated demand
	Million passenger trip /year	Million passenger trip/year	%
Jakarta	10,616	310	2.92%
Yogyakarta	3,468	6	0.18%
Palembang	1,523	4	0.27%

Source: IESR Analysis, 2025

Type	Remarks	Line (PT Operator)	Plan
MRT	Heavy rail high-speed train	Jakarta (PT MRTJ)	Jakarta Phase 2
LRT	Light-rail train (akin to Tramway)	• Jakarta (JAPRO) • Jabodebek (KAI) • Palembang (KAI)	Jakarta (5 line)
KRL	Heavy rail powered by electricity	• Commuter line Jakarta (PT KCI) • Commuter line Yogyakarta (PT KCI) • Rail link Soekarno Hatta (PT KCI)	
KRD	Heavy rail powered by diesel	• Commuter line Bandung (PT KCI) • Commuter line Kartalaya (PT KCI) • Commuter line Merak (PT KCI) • Commuter line Surabaya (PT KCI)	

Source: Various sources; IESR Analysis, 2025

[1] *Connectivity index is calculated by dividing the number of links with the number of nodes within the same system; therefore single isolated line would result in 0.5*

Chapter 3.2.

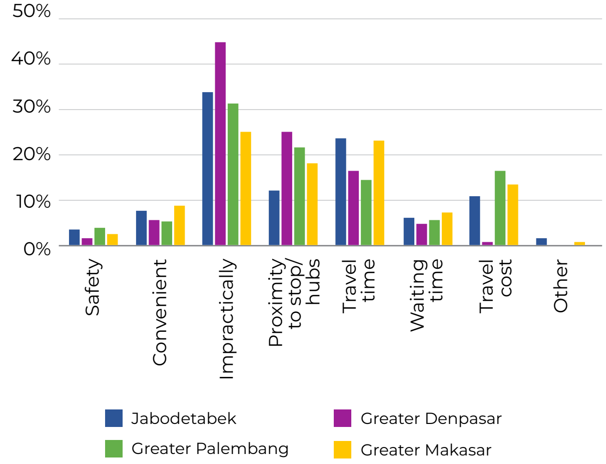
Barriers and opportunities to modal shift

- Inconvenience and cost as a low barrier to mode shift
- *Angkot* to unlock broader public transport utilization
- Buy the service scheme
- Transport metropolitan governance

Low shift toward Public Transport results from unpleasant travel experiences

- Despite recent massive development in Indonesia, public transport is still perceived as a secondary option for urban mobility. According to the most recent commuter statistics by BPS in 2023, even in a metropolitan with growing transit networks, such as the Jabodetabek, showed 79% of commuters preferred to use private vehicles, while the willingness to shift remained strikingly low, notably 3.8% of private vehicle users. The low utilization rate of public transport can similarly be found in Greater Palembang (17%), Greater Denpasar (0,9%), and Greater Makassar (4,6%), reinforcing a nationwide pattern across diverse urban contexts.
- Based on the latest survey by BPS in those four greater areas, the main reason commuters did not opt other than private vehicle was similarly due to the impracticality of public transport. This is an evident in how public transport systems have failed to satisfy both travel demand and travel experience, leading to less desirable options compared to private vehicles or other door-to-door services, such as ride-hailing services. While BPS does not provide a specific definition, this category likely includes common public complaints toward public transport such as the need for multiple transfers, inadequate routes/corridors, lack of service quality and quantity, infrequent service, unreliable schedules, and overcrowding (Ecolane, 2022).

Public transport lack shifting rationale in Indonesia's metropolitans
(case study: Jabodetabek, Greater Denpasar, Greater Palembang, and Greater Makassar)



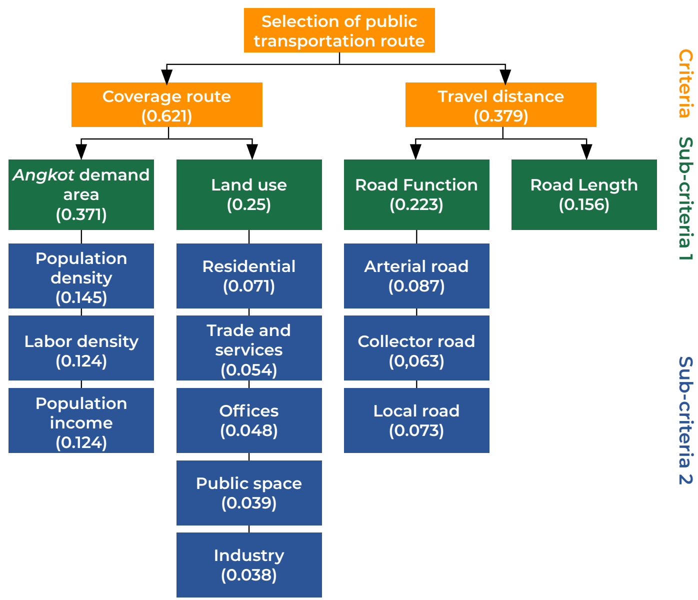
Source: BPS 2023, various regions analyzed by IESR

- The second factor that discourages mode shift is the distance of residential and/or center of activity to public transportation (PT) hubs. It is deliberately associated with the poor coverage of public transport network, which commonly accounts for a walking distance of less than 500 meters (Poelman et al, 2020) from the PT hub to the origin/destination area. At a certain rate, the PT network should not only consider the coverage in the urban core, but also account for the whole agglomeration area. As a figure, 78% area of Jakarta city has been covered by the PT network. This is a great number to attract mode shifting, ultimately to those Jakarta's residents. However, the coverage of PT network in Bodetabek area (Jakarta's agglomeration area) is in the range of 8%-29% (ITDP, 2024). The PT coverage inconsistency between major and surrounding areas allusively discourages commuters from sustainably opting for public transport as their daily main mode.
- Another factor that is highly considered by commuters is travel time. Commuters normally expect to have a more efficient time while travelling using public transport as a trade-off for their inconvenience of not using their private vehicle or door-to-door transport services. Apart from the rapid transit-based systems such as BRT, MRT, and LRT, which are growing rapidly in Jakarta, the mixed traffic road-based mass transits are unfortunately dominating in other cities, offering inefficient travel time to the public—leading to inefficient cost in certain cases. Bandung Metropolitan Area, for instance, only 20% of inhabitants are willing to use PT as their main commuting mode due to potentially inefficient travel time (2.2 times longer), while it would incur them an 18% higher cost than motorcycles (online ride-hailing and privately owned). On the same page, only 27% of total jobs are accessible within 60 minutes by walking and using PT from Bandung station (KIAT, 2022).

Optimizing *angkot*'s ability as first and last mile providers, well-planned route selection, and integration to unlock shift to bigger public transport

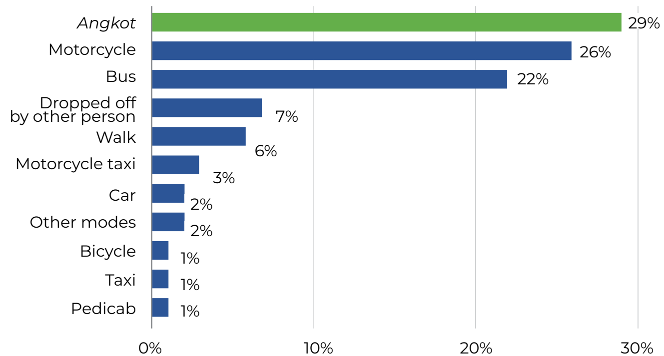
- A study in Makassar found that 55% of angkot passengers start their trips from home (Jumain et al., 2021), indicating most of *angkot* passengers come from groups of people who rely on other people to meet their mobility needs. These groups cannot use private vehicles due to their physical conditions (illness, disability, small physique), legality (not having a driver's license), and financial limitations (not having private vehicles). Providing suitable access to angkot routes and shelters is vital to attract more passengers from these groups, especially since angkot can cover the small streets typical of residential areas in Indonesia where these groups exist.
- A study in Gresik showed that the coverage capability of public transportation routes (62.1%) received a higher priority level than the travel distance parameter (37.9%) (Jauhari & Sardjito, 2015), suggesting a well-planned route selection is essential to increase public transportation occupancy rate, including *angkot*. A proper route should prioritize areas with high population and labor density, and pass through public places like trade and services centers, offices, and industrial areas. Moreover, the route length should be efficient since people use *angkot* for medium travel distance of around 2-5 kilometers (Siahaan & Lase, 2021; Jumain et al., 2021).
- Attracting more people to use angkot is crucial since angkot can increase the occupancy rate of the larger public transportation modes like bus and train. Around 29% of Trans Semarang passengers were previously angkot users (ITDP, 2017), confirming *angkot* passengers tend to shift to bigger public transportation modes if they have to. A study in Jakarta found that the addition of a microtrans (*angkot* in Jakarta) route connected to a main Transjakarta corridor correlates with a 0.71% increase of passengers in that corridor (Dharmawan, 2022), coming from microtrans' ability as a feeder to provide first and last mile trip services for passengers in residential areas. Integrating more microtrans routes into bus and train corridors should be done to unlock shift to larger public transportation modes.

Selection of public transportation route



Source: Modified from Jauhari & Sardjito, 2015

Transportation options of Trans Semarang passengers before it operated



Source: ITDP, 2017

Enhancing bus ridership through keeping fare affordable and service integration

- The mode choice survey conducted by IESR in 2023 used a stated preference method with hypothetical scenarios to assess how changes in service attributes (i.e., cost, travel time) would influence the likelihood of choosing bus travel. The analysis found that the three significant factors influencing choosing bus were cost (represented by fares), transfer cost, and number of transfers. Improving these aspects would likely enhance the attractiveness of bus travel. The cost coefficient was negative and statistically significant, indicating that higher costs reduce the likelihood of choosing the bus. The model also showed a negative alternative specific constant (ASC) for the bus mode, suggesting that even with equal performance across all modes, respondents still view buses unfavorably, likely due to unmeasured factors such as comfort or reliability.

- While cost significantly affected the decision of choosing bus, TransJakarta effectively maintained fare affordability. Transjakarta has not increased its fare since its inception in 2004 and remained IDR 3,500 as of 2025, despite ongoing inflation. If adjusted with year-by-year inflation, the fare should be IDR 9,515[2], and if the subsidy is completely removed, the fare would be IDR 13,500, considering that every passenger received a subsidy of IDR 10,000 per ticket (Sari, 2025). However, if either adjustment implemented, the TransJakarta ridership will likely decline by 6.9-7.5% under the inflation-adjusted fare and by 10.1-11.0% under the unsubsidized fare (IESR Analysis, 2025). The stagnant pricing is made possible by annual DKI Jakarta government subsidies, which totaled IDR 3.9 trillion in 2024 (BPK, 2024) out of IDR 81.7 trillion of regional budget (Government of Jakarta, 2025) and covering 90% of operational expenditure (ICCT, 2023).

- Reducing transfer costs is only possible through comprehensive service integration. Currently, Jakarta's public transport system has three main integration bodies: PT MITJ, which focuses on spatial integration along railway corridors in the Jabodetabek; PT ITJ, which develops spaces along MRT corridors; and JakLingko, which serves as a payment integrator for TransJakarta, JAKPRO (LRT Jakarta operator), and PT MITJ. However, a true multimodal service integration, for example, Transport for London (TfL) (see pg. 29 for further explanation), that involves a unified transport governance body responsible for service planning, scheduling, and a single-payment system, has yet to be fully established. Most public transport modes in Jakarta still operate independently, with limited fare integration and minimal integration in service delivery.

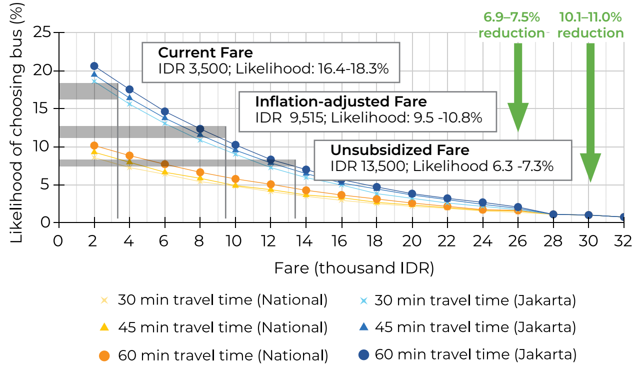
Mode choice survey through mixed logit model result[1]

Attributes	Modes					
	Car	Motorcycle	Motorcycle Ridehailing	Micro bus (*Angkot*)	Bus	Train
ASC	0.503	0.799	-1.2	ref	-0.24	0.27
Cost	-0.0892	-0.105	-0.00687	-0.2	-0.114	-0.00737
Parking cost	-0.00428	-0.016				
Toll	-0.00381					
Travel time	0.00638	-0.015	-0.014	-0.0114	0.00619	
Waiting time			-0.0316	-0.0293	-0.0157	0.00633
Transfer number				0.0372	-0.0561	-0.0277

Decrease mode utilization; Increase mode utilization

Source: IESR Analysis, 2023

Effect of bus fare on the likelihood of choosing bus
(for travel time of 30, 45, and 60 min)



Source: IESR Analysis, 2025

[1] *Coefficient magnitudes are not directly comparable across different attributes due to differing units and scales. Comparisons should be made across transport modes for the same attributes only (e.g., how cost affects mode choice among bus, rail, and others)*

[2] *This amount is calculated by adjusting the original fare (IDR 3,500) using Indonesia's inflation rate from 2004 to 2024. The inflation data was obtained from the World Bank (2024)*

Road-based mass transit investment through Buy the Service scheme incentive—a real initiative from Indonesia's governments promoting mode shift in metropolitans

- Introduced in 2020, the Teman Bus program has been implemented in 11 cities across Indonesia. Bogor (Trans Pakuan), Bekasi (Trans Bekasi Patriot), and Depok (Trans Depok) followed the footprint later in 2022 and 2024, under BisKita program managed by *Badan Pengelola Transportasi* Jabodetabek (BPTJ). The scheme was established by the Government of Indonesia, under the Ministry of Transportation (MoT) in cooperation with the Ministry of Finance (MoF), namely Buy the Service (BTS) financing scheme. It was initially ruled out in MoF Regulation No. 138/PMK.02/2022 and later revised in MoF Regulation No. 55 of 2023.
- Both programs are managed under the principle of gross contract financing scheme (ITDP, 2023). This scheme grants the authority full rights to set the specific Minimum Performance Standards (*Standar Pelayanan Minimal*/SPM) and standard operating procedures (SOP) that should be fulfilled by the operator selected through tendering process. The public, thus, may afford the service at a more sensible price regardless of miles driven per passenger on board. The scheme was very well accepted by the public and was admitted to have served around 81.8 million passengers in total (Wijaya, 2024), with 62% of BTS passengers were motorcycle users (Alfarizy, 2023). This highlights how this scheme highly encourages commuters to mode shift
- The national budget efficiency policy in early 2025 has got the scheme partially struck into the ground. With a budget cut of around 60%, the scheme can now afford only in 8 cities, including 6 former and 2 additional implemented cities, which used to be 11 cities in total (Ferdianto, 2025). These services that have been funded for 5 years are primarily expected to be taken over by the regional government to run under their own APBD allocation (Aswara, 2025).

Buy the Service financing scheme across the country in 2025

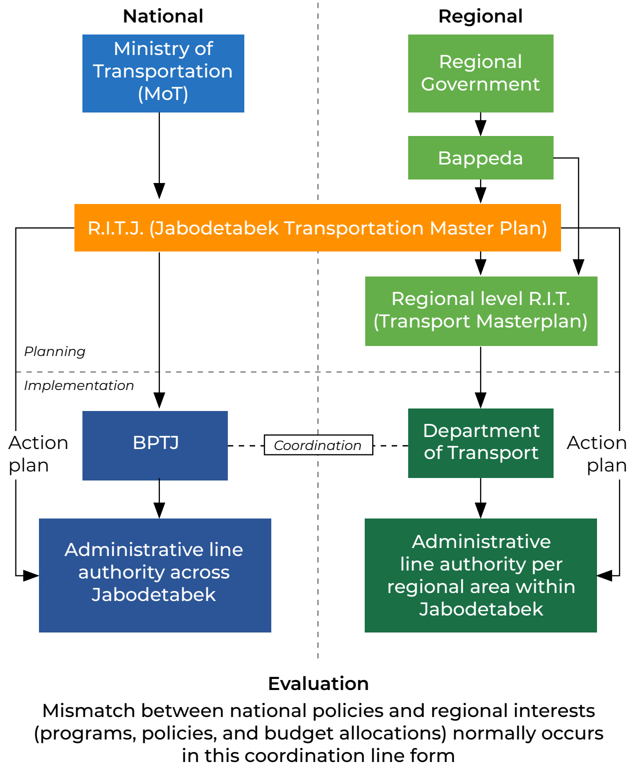
Source: IESR Analysis, 2025

- The handover process is still constrained in some regions due to the unreadiness of the regional government to single-handedly finance the system. This, unfortunately, could lead to halt the operating service entirely or partially (Fatir, 2025 & Baiduri, 2024) and/or lack of quality and quantity of services (Utama, 2025). On the other hand, some regions (e.g., Medan and Bandung) have completely taken over and run the operations on their own while being successors as the next BRT system in Indonesia (ITDP, 2023; Costa, 2025).
- The regional governments are encouraged to initiatively follow the same path by implementing the BTS financing scheme to promote more mode shift. Trans Semarang, Trans Jateng, and even Trans Jakarta, are some examples of bus services operating under municipal and provincial initiatives.

Ensuring seamless public transport integration through strong coordination and independent governance at the metropolitan level

- People's movement is not something that can be limited by territory; instead, it is even beyond that. On the contrary, organizing a public transport system must be managed and submitted to a fully rights authority in that region. Therefore, there must be a great coordination in a metropolitan level to ensure the seamless integration of transport and land-use development while satisfying the travel demand needs.
- Transport metropolitan authority is a common best practice worldwide that aims to integrate urban transport development and land use within a metropolitan area. One example is Transport for London (TfL), a primary metropolitan transport authority in London greater area that is capable of consolidating the planning, policy making, implementation, and operational of urban metropolitan transport on their own. This means that their authorizations do not depend on any institutions other than the administrative area line authority. Operating under the Greater London Authority, the authorization allows the implementation of fare integration between PT modes with a maximum daily fare depends on certain zone, called the daily cap (Transport for London, n.d).
- Meanwhile, Indonesia has implemented BPTJ as the metropolitan governance authority for Jabodetabek under MoT. Formed under Presidential Regulation 103/ 2015 concerning the Jabodetabek Transportation Management Agency, its main tasks are to develop, manage, and enhance the integration of transportation services across Jabodetabek, as per Jabodetabek Transport Master Plan/RITJ. However, some evaluations have underlined the implementation of BPTJ: the lack of a fully integrated metropolitan transportation plan—particularly regarding fare and service integration between road- and rail-based modes across Jabodetabek—inefficient transport licensing procedures, and low sense of belonging to RITJ including ambiguous perspectives against BPTJ's monitoring role and authority among related institutions. These issues result from the BPTJ's isolated authority over the planning, policymaking, implementation, operation, and evaluation of urban metropolitan transport across Jabodetabek (Bappenas, 2025).
- The absence of an independent metropolitan-level authority can be very significant in this context. The Sustainable Urban Mobility Plan (SUMP) has been developed in six pilot cities in Indonesia (see appendix 1), which will be a basic requirement for The Ministry of National Development Planning/ BAPPENAS to comprehend urban transport development prioritization in accordance with the regional/local contexts. It explores the step forward directions (planning to the implementation stages), while also understanding suitable and viable funding and financial access (Surabaya Today, 2024). The document also covers institutional setup evaluation with aims to enhance the readiness of regional government to independently consolidate their urban transport development plan across metropolitan area through stakeholder mapping.

The structure and evaluation of the existing metropolitan transport authority in Jabodetabek



Source: Bappenas, 2025

Chapter 3.3.

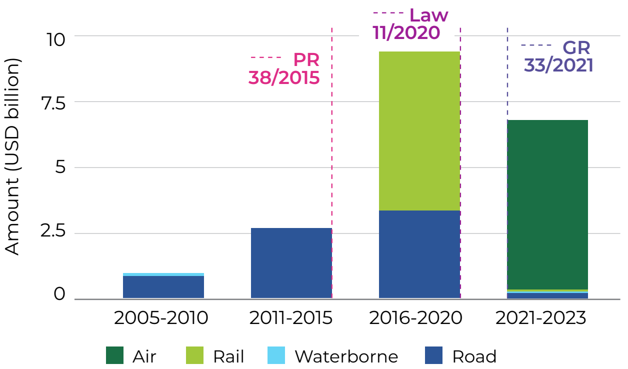
Expanding railway's potential: financing, regulatory framework, and pipelines

- PPP and blended finance mechanism for railway expansion
- Railway projects in pipeline
- High speed rail potential

PPP reform progressing, but railway investment still faces complex land acquisition issues

- Rail-based transportation holds significant potential to shift passengers and freight away from higher-emitting modes. However, developing railways, rolling stock and supporting infrastructure is costly. The Indonesian railway and rolling stock infrastructure alone will require an estimated IDR 853 trillion in investments based on the RIPNAS expansion plan until 2030 (Detik, 2022). However, current projections suggest that only around 36% of this will be covered by the state budget. This creates a significant financing gap that needs to be filled through innovative financing such as PPP.
- Acknowledging the importance of private investments, through Job Creation Law 11/2020 and Government Regulation 33/2021, the government has streamlined the regulatory process to further improve the ease of doing business in the railway sector (Ong et al., 2021). This change eliminated multiple overlapping permits, integrated business and operational licenses. Further, it reduced land acquisition requirements for development permits. It also introduced greater flexibility in leasing maintenance facilities, which previously required ownership. These changes lower the administrative and financial entry barriers for private investors, which enhances the sector's readiness for more financing options such as PPP.
- While Indonesia has made meaningful progress in reforming its PPP framework—particularly through Presidential Regulation 38/2015 and Government Regulation 33/2021—these efforts have yet to translate into a broad pipeline of private railway investments. Most PPP investment to date remains concentrated in a single project—the Jakarta–Bandung high-speed rail—which predates many of the latest reforms. However, recent progress, such as the USD 69 million PPP for the Makassar–Parepare railway in South Sulawesi, shows that the framework is beginning to gain traction beyond Java, despite persistent challenges like complex land acquisition (World Bank, 2023; ERIA & MoF, 2023). In the Jakarta–Bandung case, land compensation disputes and delays contributed to cost overruns, prompting developers to seek an additional USD 1 billion loan from the China Development Bank (Bangkok Post, 2022).

Amount of PPP invested in Indonesia's transport sector



Source: World Bank, 2023

Regulatory improvements in Indonesia's railway sector

Aspect	Before (GR 6/2017 & Law 23/2007)	After (GR 33/2021 & Law 11/2020)
Business and operational licensing	Required separate licenses for business operation and railway infrastructure development	Integrated licensing process for both business and operation
Land acquisition	Minimum 10% of land acquisition required to apply for development permit	Reduced to 5% land acquisition requirement for permit
Rolling stock maintenance facilities	Operators are required to own maintenance facilities	Permitted to lease maintenance facilities from third parties

Source: Ong et al., 2023

Railway infrastructure qualifies as a climate mitigation investment, but has attracted limited financing through green bonds

- Currently, a common instrument for railway financing in Indonesia is sovereign *sukuk*/bonds or concessional loans. The use of green bonds (listed as *Obligasi Berkelanjutan* on IDX) from transportation State-owned Enterprises (SoEs) is still limited. Notably, only PT KAI among Indonesia's transport SoE, is known to issue green bonds. The total amount of green bond from KAI is around IDR 4.7 trillion out of 13 green bond issuances (KSEI, 2025).
- The wider utilization of green bonds face barriers like many projects are not yet bankable by investor standards, and local support services—like reviewers and verifiers—are still limited. This adds cost and complexity, especially for smaller issuances (below USD 100 million). Furthermore, green bonds are much less attractive than other financing options like concessional loans, used mainly for LRT and MRT developments. Concessional loans—typically have 0.1–0.3 % interest with lengthy tenors (30–40 years) and grace periods—are far cheaper and more flexible than green bonds.
- As a key area in climate mitigation measures, most railway infrastructure qualifies as green. Hence it is suitable for inclusion in green bonds (CBI, 2022). Further, railway assets almost always qualify as green expenditures, making them ideal Use-of-Proceeds for green bonds or sovereigns. Future bonds from SoEs and corporations should be issued as green bonds to enhance their appeal as sustainable investments, attract private sector interest, and ultimately diversify funding sources.
- Currently, there are at least nine notable railway-related projects being planned or under construction in Indonesia, all of which are marked as "green." This demonstrates significant climate alignment on paper. However, several projects are still in the early planning or design phases, with few having clear completion timelines. Implementation bottlenecks, such as land acquisition delays or unclear commercial flexibility, can be mitigated by de-risking instruments, for instance, revenue guarantees.
- Among railway-related projects currently in the pipeline are MRT, LRT, and Transit-Oriented Developments (TODs). These projects are not only concentrated in Jakarta but also emerging cities as part of national efforts to improve urban connectivity. Several of these initiatives fall under the National Strategic Projects (PSN) framework. In total, railway-related PSN projects are estimated to require an investment of IDR 25.37 trillion (ERIA & MoF, 2023). Among these projects, the high-speed rail (HSR)—particularly the proposed extension from Jakarta to Surabaya—stands out as part of the Belt and Road Initiative (BRI) (Jakarta Post, 2024).

Spread of current railway projects in Indonesia

1. **Medan-Binjai-Deli Serdang (Medan LRT)**
   USD 1.42 bn (IDR 20.3 tn)
   Green
   Others
2. **Siantar-Prapat**
   USD 847 m
   Green
   Others
3. **Rantau Prapat-Duri-Pekanbaru Railway**
   USD 721 m (IDR 10.3tn)
   Green
   National Strategic Projects / KPPIP
4. **LRT Gading-Jakarta International Stadium (JIS)**
   USD 462 m (IDR 6.6 tn)
   Green
   Jakarta City Government
5. **MRT Phase 3 Kalideres-Ujung Menteng**
   USD 3.4 bn (IDR 6.6 tn)
   Green
   RPJMN 2020-2024
6. **MRT Phase 4 Fatmawati-TMII**
   USD 1.95 bn (IDR 28 tn)
   Green
   Jakarta City Government
7. **TOD* Pegangsaan Dua**
   USD 103 m (IDR 1.5 tn)
   Green
   Jakarta City Government
8. **Jakarta-Surabaya Railway**
   USD 7.2 bn (IDR 102.3 tn)
   Green
   National Strategic Projects / KPPIP
9. **Makassar-Pare Pare Railway**
   USD 574 m (IDR 8.2 tn)
   Green
   Priority Project / KPPIP

Cost | Greenness | Pipeline source | Planned | Under construction

Transit Oriented Development (TOD)

Source: Adapted from CBI, 2022

Jakarta - Surabaya HSR is a strong alternative to air travel, but sustaining a high occupancy rate is crucial to shift passengers from airlines

- The shift strategy includes moving from planes to more energy-efficient modes like trains. While planes are a form of collective transport, their high energy use per passenger-kilometer makes them comparable to cars (Holden et al., 2020). Regular trains cannot effectively replace planes due to significant time differences, but HSR at 300 km/h can compete with short-haul flights. With stations closer to city centers than airports, HSR offers a travel time advantage, especially for journeys around 800 km (Givoni, 2006).
- Indonesia's first HSR (Whoosh) connecting Jakarta and Bandung has been in operation for over a year, transporting approximately 5.8 million passengers as of September 2024. Daily ridership rose from 9,000 in October 2023 to 18,000–22,000 by October 2024, driven by increased service frequency from 14 to 48 trips per day. This number rose to 62 trips per day in 2025. Passenger occupancy is relatively high, averaging 70%–80% in low seasons and nearing full capacity during peak seasons. Furthermore, Whoosh is able to shift 45% of its users who previously traveled by car and 25% who previously used buses or travel services (KCIC, 2024). Whoosh's 40-minute travel time becomes a key advantage over the 2.5–3 hour journey by car, train, or shuttle.
- Following the enthusiastic reception of Jakarta–Bandung Whoosh, there is growing momentum to extend the HSR network to other cities. This follows the National Railway Plan (Kepmenhub 296/2020), which outlines plans to expand high-speed rail to Surabaya. Currently, three potential routes are being assessed for feasibility: the northern, central and southern corridors. Each journey would take approximately 200 minutes.
- A 200-minute (3.5-hour) journey on the HSR would be at least 4 to 9 hours faster than regular trains. However, the most significant advantage of HSR is how it competes with air travel in total journey time. While the flight itself takes around 1.5 hours, the end-to-end travel time—including transit to the airport, security checks, boarding, QGlobal trends show that HSR can capture around 35% of former airplane passengers. If Jakarta–Surabaya HSR follows this trend, it would require 4–7 daily trips and maintain 70–80% passenger occupancy to accommodate this shift.
- The Surabaya route extension is also considered a means of achieving the HSR economies of scale. At just 142 km, the current Jakarta–Bandung route would struggle to make profits, as most HSR systems typically operate at more than 400 km distance (Tenggara Strategic, 2023). The initial feasibility study also placed Jakarta–Bandung as the first phase of a bigger plan, highlighting that full investment scale and economic viability would only be realized with the completion of the entire Jakarta–Surabaya corridor (JICA, 2015).

Route options of Jakarta–Surabaya HSR

North line
South line
East line
Existing line: Jakarta-Bandung

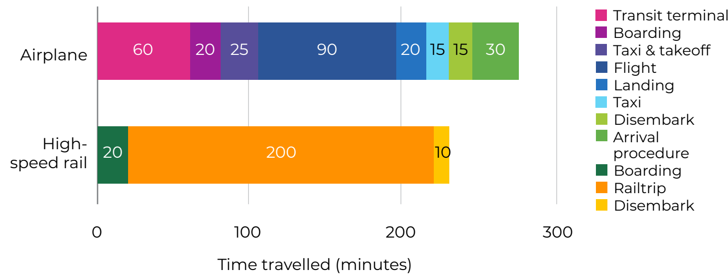
Bandung - Surabaya
via Cirebon and Semarang
- Distance: 641.96 km
- Tunnel : 51.95 km
- 14 Station + 1 Reserve
- Travel Time: 184 minutes

Bandung - Surabaya
via Cirebon and Purwokerto
- Distance: 679.19 km
- Tunnel: 44.61 km
- 15 Station + 1 Reserve
- Travel Time: 193 minutes

Bandung - Surabaya
via Kroya and Yogyakarta
- Distance: 629.45 km
- Tunnel: 21.25 km
- 13 Stations + 1 Reserve
- Travel Time: 180 minutes

Source: JICA, 2015

Estimation of Jakarta–Surabaya typical time breakdown

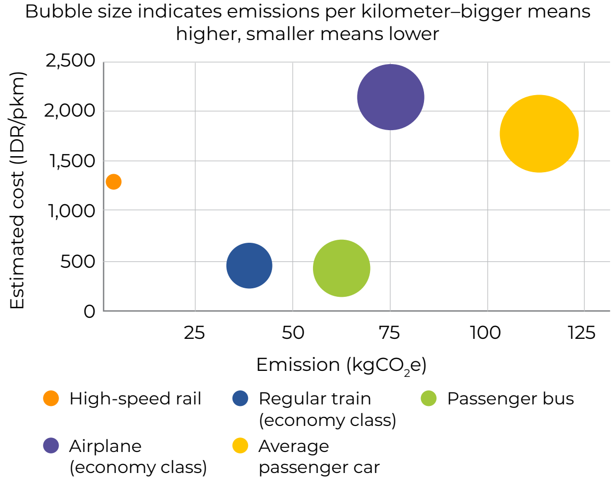


Source: IESR Analysis, 2025

High-speed rail's unique cost-to-emission performance can attract passengers, but government must manage its investment risks

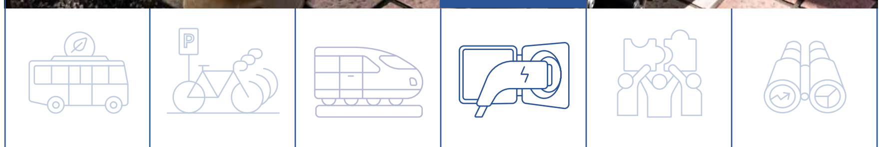
- The Jakarta–Surabaya air corridor, with around 50 flights per day, is among the busiest air corridors in Indonesia. However, this air corridor experienced a sharp decline in passengers, with load factors dropping from 43% (September 2024-January 2025) to just 5% (January-March 2025), leading airlines to reduce or discontinue services (PwC, 2025).
- The declining passenger numbers and reduced airline services along the Jakarta–Surabaya air corridor suggest a shift in travel demand. A recent survey found that 49% of Indonesia's middle class reported weaker purchasing power, with 85% attributed to the rising costs of essentials like food, energy, and transportation (Inventure, 2024). At the same time, high domestic airfares are making flights even less accessible for many travelers. Consequently, more people are seeking cost-effective and reliable alternatives to flying.
- The Indonesian government promotes HSR as an alternative to reduce road congestion with the goal of replacing trips made by conventional trains, buses, and cars. However, its cost and emissions efficiency differ significantly from other modes of transport, making it not a direct substitute for typical 800-kilometer journeys. Among the five transport modes, HSR has the lowest emissions per passenger-kilometer and the lowest total CO_2e emissions overall, assuming 0.0045 $kgCO_2e$ per passenger kilometer of emission factor (Tsui, 2023). In terms of costs for passengers, the estimated cost of HSR premium economy class is lower than both the airplane fares and the cost of a single-passenger car journey, including toll fees. Nevertheless, it remains significantly more expensive than standard conventional train fares and passenger bus tickets.

Estimated cost vs. emissions per passenger in different modes for 800 km journey



Source: IESR Analysis, 2025

- Using a shift paradigm perspective, HSR brings a unique alternative to existing transport options. It can appeal to both environmentally conscious and budget-conscious travelers. In reality, cost remains the top priority for most Indonesian travelers. A 2024 IESR survey found that low-cost rail-based public transport is a most preferred decarbonized travel option. With these in mind, HSR is expected to partly shift three groups of passengers: airplane passengers, car users who drive alone, and executive or first-class train users. The three have a similar cost range, which is also close to the estimated HSR fares. To remain competitive, based on a survey, the standard fare for the longest route should stay around IDR 800,000 to 1 million (Kumparan, 2024).
- Maintaining affordability for passengers is critical to ensure that HSR generates enough revenue to cover operational costs and justify the initial government investment. For the government, HSR is a risky investment, as already shown in the Whoosh development—where delays and cost overruns turned the initial estimation cost of USD 6 billion into USD 7.3 billion in realization. On average, HSR investment is 1.45-3 times more expensive than the investment for conventional railway systems, leading to an approximate cost of USD 22.5-50 million/mile (Albalate & Bel, 2012; Li et al., 2020). Given the 700 km extension between Bandung and Surabaya, total investment could range between USD 9.8-21.75 billion. Given the high costs, the government must be rational in weighing the benefits of passenger shifts. A well-structured financing scheme like PPP can help share investment risks while keeping HSR an attractive mode shift option.



Chapter 4.

Accelerating electromobility for motorcycles and cars

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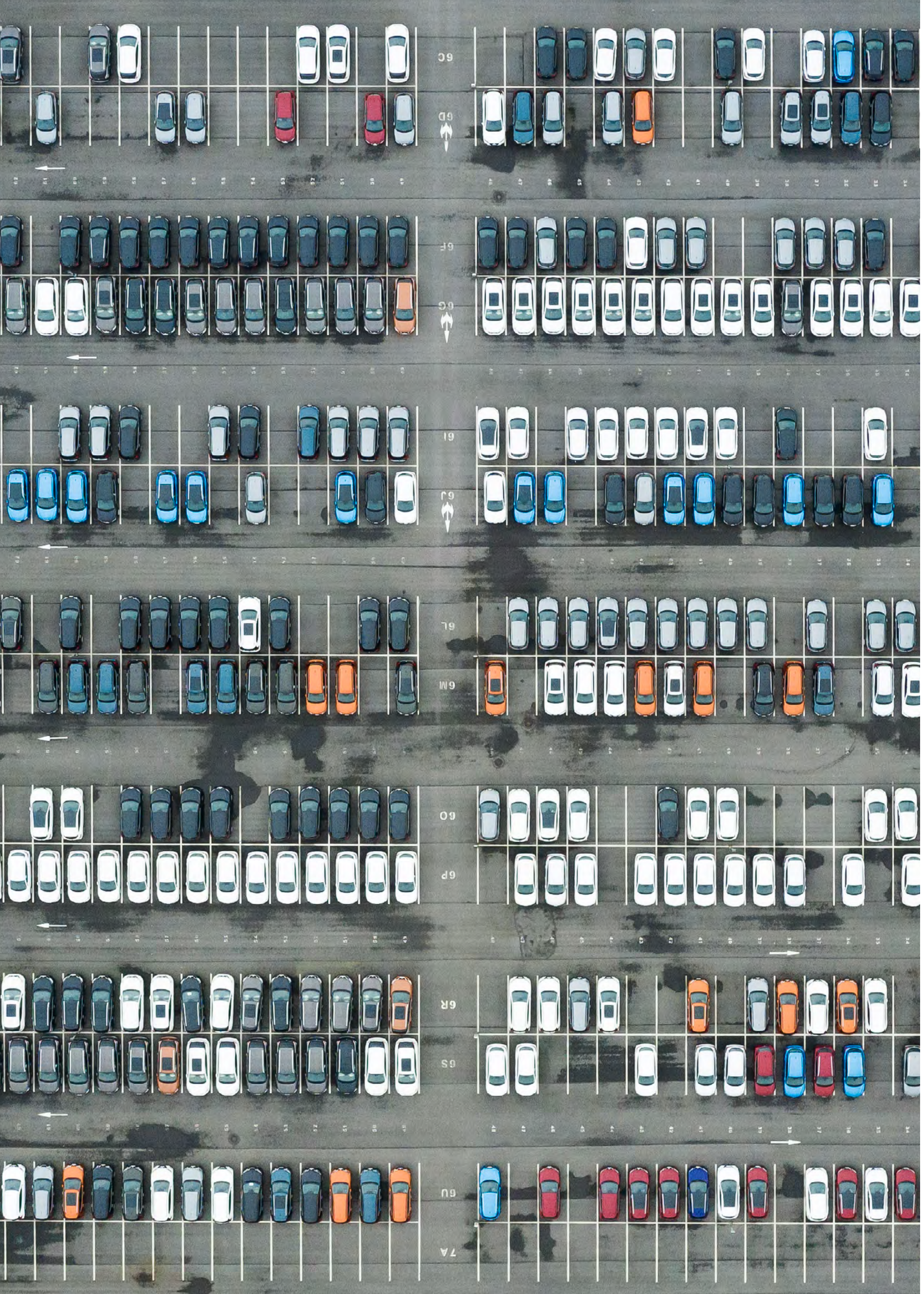


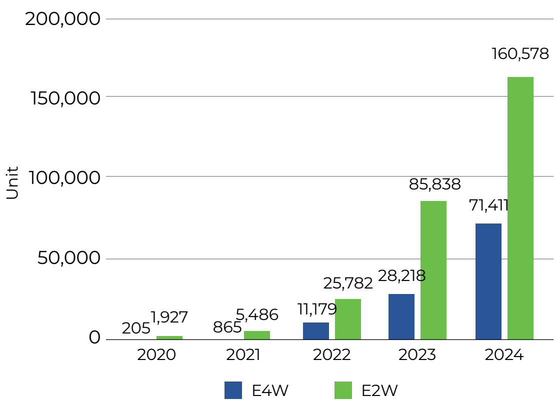
Chapter 4.1.

BEV market penetration and trends

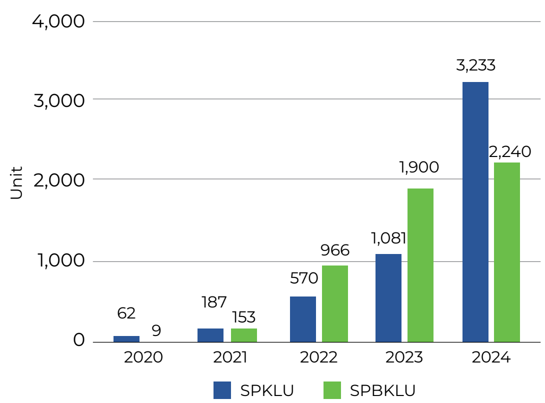
- E2W market trends and sales
- E4W market trends and sales

In the last five years, BEV has been gaining ground in the Indonesian market

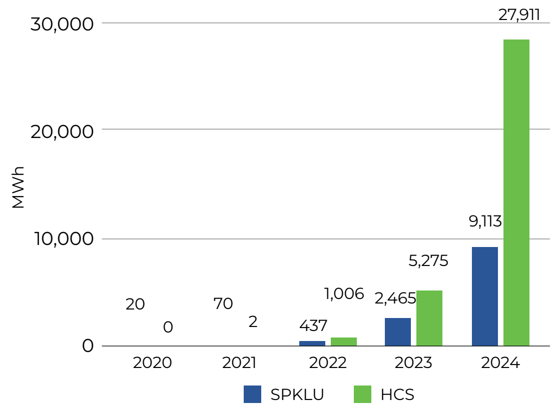
Number electric vehicle on the road



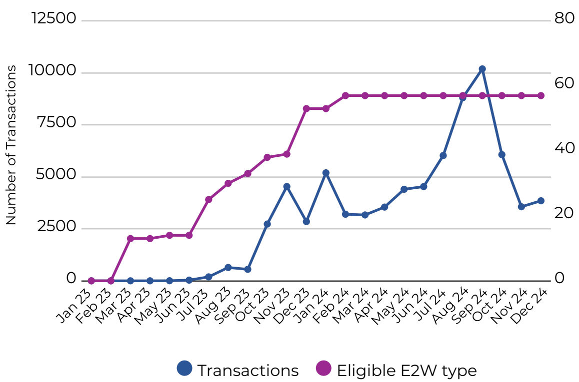
Charging infrastructure growth



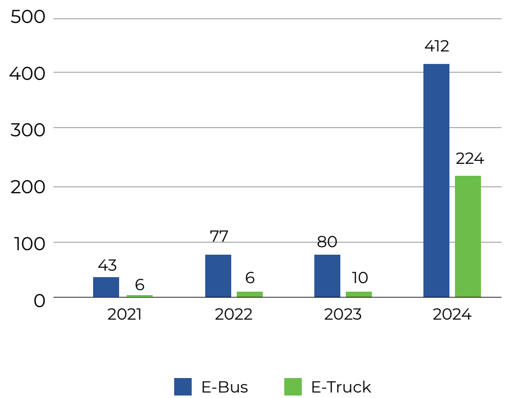
Energy consumption for E4W trend



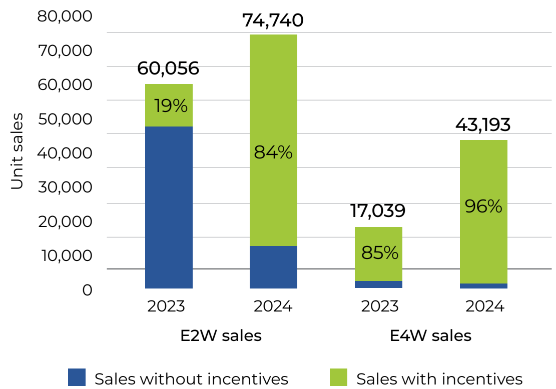
Eligible E2W for incentives and the number of transactions



E-Bus and E-Truck growth based on SRUT



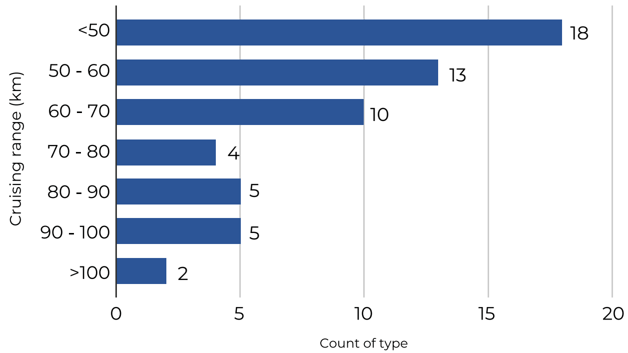
Incentive effect on BEV sales in 2023-2024



Battery subscription could boost E2W sales by making longer-range models more affordable

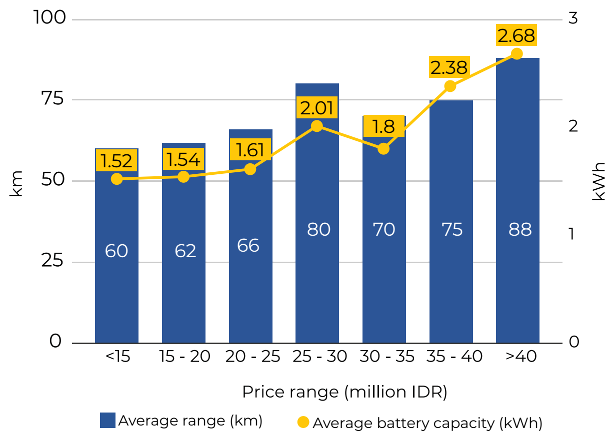
- In the latest incentive scheme for electric motorcycles (E2Ws), 57 models from 19 brands are eligible for government support (Katadata, 2024). These models use four types of batteries: LFP (28 types), Li-ion (25 types), VRLA (3 types), and SLA (1 type). In terms of price, around 75% of the eligible E2Ws are priced below 25 million IDR, quite competitive when compared to conventional motorcycles (2Ws), which is also typically cost under 25 million IDR. Among the 57 models, the minimum speed is 45 km/h and the maximum is 103 km/h.
- In terms of cruising range, about one-third of the E2W models which are eligible for incentives can travel less than 50 km on a single charge, with the shortest range being 40 km. This is significantly lower than conventional 2Ws, which often achieve more than 200 km per tank. As a comparison, 32% of commuters in the Jabodetabek travel more than 40 km a day (CNBC, 2021), highlighting a potential mismatch between E2W capabilities and the daily commuting needs for the portion of population. Although consumer demand more powerful E2W, some models who can meet the consumer needs are not eligible to get the incentive as they do not comply with local contents requirements (LCR) regulation. Models with longer range in general also has bigger battery capacity and also more expensive
- Since the government assistance scheme was introduced in mid-2023, 62,000 out of 77,000 E2Ws sold were purchased through this program (MoI, 2025). 30% of these subsidized buyers chose the longest-range models, which offer up to 130 km on a single charge and are priced at approximately 20.6 million IDR (Kompas, 2024). However, despite announcements that a new incentive scheme is forthcoming, no official regulations have been issued. This lack of clarity has led to market uncertainty, causing consumers to delay purchases. As a result, E2W sales in Quarter 1 (Q1) 2025 fell by more than 80% compared to the same period in the previous year (detikoto, 2025).
- The uncertainty around both incentives and battery technology presents major challenges to growing E2W adoption. A promising solution is the implementation of a battery subscription model. Since batteries are among the most expensive components in battery electric vehicles (BEVs), a subscription could reduce the initial purchase price by up to 50% (Oto, 2023). Battery subscription method also successfully entered the market as E2W sales with this method comprise of at least 50% of E2W total sales in 2024. Manufacturers could improve consumer confidence by offering battery performance guarantees and covering replacement costs for defective batteries (gridoto, 2024). With a battery subscription, the resale value of E2Ws would also become clearer, as it would be based solely on the condition of the vehicle itself and making ownership more attractive.

Distribution of eligible E2W type for incentives scheme in 2024



Source: IESR Analysis, 2025

Average range and battery capacity of E2W type

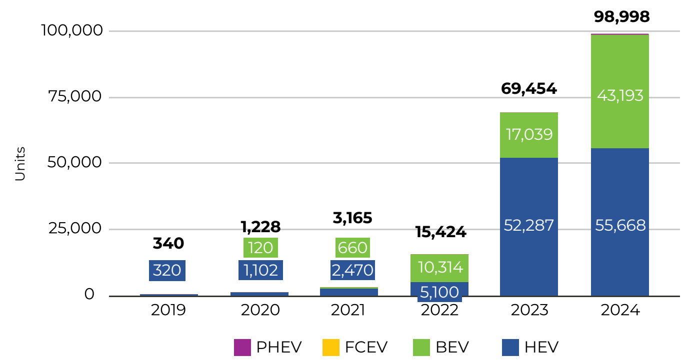


Source: IESR Analysis, 2025

Secure BEV positive trend by gaining consumer trust on technology reliability

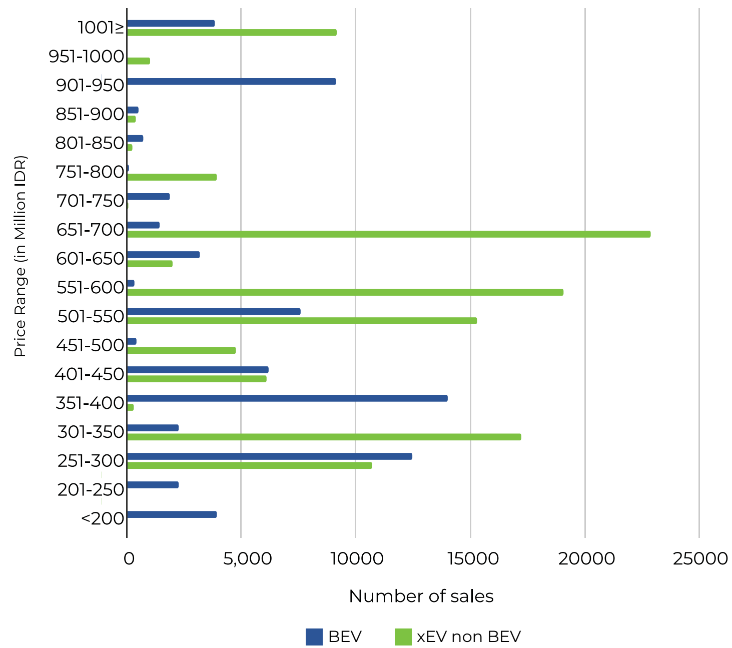
- The Indonesian car market is dominated by multi-purpose vehicle (MPV) and sports utility vehicle (SUV) types. While the MPV remains Indonesia's dream car due to its capacity to carry more passengers, the SUV market is driven by the better economic condition of Indonesian people, varying geographical landscapes (mountain, hill, coastal, sand, beach areas, etc), flood-prone areas, uneven and unpaved road condition, better comfort and safety, and also has good resale value (Supramobil, 2024), leading to a growing market share from 16-18% before 2020 to approximately 40% by 2024.
- The Indonesian automotive market has also undergone a technological shift to align with Indonesia's pledges to reach net-zero emissions (NZE) by 2060. Electric powertrain vehicles (xEV) first entered the Indonesian market through hybrid electric vehicles (HEV) and plug-in HEV electric vehicles (PHEV), which were introduced in 2019 and followed by battery electric vehicles (BEV) in 2020. Based on Gaikindo Wholesales Data from 2019 to 2024, xEV adoption surged after the COVID-19 era, with BEVs reaching 10,000 sales in 2022, and HEV sales jumped dramatically from 5,000 in 2022 to 52,000 in 2023. In 2024, BEV sales are increasing by more than 200% compared to the previous year.
- The skyrocketing demand in both the HEV and BEV segments follows a similar pattern: affordable 7-seaters from well-known brands, which aligns with Indonesia's consumer preference. However, in terms of vehicle price, the BEV and HEV markets have slightly different market preferences. Gaikindo sales data (2022 to 2024) reveals that BEVs achieved 10,000 sales in two price segments, IDR 250-300 million and IDR 350-400 million. HEVs reached the same 10,000-sales milestone in three segments, IDR 250-350 million, IDR 500-600 million, and IDR 650-700 million. Furthermore, 4 out of 5 HEV price segments analyzed actually exceeded 15,000 sales during this period. This strong sales performance across diverse price points, including premium ranges, demonstrates that price alone is not the primary barrier to BEV adoption in Indonesia. Instead, other factors hinders BEV sales, such as concerns over battery technology reliability, vehicle reliability, resale value, travel range, battery lifetime, charging times, and safety issue when charging (PWC, 2024).

Total units of electric powertrain cars in Indonesia



Source: Gaikindo Wholesales Data, 2019-2024

BEV and non BEV total sales (2022-2024) based on price range

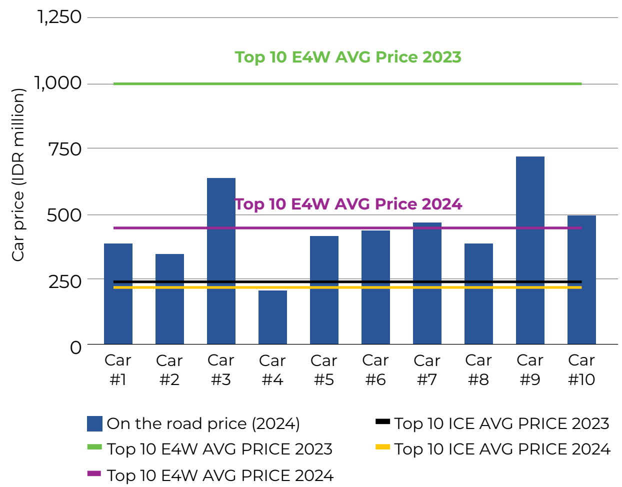


Source: Gaikindo Wholesales Data, 2022-2024; IESR Analysis, 2025

Domestic E4W market is growing, propelled by availability of more accessible models from China

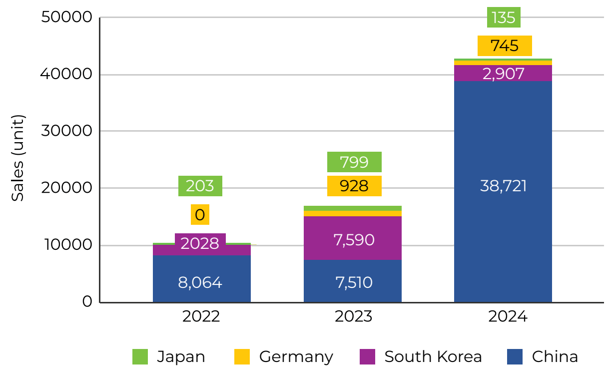
- In 2024, E4W wholesales in Indonesia saw a significant surge. A total of 43,193 E4W units were delivered, underscoring a sharp increase from the 17,012 units recorded in 2023. Continuous government incentives and the expansion of charging infrastructure help build public confidence.
- One of the primary reasons behind the growth is automotive manufacturers, primarily from China, which have been aggressive in introducing new models at competitive prices, making EVs more accessible to a broader market segment. Chinese automakers can offer more affordable models by producing at higher volumes, which spreads costs and improves manufacturing efficiency. For instance, Chinese battery costs are about 20% lower than those in the US, thanks to cheaper materials, such as LFP and NCM 811 (ICCT, 2021). Chinese automakers also have more control over the supply chain like batteries, motors, and conductors (Financial Times, 2024).
- Between 2022 and 2024, the Indonesian market witnessed a rapid influx of Chinese EV brands, with 8 brands now present. This move is mainly fueled by tariff-free access to import Completely built-up (CBU) EV units into the Indonesian market on top of the existing incentives like Value-Added Tax (VAT) and other tax exemptions. Several of these companies have already established manufacturing operations in the country, and more are expected to follow. Consequently, the number of EV models available has increased dramatically, rising from just 11 in 2022 to over 50 models by January 2025, with the majority originating from Chinese manufacturers.
- The most significant impact of these new brands has been the sharp decline in the average price of the top 10 best-selling E4Ws in Indonesia within just one year. In 2023, the average price of the best-selling E4Ws was around IDR 1 billion. By 2024, this figure had been cut in half, dropping to approximately IDR 450 million. While prices vary depending on the model, brand, and features, the overall trend highlights how increased competition, particularly from Chinese manufacturers, has made EVs more affordable for Indonesian consumers. As a result, E4Ws make up around 6.5% of total passenger car sales in 2024.

Comparison of 2023–2024 average prices for top 10 EVs and ICE cars



Source: IESR Analysis, 2025

E4W wholesales based on the country of origin of the automakers

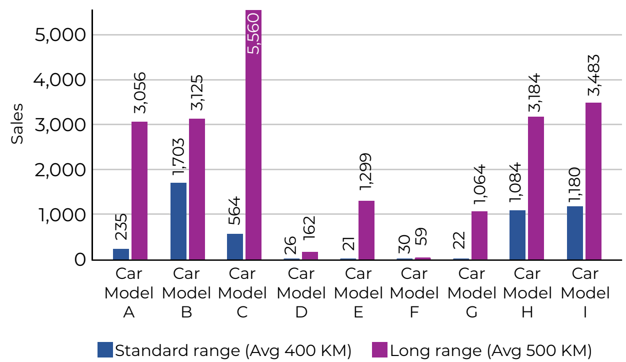


Source: IESR Analysis, 2025

Smaller BEV batteries can ease raw material demand, but Indonesia's strong preference for long-range models underscores persistent range anxiety

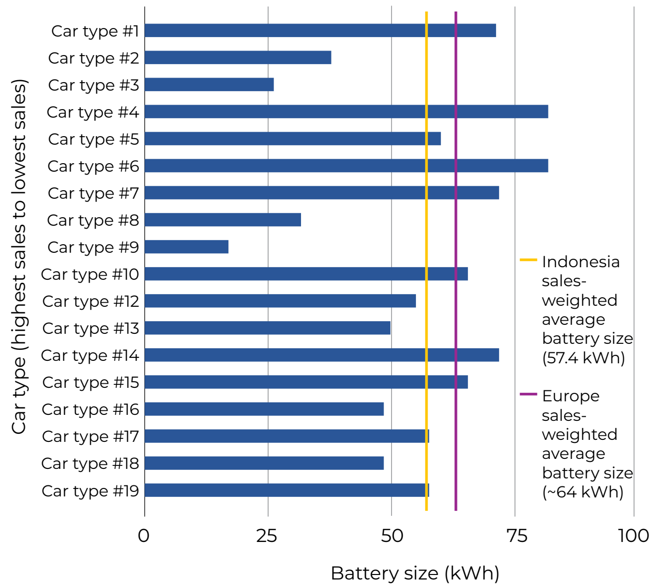
- Recent global trend in EV battery research suggests that adopting more resource-efficient batteries can significantly reduce future battery demand. Promoting smaller, more efficient vehicles could decrease battery demand by 26% by 2035 (WWF, 2023). Similarly, another report suggests that enhancing vehicle energy efficiency to reduce average battery sizes by 20% by 2030 could lead to a 28% reduction in the global battery demand by 2035 (ICCT, 2024a). Smaller batteries reduce reliance on raw materials, thereby improving resource efficiency, mitigating environmental impacts often associated with battery production, and further reducing upfront costs.
- The shift towards smaller EV batteries is particularly feasible in regions like Europe due to its high public charger availability, which reduces range anxiety (ACEA, 2024). The majority of the population also uses multimodal transport. The EU's plan to expand HSR further lessens the need for long-range BEVs for long journeys.
- According to a 2024 IESR survey, Indonesian car users travel an average of 22.5 km per trip in Jabodetabek and 16.8 km outside Jabodetabek. These distances are only a fraction of the typical BEV range, which spans between 200–500 km per charge. However, many urban centers experience significant congestion, which increases travel times and contributes to range anxiety, despite the relatively short distances. This is further exacerbated by a limited public charging network, reinforcing demand for BEVs with larger battery capacities to accommodate prolonged travel times and limited charging access.
- Indonesian consumers show a strong preference for long-range or extended-range E4Ws, which on average offer around 500 km of range—roughly 20% more than their standard-range counterparts. This highlights a strong demand for flexibility and confidence in both daily use and longer trips. Even though Indonesia's sales-weighted average battery size is 57.4 kWh—lower than in Europe (~64 kWh), South Korea (~60 kWh), and the United States (~100 kWh) (IEA, 2025)—it remains relatively large. The relatively large average battery size and strong preference over long-range types indicate the looming range anxiety barriers that Indonesian consumers still face. Without substantial improvements in charging infrastructure, efforts to promote smaller battery EVs may face resistance.

Sales comparison of long-range and standard-range variants of E4W (2024)



Source: IESR Analysis, 2025

Battery size distribution among top-selling E4Ws in Indonesia and Europe (2024)



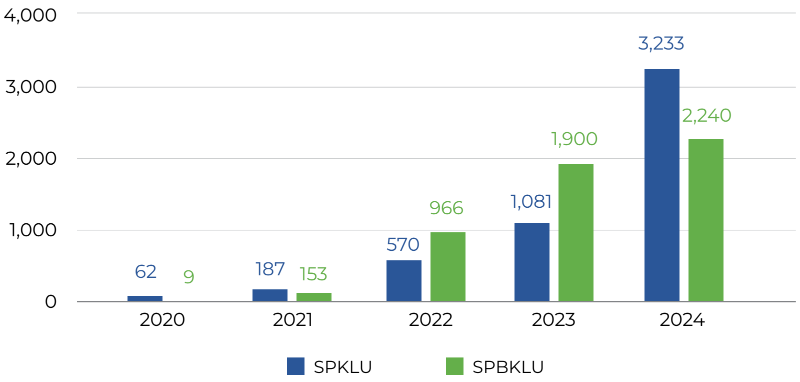
Source: IESR Analysis, 2025; IEA, 2025

Chapter 4.2.

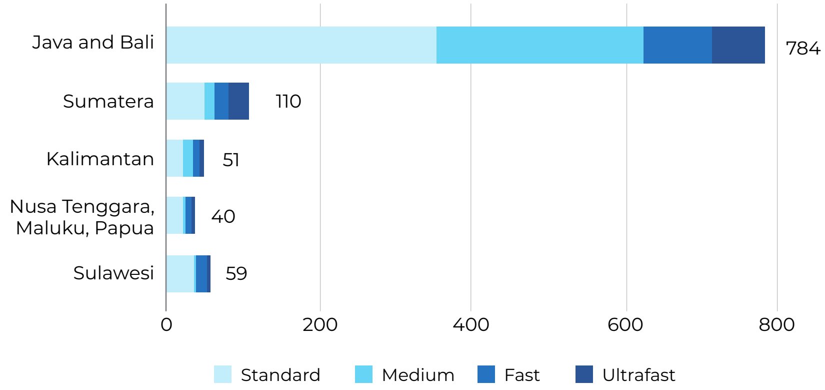
Enabling environment for the BEV acceleration

- Charging infrastructure distribution and utilization
- BEV incentives update

Java and Bali Islands dominate SPKLU distribution, diverging SPKLU installments will captivate more BEV consumers



Source: IESR, 2024a; PLN, 2025



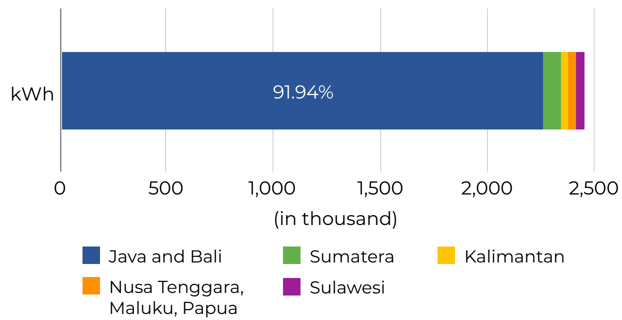
Source: PLN, 2024b

- The government, through PLN, along with its partners, continues to invest in charging infrastructure to support EV ecosystem. Currently, there are 28,536 home chargers and 3,385 unit chargers (SPKLU) throughout 2,412 locations to support electric cars. Meanwhile, for electric motorcycles, 9,956 charging stations and 2,240 battery swapping stations (SPBKLU) are available (PLN, 2025).
- However, PLN data demonstrates that until 2023, 75% of SPKLU is located in Java and Bali Islands, followed by Sumatera and Sulawesi Islands with 11% and 6%, respectively. Standard power charger dominates the SPKLU by 47% of the share, followed by medium charger (29%), fast charger (13%), and ultra-fast charger (11%). The share is also reflected at the province level as most of the chargers in each province are dominated by standard chargers, except West Java and West Nusa Tenggara, which are dominated by medium and fast chargers, respectively. West Java has the highest number of SPKLU with 238 or 23% of total SPKLU, followed by Jakarta with 201 or 19%, and East Java with 111 or 11%. Despite significant growth of SPKLU in recent years, SPBKLU growth has stalled. The growth of SPBKLU is driven by the private sector, which owns the business, depending on the number of electric motorcycle on the road.
- Nurturing the growth of charging infrastructure outside Java and Bali Islands might be another key to boosting BEV sales. Considering the size of the island, some islands like Sumatera and Kalimantan need more SPKLU than Java. However, as the demand is not that much at the moment, the government can start in more densely populated cities and also giving fiscal incentives to extend the SPKLU network on those island. Moreover, the electricity grid also needs to be ensured to support SPKLU in other island.

The use of charging infrastructure experiences remarkable growth, with ultra-fast and fast chargers alluring BEV consumers

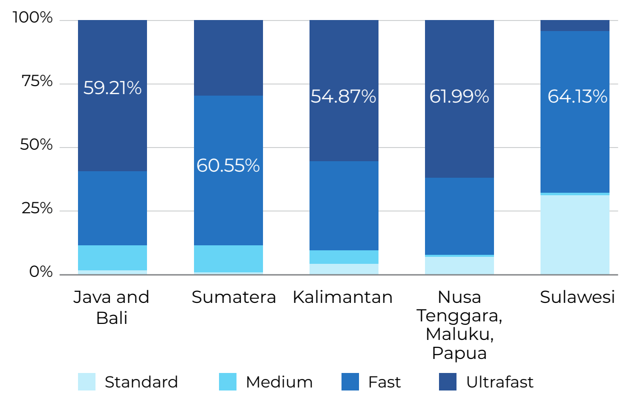
- Charging infrastructure utilization keeps increasing, growing from 0.4 GWh in 2022 to 2.4 GWh in 2023 and 9.1 GWh in 2024 (PLN, 2024a; PLN, 2025). The charging infrastructure transaction data until 2023 (PLN, 2024b) shows that the distribution of EV charging is centralized in Java and Bali regions. The usage of the charging infrastructure in these areas reaches almost 92% of total national charging infrastructure transactions. Jakarta has the biggest number of transactions, with around 56,000 transactions or around 37% of national transactions, followed by West Java with 32,000 transactions or approximately 20%, and Bali with 20,000 transactions or 13% of national transactions. Additionally, the number of charging infrastructure in those regions also comprises 70% of the total charging infrastructure nationally. Ultra-fast charging and fast charging are also favored by EV users in the regions, dominating most of the transactions.
- The growth of SPKLU utilization is not focused only on Java and Bali Islands, several provinces outside those islands also have significant increase in transaction numbers. In East Kalimantan, the number of transactions grew from 450 in 2022 to 1,086 in 2023. This significant jump comes from ultra-fast chargers, from 150 transactions to 505. East Nusa Tenggara also has a big leap in number of transactions, from only 57 in 2022 to 2,429 in 2023. Ultra-fast and standard chargers have a substantial impact, as 2,000 new transactions come from those two charger types in this province. In Sulawesi, especially in South, Southeast, and West Sulawesi areas, fast and standard charger transactions experience remarkable growth, contributing to 1,500 more transactions from the previous 1,904 transactions in 2022.
- Ultra-fast charging will be the fastest charger type to reach the break-even point as their transaction number and energy delivered are on a positive trend. It is estimated that ultra-fast charging has at least 50% shares of total transactions and 60% shares of energy delivered in charging infrastructure in 2024 (PLN, 2024b). In addition, the payback period of ultra-fast charging infrastructure is less than 10 years, assuming the cost of building ultra-fast charging infrastructure reaches 1 billion IDR, and a margin of 1,000 IDR/kWh.

Energy transferred by plug-in charger per island in 2023



Source: PLN, 2024b

Energy transferred by charging type per island in 2023



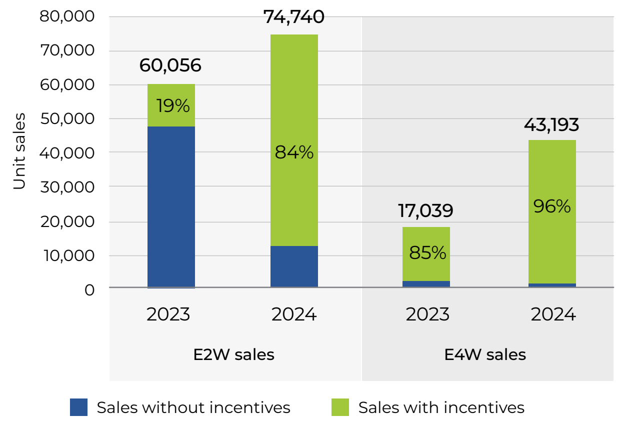
Source: PLN, 2024b

Incentives plays an important role in BEV sales growth, yet E2W and E4W incentives needs to be readjusted carefully

List of policies that affect BEV price

Incentive type	Vehicle type	Reduction	Status	Regulatory framework
Vehicle ownership tax reduction	All BEV	90% discount	Ongoing	Ministry of Home Affairs (MoHA) No.8/2024
Title transfer fee exemption	All BEV	Exemption	Ongoing	MoHA No. 8/2024
Value added tax reduction	E4W and e-bus with at least 40% LCR	10% reduction	Ongoing, updated from MoF No. 38/2023	Ministry of Finance (MoF) No. 12/2025 (expired at the end of 2025)
Value added tax reduction	E-bus that has 20% to 40% LCR	6% reduction	Ongoing, updated from MoF No. 38/2023	Ministry of Finance (MoF) No. 12/2025 (expired at the end of 2025)
Luxury tax reduction	E4W and e-bus	Exemption	Ongoing	MoF No. 12/2025 (expired at the end of 2025)
Government assistant scheme for E2W	E2W with at least 40% LCR	7 million IDR	Expired	Ministry of Industry (MoI) No. 6/2023
Incentives to import CBU E4W	E4W	Import and luxury tax waiver	Ongoing	Ministry of Investment (MoInv) No. 6/2023 (expired at the end of 2025)

Incentive effect on BEV sales in 2023-2024



Source: IESR Analysis, 2025

- Indonesia has implemented various BEV incentives, including exemptions or reductions in luxury tax, vehicle tax, title transfer fees, value-added tax (VAT) discounts for E4Ws, and an IDR 7 million incentive for E2Ws. Zero import duties for completely knocked-down (CKD) and now CBU E4Ws have further expanded market options, contributing to lower EV prices. Model availability has also driven sales. As an example, E2W models eligible for incentives increased from 14 to 53 models by the end of 2023, showing a similar trend in E4Ws.
- Except for E2W sales in 2023, over 80% of E2Ws and E4Ws sold in Indonesia were purchased with incentives, highlighting their importance. The government should continue E2W incentives, potentially by linking subsidies E2W and battery performance, such as battery capacity (Economic times, 2024), longer travel ranges, and life cycle to promote better E2W quality. Furthermore, these incentives should promote higher battery chemistry performance in domestically produced batteries, moving beyond reliance solely on local content requirements (LCR). Access to enhanced support would require manufacturers to meet defined performance thresholds (e.g., minimum energy density, cycle life), ensuring funds target qualified players advancing E2W battery technology. This approach pushes Indonesia's E2W industry to master better battery technology, building export-ready capabilities.
- Several manufacturers that apply to be eligible for incentives on import CBU E4W will finish their 2-year free import duty at the end of this year, and therefore must begin local production next year. The government should enforce compliance with production commitments and monitor imports. With strong E4W sales growth, incentives should gradually shift toward supporting local E4W industry development and strengthen Indonesia's ambition to become a global BEV hub.

Chapter 4.3.

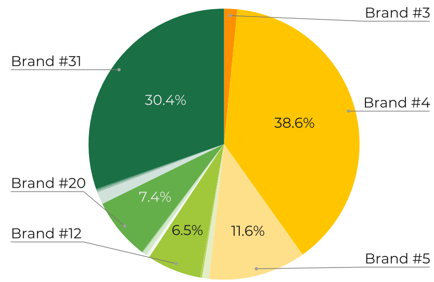
Supply-side regulations and battery sustainability in BEV transition

- BEV sales mandate
- BEV battery supply chain
- BEV battery sustainability

A sales mandate can drive supply and adoption, but must accommodate market diversity and local readiness

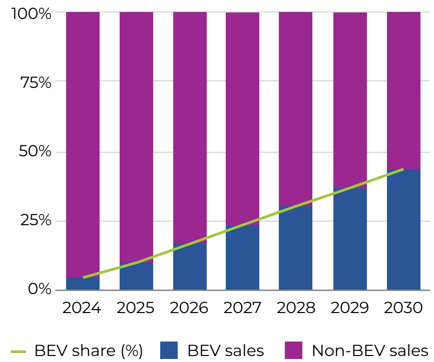
- Supply-side regulations (SSRs) are critical to strengthen domestic E4W industry development and support Indonesia's ambition to become a global BEV hub. Globally, countries have implemented various SSRs to drive the BEV transition and strengthen domestic industries. China combined sales mandate with fuel economy standards; the EU enforced stricter CO_2 emission limits; and the US introduced both sales requirements through the Advanced Clean Cars II and production incentives via the Inflation Reduction Act's (IRA) credits to boost local manufacturing (RMI, 2024; ICCT, 2024b).
- SSRs essentially aim to encourage vehicle manufacturers to sell increasingly more clean vehicles such as BEV, PHEV and HEV over time. One of the primary channels is through sales mandate. Sales mandate requires manufacturers to ensure that a growing percentage of their annual vehicle sales are electric, often enforced alongside credit trading schemes and fuel economy standards. The sales mandate counts BEV, HEV, and PHEV sales toward compliance, with credit points awarded for each unit sold. To achieve full electrification, the mandate gradually increases the points allocated to BEVs while reducing those for HEVs and PHEVs each year. The mandate has spurred innovation within the industry, with manufacturers increasing R&D, forming partnerships, and filing EV-related patents (Hardman et al., 2018).
- In 2024, BEVs accounted for an average of 22.6% of sales among the 31 registered manufacturers, though this figure is skewed by a small number of BEV-only brands, while the other brands are not selling BEVs at all. As a result, E4W penetration in the car market stayed low: from 1% in 2022 to 1.7% in 2023, before jumping to 4.9% in 2024 (Gaikindo, 2023; Gaikindo, 2024).
- The Indonesian government, via ENDC, targets 2 million E4Ws on the road by 2030, while a previous 10% sales share target was set by the former Coordinating Ministry of Maritime and Investment. Achieving the ENDC target would require a more ambitious growth; E4W sales must reach 10% of annual car sales by 2025 and continue increasing by approximately 7% each year to reach 44% of total car sales by 2030, assuming a linear 6.4% annual growth in overall car sales. A BEV sales mandate could follow this growth path, gradually raising the required share each year to keep the adoption numbers on track.
- Given the Indonesian BEV market that is highly concentrated and manufacturers are not yet diversifying their offerings, a BEV-only sales mandate would likely benefit a few dominant players. In the early years, the mandate should continue to integrate PHEVs and HEVs to give space for broader participation. It must also be paired with measures that promote domestic industry development, such as easier access to local battery supply chains and support for domestic vehicle assembly. In parallel, Presidential Instruction 7/2022 signals the government's intent to lead BEV adoption through public procurement to build early demand, support ecosystem development, and provide market confidence for manufacturers.

E4W market share from all manufacturers



Source: IESR Analysis, 2025

Projected E4W sales growth under the BEV sales mandate to meet 2030 ENDC adoption target

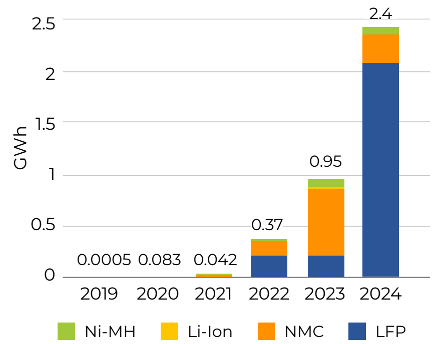


Source: IESR Analysis, 2025

Diversify battery technology, build and integrate Indonesia's battery supply chain through incentives

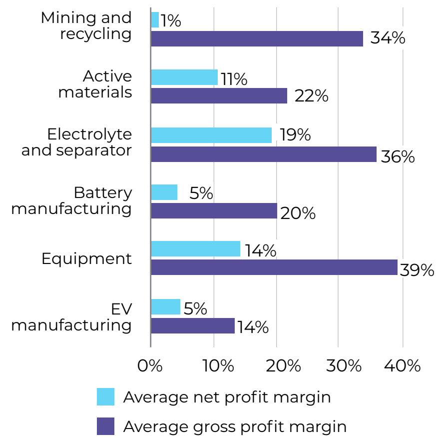
- Recent BEV growth demonstrates a significant increase in battery demand, with Indonesia's E4W battery demand growing from 0.95 GWh in 2023 to 2.4 GWh in 2024, as BEV sales increased by 26,000 units during that period. In terms of battery demand distribution, while HEV vehicles utilize lower battery capacity and predominantly employ Li-ion and Ni-MH batteries, lithium ferro phosphate (LFP) and nickel-mangan-cobalt (NMC) technologies dominate the market share with 86% and 11%, respectively. The dominance of LFP technology aligns with global trends, as 59% of battery production in 2024 consisted of LFP batteries, reflecting the industry's shift toward cost-effective. The LFP is also less likely to experience thermal runaway battery chemistries. (Volta Foundation, 2024). Based on these market trends, Indonesia must strategically pivot its battery development plan, not only focusing on nickel-based batteries, but also iron-based batteries and other promising battery chemistries to capture greater value in the evolving market.
- Despite possessing the world's largest nickel reserves and producing approximately half of global nickel mine production, Indonesia currently achieves only 2-11 times added value from nickel smelting and nickel sulfate production from existing plants, far below the potential 60-fold value addition achievable through integration into the BEV industry (Energy Shift Institute, 2024). The economic reality reveals that mining and recycling operations, which represent the most dominant segment in Indonesia's nickel downstream industry, generate the lowest average net profit margins compared to other segments of the value chain, such as cathode production, battery cell manufacturing, BEV manufacturing, etc (Volta Foundation, 2023). Furthermore, the lack of industrial connectivity within Indonesia's battery value chain presents a significant challenge since numerous companies prefer to directly export their output or import raw materials rather than develop integrated domestic supply chains, thereby hindering Indonesia's ability to establish a comprehensive end-to-end battery manufacturing ecosystem. This fragmented approach necessitates immediate government intervention through comprehensive policy reforms to optimize value addition in the battery and BEV industries.
- The government needs to implement a comprehensive, technology-agnostic incentives program that prioritizes output-based production incentives that reward actual manufacturing volumes across diverse battery chemistries, including LFP, NMC, and next-generation technologies, to accelerate the diversification of Indonesia's battery portfolio beyond nickel-dependent technologies. Production-linked incentives (PLI) can be one of the solutions as it directly links the incentives to value addition under a certain period (Law Asia, 2020). Concurrently, incentives should target BEV and battery manufacturers with fully integrated domestic value chains to resolve industry fragmentation, alongside dedicated R&D funding for Indonesia-specific battery solutions that enhance global competitiveness. Critically, these measures must be underpinned by a stable political environment, predictable regulations, and a pro-investment business climate to ensure long-term industry confidence and sustainable growth.

Battery capacity growth trend based on EV sales



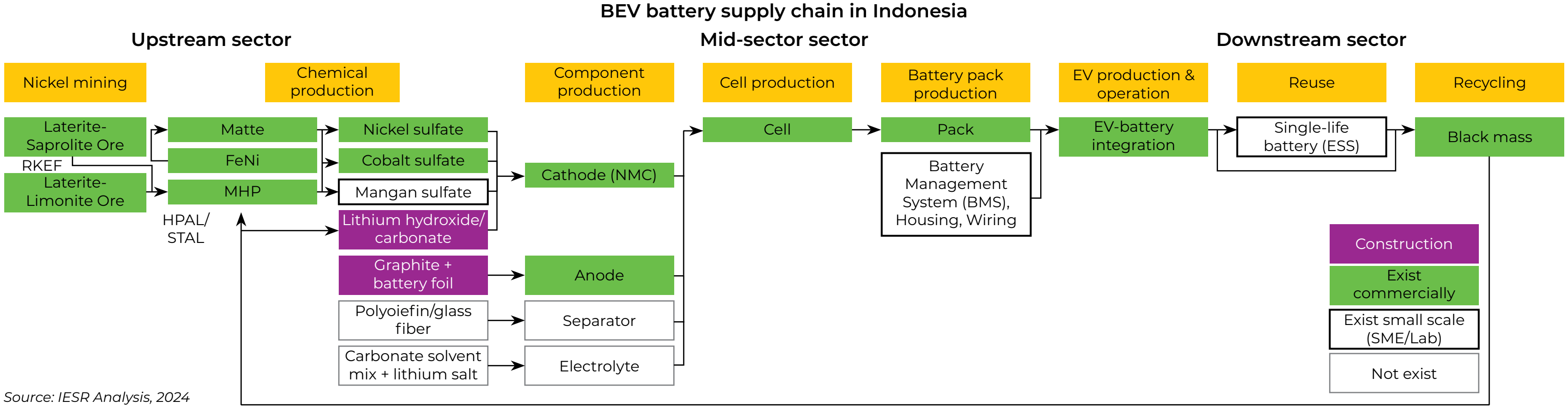
Source: IESR Analysis, 2025

Profit margin across the battery industry value chain



Source: Volta Foundation, 2023

ESG still becomes an issue, ensuring global sustainable compliance is vital to increase Indonesia's BEV competitiveness in the international market



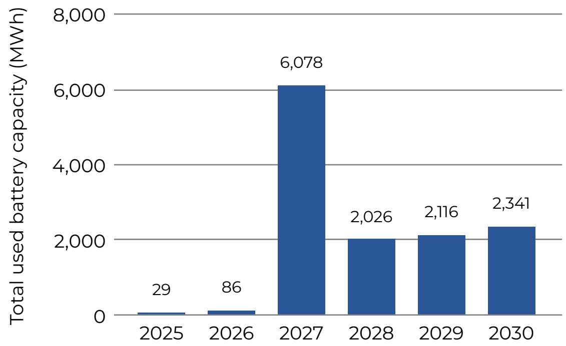
Source: IESR Analysis, 2024

- Indonesia has launched a groundbreaking USD 5.9 billion integrated battery project through a joint venture between state-owned PT Antam, the national consortium Indonesia Battery Corporation (IBC), and CBL (a CATL subsidiary) in East Halmahera (North Maluku) and Karawang (West Java). The project targets 15 GWh annually for BEVs, structured across 6 phases, which includes battery-grade nickel smelting, cobalt sulfate, precursor production with lithium hydroxide (LiOH), battery cell manufacturing (6.9 GWh/year by 2026, with addition of 8.1 GWh/year in 2028) and battery recycling. This vertically integrated ecosystem leverages Indonesia's nickel resources and CATL's technology to position the nation as a global battery hub, with phased commissioning between 2026 and 2031 (CNBC, 2025).
- However, Indonesia's ambition to become a global hub for BEV batteries faces Environmental, Social, and Governance (ESG) challenges. The challenges stem from human rights violations, deforestation, inadequate waste management practices, also water and air pollution (IESR, 2024b). Additionally, the coal-fired power plants, with a combined capacity of 3.78 GW, used to support the nickel industry, exacerbate air pollution. To overcome these challenges and fully leverage its mining potential, Indonesia must invest in cleaner mining technologies and enforce stricter environmental regulations. One approach is to adopt responsible mining practices, which include respecting human rights and the aspirations of affected communities, providing a safe, healthy, and supportive work environment, minimizing environmental harm, and leaving positive legacies (IRMA, n.d.).
- If Indonesia does not intervene with ESG issues in BEV battery supply chain, Indonesia may be unable to export its locally produced BEV to several foreign markets. To capture the full value and access key markets, such as the EU, mandatory compliance with international standards, including the EU Battery Passport, is critical for Indonesia's battery industry Transitioning to lower-carbon extraction methods and improving tailings management, as well as preparing for urban mining (recycling from used batteries), will be essential to ensure the longevity and sustainability of Indonesia's BEV battery industry. Concurrently, the Indonesian government should redesign incentives to accelerate renewable energy adoption in industrial production, scale midstream manufacturing industries (e.g., cathode/cell production), and continuously drive industries to integrate cleaner technologies. Systemic recalibration of these policies will ensure alignment with global sustainability benchmarks and maximize export competitiveness.

Huge potential within used BEV batteries in near term, but battery waste collection, transport, and pricing issues remain challenging to achieve full BEV circularity

- Indonesia needs to develop schemes and business models for managing spent BEV batteries. Effective management of these batteries through reuse and recycling can optimize their remaining value while minimizing environmental impacts and the costs associated with hazardous waste. From private BEV adoption alone, an estimated 86 MWh of spent battery cells will be available by 2026, and at least 2 GWh of spent batteries will become available annually from 2027 if the ENDC target for BEV adoption is met. However, no companies currently specialize in collecting or recycling these batteries on a large scale due to the limited availability of end-of-life cells, and it is not easy to transport hazardous and toxic waste.
- Repurposing degraded battery cells from BEV fleets could offer a cost-effective solution for developing battery energy storage systems (BESSs). When a BEV battery's capacity degrades to around 80% after multiple charging cycles, it can no longer perform effectively as a battery in BEV and needs replacement. However, these used batteries can still be repurposed for applications like BESS to support variable renewable energy (VRE) or as backup power units. Since battery cells account for about 30% of residential BESS costs and over half of the costs for commercial and grid-scale systems (NREL, 2024), using spent BEV batteries could significantly lower overall expenses.
- After the battery serves for BEV mobility purposes, it still holds potential value through recycling. Metals extracted from recycled battery cells can be sold or reused to produce new cells. Although the profitability of recycling is uncertain, recycling nickel-based BEV batteries with a capacity of 60 kWh is expected to yield a profit of around USD 727. However, the current cost of recycling LFP-type cells is estimated to exceed the value of the recovered materials (Cho, 2022). Ongoing research aims to improve the efficiency and economics of the recycling process, and future breakthroughs could enhance the profitability of battery recycling. Moreover, trials on dismantling, repurposing, and recycling degraded BEV battery cells have only been conducted on a small scale, mostly in research laboratories.
- Investing in the end-of-life battery industry and research will be crucial to enhance Indonesia's position as a regional manufacturing hub and to unlock the full circularity potential of its BEV ecosystem. ASEAN countries, rich in critical minerals needed for battery production, have attracted global interest. By 2030, Indonesia is expected to contribute half of ASEAN's cell production capacity and has already established its first large-scale BEV battery cell plant. However, in the long term, domestic production of critical minerals will be depleted, and fluctuating prices of imported materials like lithium could affect the competitiveness of the domestic industry.

The estimated waste battery potential from BEV per year



Source: IESR Analysis, 2024

Battery cell recycling economic value comparison

	NCM811	LFP	Difference
Gains from recycling (value - cost)	**$727**	**-$410**	**$1,137**
Recycling value	$1,668	$930	
Recycling cost	$942	$1,341	
Battery price (in 2021)	**$8,408**	**$7,942**	**$466**

Source: Cho, 2022

Chapter 4.4.

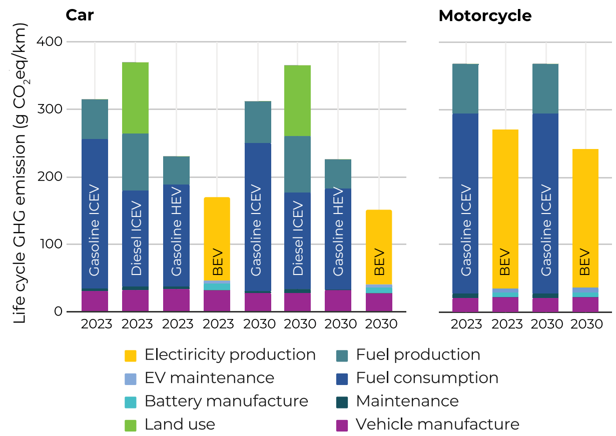
Fuel and ICE transition pathways

- LCA and TCO between different car powertrains
- Progress in EURO standard
- Progress in synthetic fuel

BEVs emit 40–50% less carbon than other vehicles, yet renewable energy adoption and coal phase-out are required to reduce other air pollutants

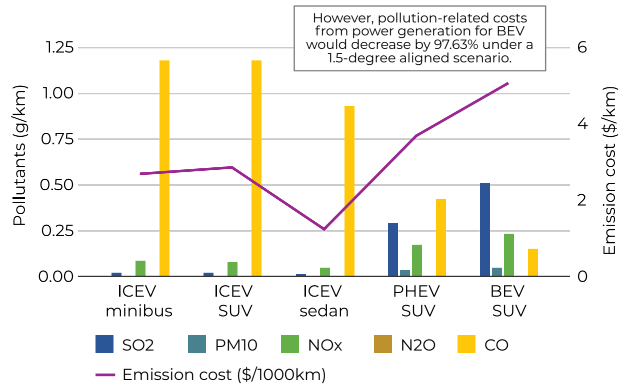
- BEVs outperform other passenger car options in terms of lifecycle CO_2 emissions, with only 169 CO_2e/km driven. This means BEVs emit 46% less than ICEV gasoline, 54% less than ICEV diesel (including land-use emission from biodiesel production), and 41% less than HEV vehicles per vehicle kilometer driven. This is based on a 2023 projection, which reflects the current electricity grid mix (ICCT, 2023). This number is expected to increase further in the 2030 projection when further renewable energy penetration takes places, reaching 161 CO_2e/km driven, which means 51% less than ICEV gasoline, 58% less than ICEV diesel, 32% less than HEV vehicles per vehicle kilometer driven. Meanwhile, for motorcycles, BEVs will produce 26% less CO_2 emissions than its ICEV counterparts using the 2023 projection and 34% less if using the 2030 projection.
- In addition to lower lifecycle CO_2 emissions, BEVs also help reduce local air pollution, as they do not produce tailpipe emissions (EEA, 2018). However, from the perspective of air pollution life cycle analysis, EVs emit higher SO_2, PM_{10}, NO_x, and N_2O per kilometer driven from the upstream and power plant processes. When these emissions are monetized, the EVs reach USD 5 emission cost per 100 kilometers and are 77% higher than ICEVs and 37% higher than PHEVs (IESR Analysis, 2025; Veza et al., 2023) within the same SUV class.
- However, stationary sources, such as power plants, are generally easier to regulate and less harmful compared with tailpipe emissions that are directly exposed to high-density urban areas. Moreover, this upstream pollution will be significantly reduced as renewable energy adoption increases over time and coal is phased out of the grid. For example, within the 1.5°C aligned scenario, which includes a coal phase-out (including captive) scenario, it is estimated that air pollution-related costs will be reduced by 97.63% compared with the current renewable energy plan in Presidential Regulation 112/2022 (Myllyvirta, 2023). In the short term mitigation, air quality improvements can also be achieved through mandatory air pollution controls (APCs) on coal plants, which are projected to reduce SO_x by 73%, NO_x by 64%, dust by 86%, and mercury by 71% by 2035 (Myllyvirta, 2023).

CO_2 emission throughout lifecycle for various types of cars (left) and motorcycles (right) in Indonesia



Source: ICCT, 2023

Lifecycle air pollution emissions and emission costs of various types of cars in Indonesia

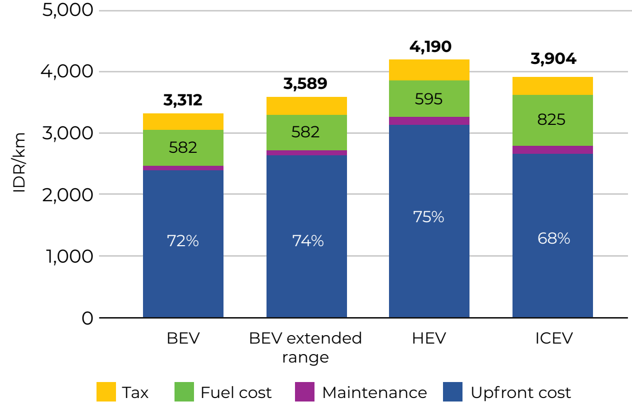


Source: Veza et al., 2023

BEV is the most economical vehicle option, yet establishing second-hand market and innovative financing remain critical

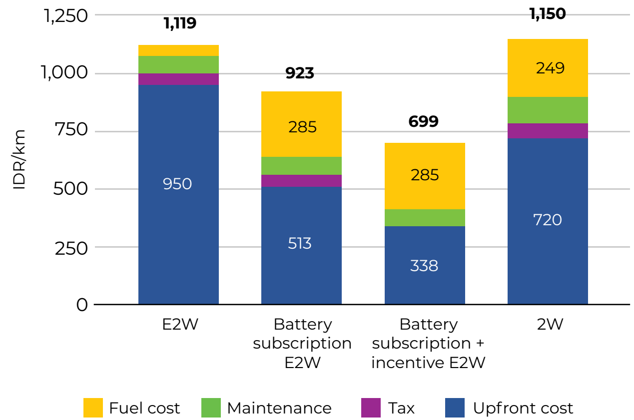
- Driven by affordable new models, the total cost of ownership (TCO) for E4Ws has decreased significantly from 4,348 IDR/km (IESR, 2023) to a maximum of 3,589 IDR/km, solidifying their position as the most economical choice with lower TCO than petrol cars in all scenarios. Across vehicle types, the upfront purchase cost dominates TCO at approximately 70%, followed by fuel costs at around 20%. In fuel cost comparisons, HEVs are marginally more expensive than E4Ws at just 13 IDR/km extra, while ICEVs cost approximately 243 IDR/km more than E4Ws. Overall, E4Ws offer substantial savings of IDR 120-170 million in 8-10 year life cycle over HEVs, which have the highest TCO.
- However, E4W's long-term TCO competitiveness faces uncertainty due to Indonesia's nascent second-hand EV market. ICEVs and HEVs could achieve the lower TCO compared to E4Ws if they have at least 30% of their upfront cost as their resale value after 8-10 years, and E4Ws do not have resale value. With that in mind, establishing a robust second-hand market with clear valuation standards is essential to secure long-term TCO competitiveness against ICEVs and HEVs.
- A similar economic advantage exists for two-wheelers: E2Ws already achieve lower TCO than ICE motorcycles (2Ws) within a 4-year lifecycle. 2W is the most expensive option at 1,149.5 IDR/km, followed by standard E2W (1,119 IDR/km), battery subscription E2W (922.5 IDR/km), and battery subscription with incentives (698.75 IDR/km), as the most economical option. Upfront cost remains the dominant TCO component across schemes, constituting 85% for standard E2W, 57% for battery subscription E2W, 49% for incentivized subscription E2W, and 64% for ICE 2Ws.
- Crucially, E2W ownership models involve significant trade-offs. Battery subscriptions reduce upfront costs but inflate operational expenses, while standard schemes face hidden battery replacement costs after around 4 years of usage. Therefore, accelerating E2W adoption fundamentally depends on supportive policies, including mainstreaming affordable battery subscription models and maintaining purchase incentives to overcome high upfront costs.

TCO comparison of BEV, HEV, and ICEV cars in 8 years lifecycle



Source : IESR Analysis, 2025

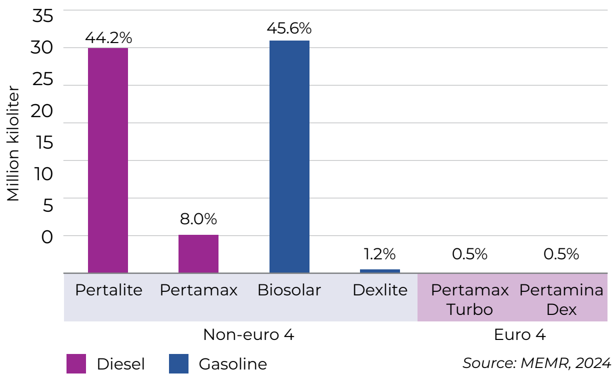
TCO comparison of BEV and ICEV motorcycles in 4 years lifecycle



Source : IESR Analysis, 2025

High-sulfur fuel holds back progress in air pollution mitigation, curtailing benefits from the Euro 4 emission control system and biofuel use

Domestic fuel sales for transportation sector in 2023



Source: MEMR, 2024

Sulfur limits for each fuel category according to existing regulations

<table>
<tr><th></th><th>2023</th><th>2024</th><th>2025</th><th>2026</th><th>2027</th><th>2028</th><th>Regulation</th></tr>
<tr><td colspan="8">Diesel</td></tr>
<tr><td>CN 48 / B40</td><td colspan="4">2000 ppm</td><td colspan="2">50 ppm</td><td>KEP.DJM 384.K/MG.06/DJM/2024</td></tr>
<tr><td>CN 51 / B40</td><td colspan="6">50 ppm</td><td>KEP.DJM 384.K/MG.06/DJM/2024</td></tr>
<tr><td>CN 51 / B0</td><td colspan="6">50 ppm</td><td>KEP.DJM 447.K/MG.06/DJM/2023</td></tr>
<tr><td colspan="8">Gasoline</td></tr>
<tr><td>RON 90</td><td colspan="6">500 ppm</td><td>KEP.DJM 0486.K/10/DJM.S/2024</td></tr>
<tr><td>RON 91</td><td colspan="2">400 ppm</td><td colspan="2">350 ppm</td><td>300 ppm</td><td>50 ppm</td><td>KEP.DJM 110.K/MG.01/DJM/2022</td></tr>
<tr><td>RON 95 / E5</td><td>300 ppm</td><td colspan="5">50 ppm</td><td>KEP.DJM 252.K/HK.02/DJM/2023</td></tr>
<tr><td>RON 98</td><td colspan="6">50 ppm</td><td>KEP.DJM 0177.K/10/DJM.T/2018</td></tr>
</table>

Non-Euro 4   Euro 4

Source: Ditjen Migas, 2025

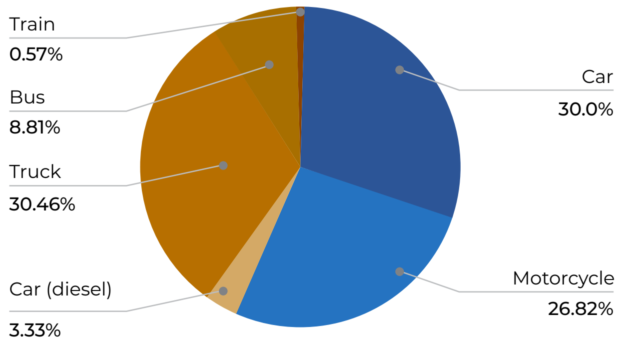
- While not significantly contributing to GHG emission reduction, fuel quality improvement is a necessary short-term fix for air quality deterioration from transportation sector. The Ministry of Environment and Forestry (MoEF) has adopted Euro 4 equivalent exhaust emission standards for 4-wheeled vehicles and Euro 3 equivalent for 2-wheeled vehicles. However, only 1% of fuel available in Indonesian market is compatible with Euro 4 requirements. High sulfur content is particularly highlighted as a crucial parameter due to its interference with the performance of emission control systems such as diesel particulate filters.
- Despite the important role of low sulfur fuel for sustainable mobility, existing regulations only mandate a 50 ppm sulfur limit—aligned with Euro 4 requirement—for the high-performance fuels, such as CN 51 (diesel) and RON 95 and 98 (gasoline). The majority of domestic refineries are currently incapable of producing Euro 4 compliant-fuel, requiring retrofit and installation of hydrotreater units which, could increase the production cost by up to IDR 500 per liter, according to Pertamina's estimation.
- A study by CORE Indonesia et al. (2024) found that improving the fuel quality in Jabodetabek to match the Euro 4 standard could reduce 95% of annual PM emissions. This will avoid 86%, 69%, and 84% of pneumonia, ischemic heart disease, and chronic obstructive pulmonary disease from air pollution*, respectively. The reduction of air pollution-related illnesses is associated with at least IDR 550 billion annual savings from government spending on health treatment costs.
- Biofuels, typically containing low to no sulfur, have the potential to help reduce sulfur-related emissions. The presence of oxygen molecules in biodiesel and bioethanol also improves combustion, reducing pollutants from incomplete combustion, such as CO, HC, and PM, while increasing NO_x emissions due to higher combustion temperature. Implementation of post-combustion emission control system, such as SCR, could minimize the increased NO_x emissions. However, the current practice of biofuel blending with high sulfur petroleum fuel limits its potential benefit in emission reduction. For example, B30 Dexlite still contains 1,200 ppm of sulfur, well exceeding the Euro 4 requirement. Furthermore, increasing biofuel utilization, particularly in passenger transport, still faces challenges, as further elaborated in the next slide.

These are the top three (in terms of BPJS claims) out of 12 diseases associated with air pollution exposure

Slow progress in bioethanol and biogasoline adoption limits biofuel potential in decarbonizing passenger transport

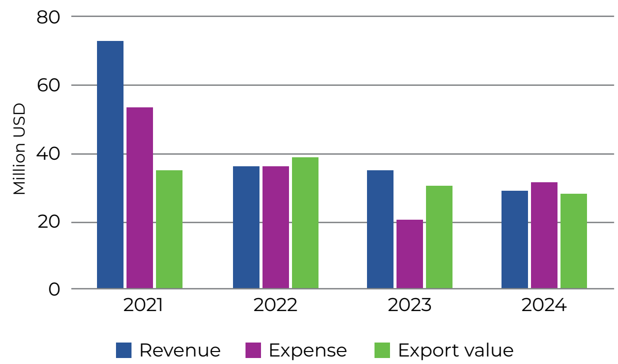
- Biofuel utilization is often proposed as one of climate mitigation measures in the transport sector. ENDC projected biofuel, FAME biodiesel specifically, to contribute 47 $MtCO_2$ emission reductions or 26% of the total emission reduction target from the energy sector in 2030. Indonesia has implemented 40% FAME blending since 2025, and the blending rate is expected to increase further as trials for B50 are already underway. However, FAME biodiesel's potential to decarbonize passenger transport is limited, as it only works with diesel engines, primarily used for freight transport (trucks)—estimated to contribute around 70-75% of diesel consumption (IESR, 2020).
- The majority of passenger cars and motorcycles use gasoline engines. The government started a limited deployment of 5% ethanol blend gasoline (E5) in 2023. By the end of 2024, only 7,500 kiloliters of E5 gasoline was sold. The lack of demand, high production cost, alcohol levy, and lack of incentive/subsidy mechanism remain the major hindrance to its adoption. The alcohol levy alone costs IDR 1,000 per liter of E5 gasoline, which currently is borne by Pertamina and not reflected in the retail price. To accelerate demand creation, the government intends to expand the E5 blending mandate to cover other cities and other fuel retailers.
- In addition to bioethanol, the development of biogasoline production using industrial vegetable oil (IVO)* has started since 2017 and was included in the 2020-2024 National Strategic Project. A pilot plant for IVO production (6 tonnes per hour) has been built in South Sumatera and for biogasoline production (1,000 liters per day) in Central Java. As the technology is still in a development phase, the government has not yet established any target for biogasoline utilization.
- Cost competitiveness against the existing petroleum fuel has been a lingering concern around the utilization of biofuel. Formulating a sustainable financing scheme is, therefore, crucial to drive market adoption. The existing financing source from the palm oil export levy, which the biodiesel program has relied on, has proven to be unsustainable. Since 2025, the biodiesel subsidy from Indonesian Oil Palm Plantation Fund Management Agency (BPDPKS) has been restricted to the public service obligation (PSO) market, following a declined palm oil export and increased subsidy demand in 2024.

Estimated share of fuel consumption by vehicle type (2020)



Source: IESR, 2020

BPDP revenue and expense and palm oil export value



Source: BPDP, 2024, Listyarini 2025

Chapter 5.

Just and equitable transition to low-carbon transport

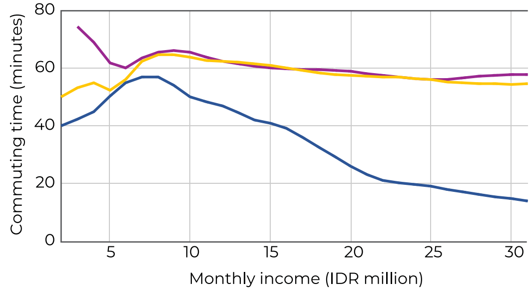
Contents:

- Equity and inclusivity in mobility
- Access to clean vehicle

The current commuting transport system reinforces embedded mobility inequalities

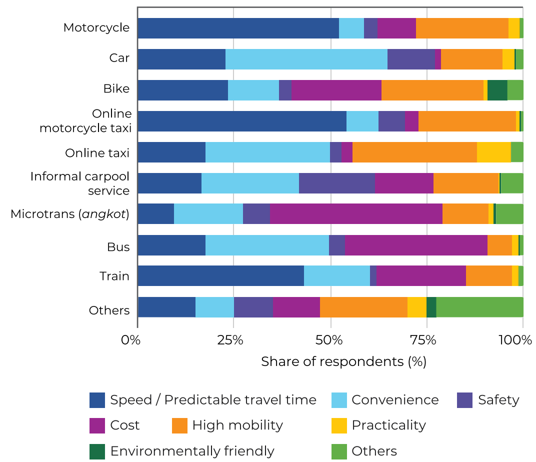
- The current commute mobility patterns are deeply inequitable, particularly in terms of access, affordability, and land use planning. Inequalities often concern an uneven distribution of transport opportunities in different places, of different people's ability to use the existing transport system, or often as both combinations (Ternes et al., 2024). In Indonesia, higher-income individuals can afford to live closer to work—reducing travel time— and are able to use relatively safer and more reliable private vehicles like cars. On the contrary, lower-income individuals, often live on the urban periphery, have to rely on longer and less reliable public transport or riskier and more polluted motorcycles.
- Higher-income motorcycle users commute about 64% faster than their lower-income counterparts (BPS DKI Jakarta, 2015). For car users, while travel time does not vary significantly across different income levels, cars provide safer travel and better protection from pollution (Patel et al., 2016). On the other hand, public transport users experience very small time savings even if they have higher than average incomes, highlighting inefficiencies in public transport. These commuting disparities, generally driven by income differences, could further increase economic inequalities, as higher-income individuals with access to private vehicles and better-located housing are able to use more productive hours, while lower-income workers spend more time commuting at the expense of work, rest, and personal growth.
- Due to various trade-offs, Indonesian commuters have no ideal commuting option, especially those from lower-income groups. However, a clear trend emerges: as incomes rise, commuters increasingly prefer the comfort and reliability of cars. At a monthly income level of around IDR 4 million and above, the share of motorbike and public transport users declines, while car utilization increases (Janssen et al., 2022). This suggests that as income improves, commuters tend to substitute motorbikes and public transport for cars. For car/taxi users, comfort and practicality are the most important factors (BPS, 2023).
- The concept of a just transition in Indonesia's net-zero transport sector ensures that the shift toward low-carbon mobility is equitable, accessible, and inclusive. It seeks to provide accessibility to basic transport (needs), ensure equal access to transport services (justice), and ensure that the impacts of transport activities do not threaten environmental sustainability (limits) (Holden et al., 2013). Therefore, in essence, sustainable mobility in itself already incorporates just aspects. Key measures include increasing affordable access for clean vehicles, improving accessibility and inclusiveness of transit systems, and improving road transport safety. This is particularly crucial in Indonesia, where both public transport accessibility and private EV ownership remain significant challenges for many.

Relationship between commuting time and monthly income



Source: BPS DKI Jakarta, 2014

Factors influencing transport mode choice



Source: BPS, 2023

Inclusive mobility starts by reaching both more places and more people through better integrated and accessible end-to-end services

- Mobility access is shaped by factors like income, gender, disability, age, and education. Transport systems in Indonesia have historically favored private vehicle users, leaving low-income individuals, children, women, the elderly, and people with disabilities underserved and barely have access to mobility. These groups either lack the resources to own private vehicles or face physical, social, or financial barriers to driving. Achieving equity in mobility is going beyond the usual metrics of travel time savings to focus on whether people can reach essential services like jobs, education, and healthcare.
- Women in Indonesia are significantly more dependent on public transport or ride-hailing (e.g., ojek); for instance in Jabodetabek nearly 20% of women using these services compared to only 8% of men (BPS, 2023). Similarly, in Mebidrango area in Medan, more women (16.7%) are using more public transport than men (8.8%) (Egis, 2022). Many women also travel as passengers in private vehicles rather than driving, reflecting unequal access. Yet, public transport is not always safe. Surveys show that 23-25% of women have experienced sexual harassment while using public transit, and many do not feel comfortable reporting it (Antara, 2023). Although public transport operators have begun providing women-only spaces (e.g., pink buses, dedicated cars), real safety improvements require more systemic change and cultural accountability.
- While some progress has been made, many public transport facilities remain inaccessible for people with disabilities. Issues ranging from poorly connected ramps and elevators to inconsistent implementation of universal design. In Jakarta, initiatives like braille signage, audio-visual aids, and SOP regulations (DKI Jakarta Regional Regulation 2/2024) are promising steps. Unfortunately, the connectivity and provision between each facility are still questionable, creating public doubt whether public transport in Jakarta has been entirely inclusive. A more inclusive system must guarantee consistent accessibility—not only at main stations but across the entire mobility chain—and replicate good practices in other regions.
- For underserved groups, fulfilling essential travel needs (e.g., to workplace, school, grocery shopping) is often made possible through the TransJakarta network in Jakarta or using angkot in other cities. However, these underserved groups struggle when they have to make incidental trips (e.g., visit relatives or deal with urgent matters). For these trips, there are often no affordable or reliable options.
- Ensuring a public transport that covers high connectivity is essential. Improving better integration of paratransit services and universal design in first- and last-mile infrastructure help to support the full range of trips people need to make. The government can divide roles with the private sector, each taking on different routes which maximizes connectivity. Seamless, reliable connections between routes, stations, and surrounding areas allow people to complete full journeys—not just trips.

Percentage of mode share by gender in Mebidangro (Greater Medan Metropolitan Area)

PRIVATE VEHICLE 87.0%

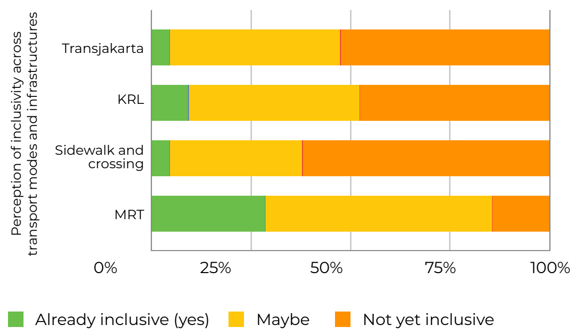
	Walking	Bicycle	Motorcycle	Car (driving)	Car (not- driving)	Truck/van	
	11.8%	1%	60.4%	11.8%	5.8%	0.4%	**91.2%**
	17.2%	1%	50.1%	4.4%	10.5%	0.1%	**83.3%**

PUBLIC TRANSPORTATION 13.0%

	Motorbike taxi (conventional)	Motorbike taxi (online)	Bentor	Taxi (online)	Angkot (Microbus)	Bus	Train	
	0.1%	2.5	2%	0.5%	3.4%	0.3%	0.02%	**8.8%**
	0.2%	4.5%	3.7%	0.8%	7.3%	0.3%	0.02%	**16.7%**

Source: Egis, 2022

Public perspective of inclusivity in public transport in Jakarta

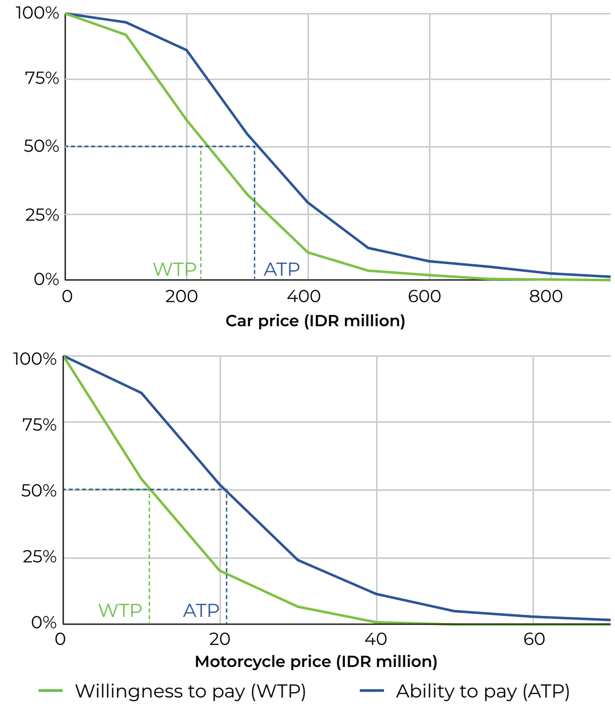


Source: ITDP & GAUN, 2021

Second-hand market is the only access to clean vehicles for some but the ecosystem is still underdeveloped

- Access to clean vehicles is a core element of a just transition in Indonesia's transport sector. That means affordability is the key. While EV prices are gradually declining, they remain out of reach for most Indonesians. A 2024 IESR survey found that the ability to pay (ATP) for an electric car is around IDR 325 million, but the willingness to pay (WTP) is only IDR 225 million—below the price of most electric car models available today. For electric motorcycles, the gap is even bigger; ATP is about IDR 22 million, while WTP is just IDR 10 million. This large difference between ability and willingness to pay reflects a low perceived value of EVs. Many potential consumers still question EV performance, reliability, and long-term support, which undermines confidence in the technology.
- Even with more affordable models entering the market, EVs are still too expensive for many people—especially when compared to what they are actually willing to pay. An entry-level electric motorcycle with a 1.5 kWh battery costs around IDR 27 million, while similar ICE motorcycles are closer to IDR 18 million. The recent pause in government price incentives makes this price gap harder to close. For electric cars, even the cheapest models are still aimed at middle-class buyers in big cities.
- One of the options to expand access to clean vehicles—particularly for low- and middle-income households—is through the secondhand market, where Indonesia already has a strong foundation. In 2019, over 2.5 million used cars were sold, compared to just 1.03 million new car sales in the same year (Makreo Research, 2024; AAA, 2020). This shows that for many Indonesians, the used vehicle market is the primary gateway to private mobility.

Ability to pay and willingness to pay for electric vehicles for Indonesian consumers



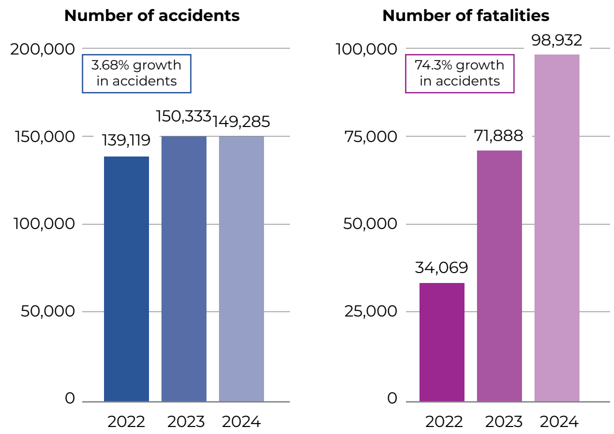
Source: IESR Analysis, 2024

- The healthy demand for used vehicles suggests that a strong second-hand EV market could serve as a critical bridge for expanding clean vehicle access, especially to lower-income groups. A well-functioning second-hand EV market could play a critical role in ensuring that the transition to cleaner transport is not just fast—but fair. For a just transition, access to clean vehicles must extend beyond early adopters in urban centers and become viable for those currently underserved by both credit and new vehicle markets.
- A strong secondhand EV market depends on a strong new EV market. Nevertheless, many Indonesians are still hesitant to buy new EVs because the resale value is uncertain. One reason is that warranties and battery guarantees often do not carry over to second-hand buyers, which makes used EVs less attractive. Without confidence in resale, first-time buyers hold back —and without first-time buyers, there is no supply for a second-hand market. The government can help by making warranties transferable, requiring battery health checks, and offering support for used EV purchases. The used EV market shows signs of progress already by being the fastest-growing segment in Indonesia's used car market, projected to grow at a Compound Annual Growth Rate (CAGR) of approximately 13% between 2024-2029 (Mordor Intelligence, 2024).

Pedestrians are more vulnerable than other road users, safer infrastructure and rules are urgently needed

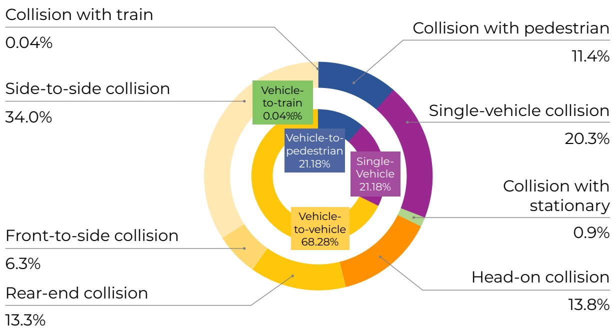
- In the last three years, Indonesia has experienced an upward trend in traffic incidents, increasing from 139,119 cases in 2022 to 150,333 in 2023 and 149,285 in 2024, implying an average annual growth of approximately 3.68 % (POLRI, 2025). Although the rate of increase in traffic incidents has been moderate, the number of fatalities has risen far more dramatically. In 2022, there were 34,069 traffic-related deaths, which more than doubled to 71,888 in 2023, and continued to rise to 98,932 in 2024. This represents an average of 74.3% growth in fatalities over the past three years. The majority of these incidents often involve individuals of productive age (47%). However, these incidents are also alarming since a significant proportion of them involves children under 17 years old (23%) (POLRI, 2025).
- Currently, road traffic accidents are the 8th leading cause of death in Indonesia and are projected to rise to the 5th position by 2030 (KORLANTAS, 2024). The majority of these accidents involve motorcycles (72%), followed by passenger cars (12%) and trucks (10%). Meanwhile, accidents involving buses and special vehicles, such as three-wheelers, account for 5% and 1%, respectively. Although human error remains the predominant cause of traffic accidents (88%) (Santosa et al., 2017), it is evident that the extensive use of motorcycles significantly contributes to the heightened risk and exposure.
- Most accidents involve either single-vehicle incidents (21.18%) or vehicle-to-vehicle collisions (68.28%), indicating that the vast majority of incidents occur among motorized vehicle users themselves (KORLANTAS, 2024). However, collisions involving pedestrians[1] account for 11.4% of all cases, which is a disproportionately high figure considering their national modal share is only 1.5% (See Chapter 1). The high figure emphasizes the magnitude of vulnerability pedestrians face as road users.
- In a just mobility system, all road users—especially pedestrians and cyclists—must have equal rights to safety and fair access to protective infrastructures, which also enhances the appeal of sustainable modes. A higher standard of safety is also needed. While several Indonesian provinces have already introduced regulatory frameworks for bicycle infrastructure (see Chapter 2), many still need to improve them. Additionally, most of the frameworks do not include behavioral rules, such as right-of-way for pedestrians and cyclists in other lanes. Global best practices, such as the UK's updated Highway Code, prioritize vulnerable road users, which grants pedestrians and cyclists greater priority at crossings and mandates safe passing distances when overtaking (ETSC, 2022). This approach helps create a safer environment for pedestrians and cyclists beyond physical infrastructure.

Traffic incident and fatalities trend from 2022 to 2024



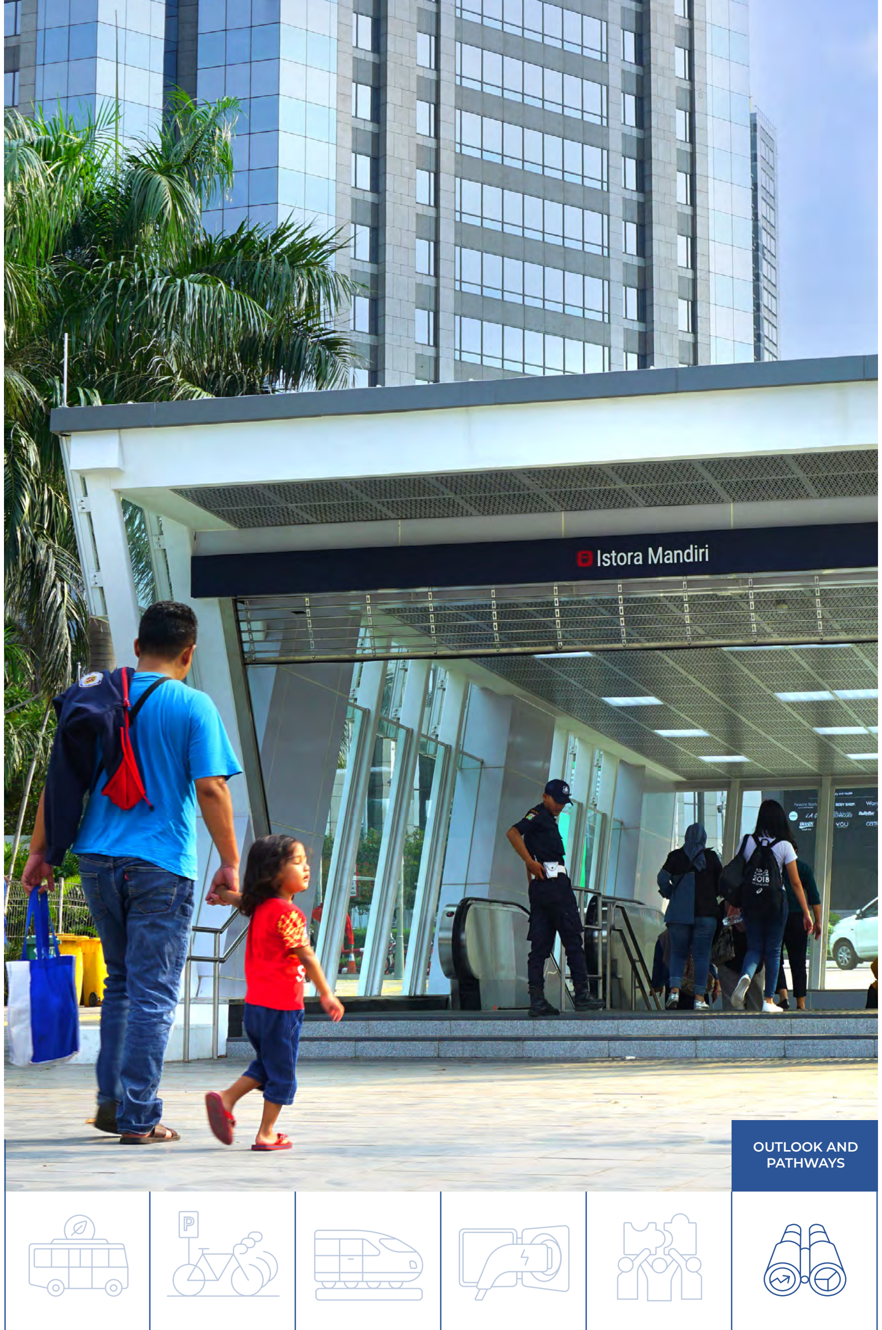
Source: POLRI, 2025

Traffic incident by collision types in 2023



Source: KORLANTAS, 2024

1 *Since "pedestrians" are not specifically defined in the data source, it is very likely that this category also includes users of non-motorized transport, such as cyclists, rickshaw passengers or drivers, and individuals pushing carts (gerobak).*



Chapter 6.

Mobility outlook and decarbonization pathways

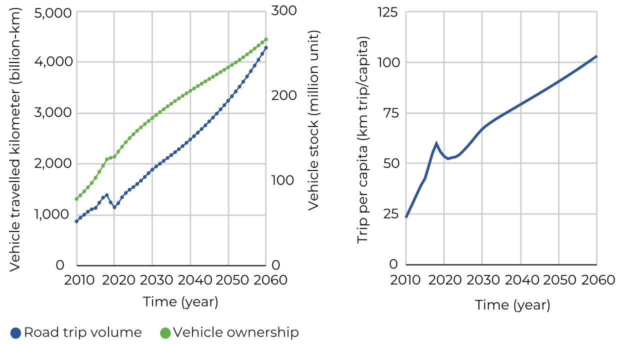
Contents:

- Mobility demand outlook
- BEV adoption outlook
- Transport decarbonization pathways

Rising mobility demand is expected to increase vehicle ownership and fuel consumption, putting pressure on the oil supply

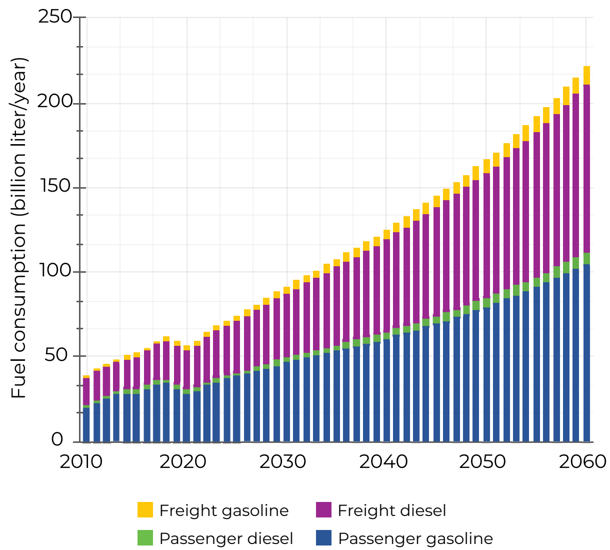
- Indonesia's economy continues to grow, albeit at a slower pace. It will increase access to employment, education, and leisure, which translates into more need to travel (Rezki et al., 2025). As of 2050, road transport volume is projected to increase and reach approximately 3.2 trillion vehicle-kilometers by 2050, with an annual growth rate of 3.27%. This growth is coupled with rising per capita travel demand, which in 2025 is approximately 56 km-trip intercity trips (excluding the intracity) per capita per year and is expected to nearly double to 90 km-trip per capita by 2050, reflecting an average annual increase of 3.12%.
- This growing demand eventually has to be served with a type of supply, either through the owning of private vehicles or through public transport if available to them. From the vehicle ownership perspective, under the Baseline Scenario, vehicle ownership is projected to increase from 155 million units (20 million for cars and 135 million for motorcycles) in 2025 to 234 million units by 2050. This implies Indonesia is going through a rapid motorization rate of approximately 189.5 cars and 525.5 motorcycles per 1,000 population by 2050. While the car ownership rate alone may not seem excessive (e.g., the EU averages around 574 cars per 1,000), the combined figure of 714 vehicles per 1,000 population reflects a significantly high overall motorization level.
- Mobility growth will pressure the national energy systems. Currently, the transport sector is the biggest consumer of oil, accounting for around 72% in 2022 (IEA, 2022). Without necessary intervention, under the Baseline Scenario, fuel consumption from the road transport sector continues to increase and is projected to reach 167 billion liters annually by 2050, or 123% increase from 2025 to 2050.
- However, there is a pressing issue about the domestic supply, with only 66.5% of oil demand being met domestically in 2022 and this trend has decreased by 56% since 2002 (IEA, 2022), which exposes Indonesia to the risk of relying on fuel importation. These findings underline the urgency to address the growing need for mobility through any means, including energy diversification (through electrification or synthetic fuel), investment in public and non-motorized transport infrastructure, or reducing the need for travel altogether.

Indonesia's national intercity trip per capita projection (left) and road trip volume and vehicle ownership projection (right) until 2060



Source: IESR Model, 2024

Indonesia's national fuel consumption by projection until 2060 by fuel type in Baseline Scenario

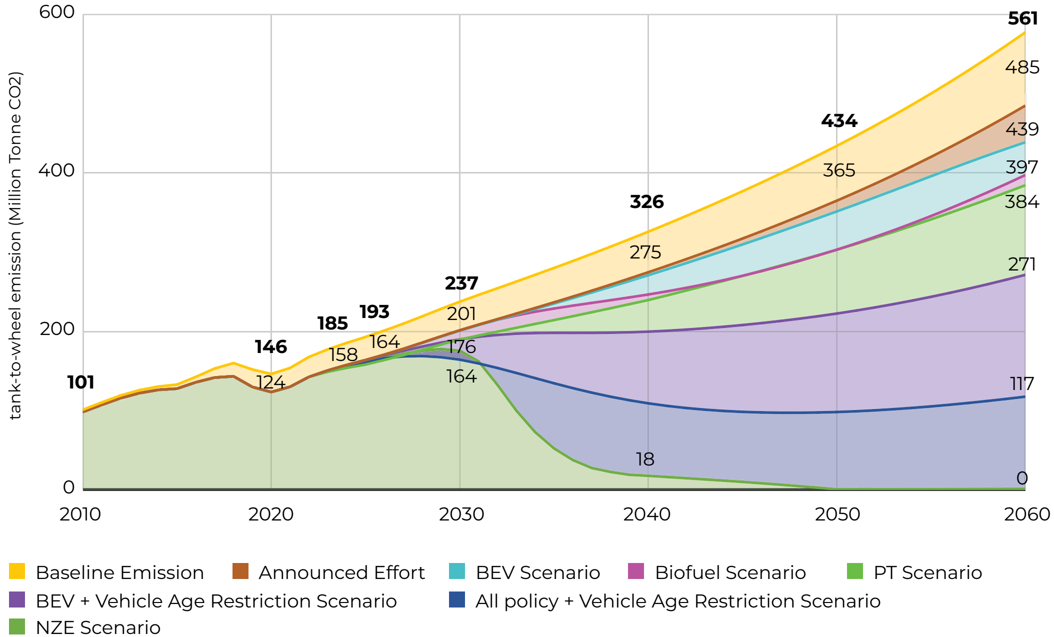


Source: IESR Model, 2024

Road transport emissions drop 76% when all ASI policies are implemented together

- Road transport emissions are projected to reach 561 million tonnes of CO_2 by 2060 without aggressive intervention. Current efforts, such as biofuel usage (B30), public transport utilization, and remote work schemes, only reduce emissions by around 80 million tonnes. This leaves 485 million tonnes of CO_2 emissions in 2060, underscoring the urgent need for more ambitious regulations to close the gap between existing policies and climate targets.
- In our model, the biofuel blending mandate is assumed to be increased to B60 by 2040 and will cut 88 million tonnes from passenger and freight transport by 2060. However, the land-use emissions calculation is excluded from the model and may offset part of these gains. Boosting public transport to 40% modal share (from 16% in current efforts) slashes 101 million tonnes, making it the single most effective lever. While introducing BEV adoption can cut emissions by 46 million tonnes, combining it with vehicle age restrictions propels BEV adoption in 2060 from 15 million E4W and 47 million E2W to 66 million four-wheelers and 143 million two-wheelers, and further reducing emissions by 210 million tonnes. Each strategy delivers substantial standalone benefits.

Projected road transport emissions under several policy scenarios



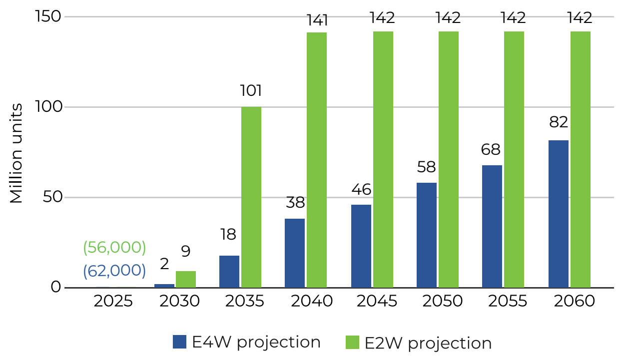
Source: IESR Model, 2024

- When these policies are combined, peak emissions will drop 18% (from 201 to 164 million tonnes) by 2030, while 2060 emissions will plummet 76% (from 485 to 117 million tonnes), as evidenced by the “All Policy + Vehicle Age Restriction” curve. This proves that transport decarbonization is most effective when integrating A-S-I strategies rather than relying on isolated solutions.
- Despite the significant reduction in the "All Policy + Vehicle Age Restriction" scenario, around 117 million tonnes CO_2 becomes residual emissions persist primarily from heavy-duty vehicles (HDVs) and biofuel blending limitations. HDVs remain minimally decarbonized, and biofuels’ dependence on fossil fuels perpetuates emissions. Closing this gap requires urgent HDV-focused solutions like electrification, hydrogen adoption, or other clean technologies. These steps are critical to achieving NZE and maximizing sector-wide reductions beyond current projections.

Push-pull strategy to boost BEV sales, yet infrastructure, supply chain development, and consumer trust become major hurdles in the future

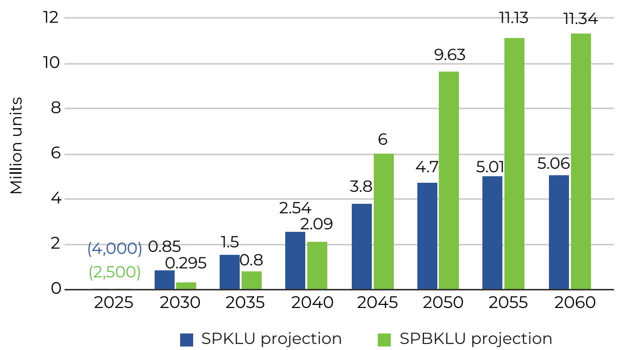
- The IESR NZE scenario extends the "All Policy + Vehicle Age Restriction" framework, implementing stringent policy parameters to achieve deep decarbonization. The biofuel policy shifts to a clean fuels mandate, requiring fuels with near-zero lifecycle GHG emissions, surpassing 100% biofuel blending. Fuel economy standards remain fixed (e.g., 19 km/liter for gasoline/diesel cars, 4.8 km/liter for buses). A ban on new ICE vehicle sales will take effect in 2030 for both cars and motorcycles, combined with a mandatory vehicle scrappage policy retiring passenger vehicles at 15 years and motorcycles at 10 years. EV adoption targets reach 100% market share for both cars and motorcycles by 2040. Moreover, the public transport mode share must reach 40% by 2060, supported by widespread WFH policies to reduce overall transport demand.
- Electrification is pivotal for decarbonizing Indonesia's transport sector. The government targets a cumulative reduction of 7.23 million tonnes of CO_2 by 2030 through BEV adoption under the ENDC (DGE MEMR, 2024). Under the current trajectory, BEV adoption will reach only 15 million E4Ws (16% of 91 million total cars) and 47 million E2Ws (21% of 223 million motorcycles) by 2060, resulting in minimal emission reductions. To accelerate progress, policies like BEV purchase subsidies, fossil fuel price hikes, phase-out mandates for conventional vehicles, and age restrictions could boost adoption to 82 million E4Ws and 142 million E2Ws by 2060.
- This BEV growth must be matched by charging infrastructure expansion. To serve 66 million E4Ws and 142 million E2Ws, SPKLU must scale to 5 million units and SPBKLU to 11.34 million units by 2060, a 1,000-fold increase from current levels. This implies ratios of 1 SPKLU per 16 E4Ws and 1 SPBKLU per 13 E2Ws. Delivering this infrastructure requires an estimated IDR 6,000 trillion in investment by 2060, necessitating innovative business models (e.g., PPPs) to mobilize capital. While home charging remains preferred, E4W charged in home charging consumed almost 28 GWh or around 3 times the consumption in SPKLU in 2024 (PLN, 2025). Strategically located public infrastructure is critical to alleviate range anxiety and spur adoption.
- Despite ambitious targets, BEV adoption faces near-term headwinds. Concerns over vehicle and charger reliability deter potential consumers, and negative incidents gain rapid media attraction. To build confidence, enforceable policies must mandate industry-wide standards for BEV safety, charger uptime, and consumer protections, such as real-time charger monitoring and certified maintenance protocols.

BEV projection under IESR NZE scenario



Source: IESR Model, 2024

Charging infrastructure projection under IESR NZE scenario



Source: IESR Model, 2024

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Appendices

Appendix 1 - Public transport penetration overview in Indonesia

No	Urban Area/ Core City	Agglomeration Area	Covered urban areas	SUMP Year Estab-lished	Metropolitan Transport Agency	Integrated Urban Transport Systems						
						Dedicated Lane Rapid Transit				Road-Based Mass Transit		
						Rail-Based Commuter	MRT	LRT/Tram	BRT (existing and ongoing development)	Metropolitan/ Intercity Commuting Bus	Intra City Commuter Bus	Microbus/ Shuttle
1	**DKI Jakarta**	**Jabodetabek**	Jakarta-Bogor-Depok- Tangerang-Bekasi	2020	**Transport metropolitan authority:** BPTJ **PT Integration and TOD area:** - MITJ (Jabodetabek) - ITJ (Jakarta) - Jaklingko (fare integration)	KRL Commuter Line Jakarta	- MRT N-S Phase 1 *(Operating)* - MRT N-S Phase 2 *(Construction)* - MRT E-W Phase 1 *(PSN / National Strategy Project)*	- LRT Jakarta - LRT Jabodebek	BRT Transjakarta*	- Transjabode-tabek - JR Connexion - Transjakarta Extension	Transjakarta*	- Angkot - Mikrotrans
2	**Bandung**	**Bandung Basin Metropolitan Area (BBMA)**	Bandung-Cimahi- Bandung Regency- Bandung Barat Regency-Sumedang	2021	**Metropolitan area authority:** BP Cekungan Bandung	- KA Kiaracondong Cicalengka - KRD Commuter Line Bandung		LRT Bandung Raya *(FBC stage)*	MASTRAN: BRT Bandung Raya *(expected to fully operate in 2027)*	Metro Jabar Trans* *(previously Trans Metro Pasundan)*	- Trans Metro Bandung - Bus Kota DAMRI	- Angkot - Bandros *(tourism)*
3	**Medan**	**Mebidangro**	Medan-Binjai-Deli Serdang-Karo	2022	**Ongoing process for BRT operator set up*	- KA Layang Medan- Binjai - KA Medan-Belawan			MASTRAN: BRT TransMebidang *(expected to fully operate in 2027)*	TransMebidang	Trans Metro Deli	- Angkot
4	**Denpasar**	**Sarbagita**	Denpasar-Badung- Gianyar-Tabanan	2022	-			LRT Bali *(groundbreak-ing in 2024)*		Trans Sarbagita	Trans Sarbagita *(covers former BTS Trans Metro Dewata)*	- Angkot - Kura-Kura Bus - Komotra *(tourism)*
5	**Makassar**	**Mamminasata**	Makassar-Maros- Sungguminasa-Takalar	2022	**Ongoing study for metropolitan authority set up*	KA Makassar-Parepare				Trans Mamminasata		Angkot/Pete-Pete
6	**Sema-rang**	**Kedungsepur**	Semarang-Kendal- Demak-Ungaran-Salatiga-Purwodadi	2022	**Ongoing study for metropolitan authority set up*	KRL Commuter Line Kedungsepur			BRT Trans Semarang *(ongoing development)*	Trans Jateng*	Trans Semarang*	- Angkot - Trans Semarang Feeder*
7	**Surabaya**	**Gerbangkerto susila**	Surabaya-Gresik- Bangkalan-Mojokerto- Sidoarjo-Lamongan	2024	**Ongoing study for metropolitan authority set up*	KRD Commuter Line Surabaya				Trans Jatim*	- Suroboyo Bus - Trans Semanggi Surabaya*	- Angkot - Wara Wiri Suroboyo*

Source: Various Sources, IESR Analysis, 2025

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Appendix 2 - Intercity rail pipeline across islands for year 2030 based on National Railway Plan (RIPNAS) 2030

Java railway plan for 2030

Appendix 2 - Intercity rail pipeline across islands for year 2030 based on National Railway Plan (RIPNAS) 2030

Sumatera railway plan for 2030

Kalimantan railway plan for 2030

Appendix 2 - Intercity rail pipeline across islands for year 2030 based on National Railway Plan (RIPNAS) 2030

Sulawesi and Maluku railway plan for 2030

Papuacrailway plan for 2030

Appendix 3 - Modal share survey methodology and assumptions

- The survey was conducted using a face-to-face approach in 2024, targeting travelers across various regions. A total of 1,600 respondents participated in the study, with 750 respondents from Jabodetabek and 850 respondents from 8 other cities: Semarang, Medan, Palembang, Padang, Balikpapan, Makassar, Denpasar, and Jayapura. The survey was structured into three main components:
- (1) Modal Share Analysis: This component collected data on the relative use of different transport modes, measured in passenger-kilometers, to assess each mode's contribution to overall transport volume. It also included information on vehicle usage, travel distance, and travel time, segmented across the first mile, backbone (main segment), and last mile of trips. For the Jakarta area, additional questions were included to evaluate the effectiveness of TOD and LEZ. These questions aimed to identify behavioral differences before and after TOD implementation (the prerequisite to be respondent for this part is the respondent has to live or work within a designated TOD area development) and LEZ exposure (the respondent has to have travel route passes through an LEZ).
- (2) Transport Policy Preference Survey: This component was conducted only in DKI Jakarta for local TDM policies, and at the national level for BEV policy preferences. For the TDM survey, respondents were asked to express their opinions (using a Likert scale) on various policy options, including odd-even license plate policies, congestion pricing, and public transport subsidies. These policies may or may not have already been implemented. For the national-level EV survey, preferences were gathered regarding support mechanisms such as financial incentives, charging infrastructure availability, and other EV adoption factors.
- (3) Stated Preference Survey: This component was designed to capture both WTP and ATP and significant factors influencing travel mode choice. The stated preference questions were divided into two categories: (1) Mode-based preferences, to understand choice among different travel modes (i.e., car, motorcycle, bus, microbus, railway, and ride-hailing). (2) Vehicle-based preferences, focusing on preferences for BEVs over other vehicles (i.e., BEV motorcycle, conventional motorcycle, and converted (conventional motorcycle that converted into the BEV motorcycle). The survey data were analyzed using a mixed logit model to account for random variation in individual preferences.
- The example utility functions generated from the survey are shown below. Each mode may include different attributes in its utility function, depending on the significance of those attributes for that specific mode.

$$U_{i,j}^{mode} = \beta_{cost}^{mode} \cdot cost_{i,j} + \beta_{duration}^{mode} \cdot duration_{i,j} + \beta_{parking}^{mode} \cdot parking_{i,j} + \varepsilon_{i,j} + \sigma_{i,j}$$

β coefficients represent utility weights for each attribute,

ε represents the random error term,

σ captures individual-specific preference heterogeneity.

Appendix 4 - Emission model methodology and assumptions

- The study employs a system dynamics approach, integrating both quantitative and qualitative data to simulate the impact of various policies. This method offers a comprehensive understanding of how different interventions interact, revealing synergies, trade-offs, and potential unintended consequences in the transport system. The approach is non-spatial; therefore, the spatial variables are aggregated into average values. The study uses a tank-to-wheel model and strictly calculates final fuel consumption without considering upstream energy production and land use, land-use change, and forestry (LULUCF). The result of this study does not consider the emissions in the upstream energy supply (fuel and electricity).
- The national travel model is built based on travel data from the national origin-destination (OD) passenger matrix table, obtained from the National Transportation Policy Agency (BKT) of the Ministry of Transportation for the years 2006, 2011, and 2018. However, a key limitation is that mode share data based on OD is only fully available for the year 2006, and only for generic modes: (1) Land, (2) Rail, (3) Ferry, (4) River/Water, (5) Sea, and (6) Air. For the 2011 and 2016 data, mode-specific breakdowns are not available. Therefore, a proxy is required to estimate the mode share distribution for travel in 2011 and 2016.

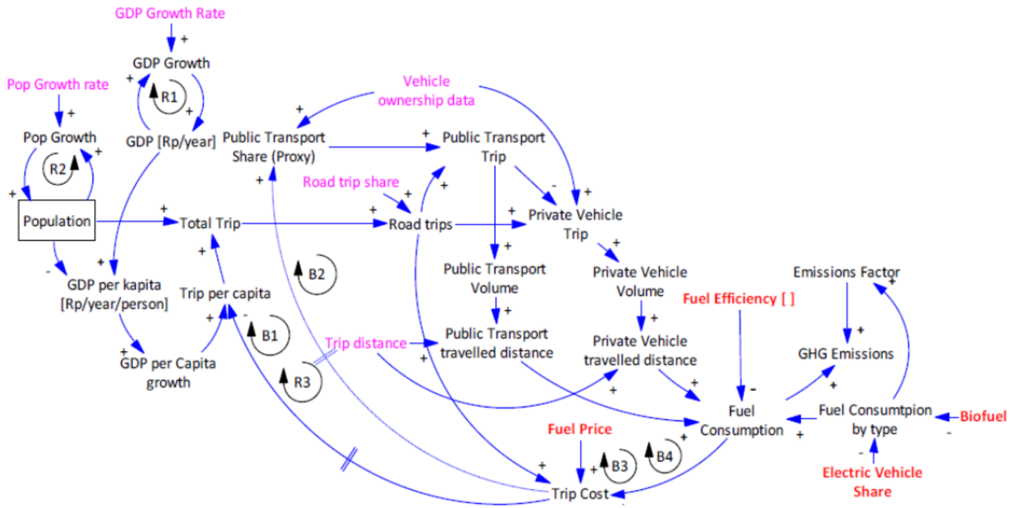
Variables for the system dynamics in the national emission transport model

Endogenous variable	Exogenous variable	Ignored variable	Policy entry point
Total travel volume	GDP elasticity per capita on vehicle growth	Number of households	Fuel price (by fuel type) and its dynamics
Travel per capita	Population and population growth rate	Gender	Efficiency rate of conventional vehicles
Number of land vehicles (motorcycle, car, bus)	GDP and economic growth rate	Trip generation and attraction (OD matrix)	Dynamics of EV ownership
Land mode travel	Mode share of land transportation	Trip purpose	Biofuel usage
Land travel volume	Emission factor		Public transport mode share
Fuel consumption	Fuel efficiency by vehicle type		
Transport emissions			
Emission intensity per km and per trip			

Appendix 4 - Emission model methodology and assumptions

- In this system dynamic, we built a national simplified Causal Loop Diagram (CLD) in the transport system, which includes three main influencing factors: population growth rate, economic growth rate (GDP growth), and trip cost. Historical data is therefore used to analyze changes in total travel volume, which are divided into components influenced by GDP per capita, population, and cost, to project the travel volume into the future. GDP and population determine GDP per capita, which therefore positively affects trips per capita and, in turn, total trips.
- This model found the loops as follows: with road trips increasing, trip costs also rise, creating a negative feedback loop where higher travel costs reduce trip per capita. Total trips are allocated to road travel using historical mode share assumptions, which are then further divided into two main modal shares: (1) private and (2) public transport trips, based on vehicle ownership and usage of the public transport system (i.e., bus)
- These trips are then converted into the fuel consumption using the fuel efficiency to calculate the final emission, and separated into two mains fuel source: diesel and gasoline.

Causal loop diagram for the national emission transport model



Appendix 5 - Key indicators of IESR NZE Scenario

Category	Units	2020	2025	2030	2035	2040	2045	2050	2055	2060
E4W stock	Million units	0	0	2	18	38	46	56	68	82
E2W stock	Million units	0	0	9	101	141	142	142	142	142
Passenger vehicle gasoline consumption	Million kL/year	28	36	37	12					
Passenger vehicle diesel consumption	Million kL/year	1	1	1	0					
BEV electricity consumption	GWh/year	1	128	4,958	49,089	78,835	88,135	98,647	104,766	112,315

Model assumptions and key points:

- The IESR model is tested with several policy intervention scenarios, such as the BEV adoption, the biofuel, the public transport, the WFH, the BEV and vehicle age restriction, the all policy and vehicle age restriction, and the NZE scenarios, with the baseline year for the model being 2019.
- The model, as well as BEV adoption, biofuel, public transport, and WFH scenarios, are built and verified using historical data.
- The vehicle age restriction scenario is also coupled with 100% BEV sales mandates, which are implemented in 2027 and 2030, respectively. The policy, along with the increased utilization of public transport, is expected to reduce the number of cars and motorcycles from 91 million units to 82 million units and from 175 million units to 142 million units, respectively.
- The NZE scenario is based on the assumption that the freight vehicle has a zero-emission policy in place.
- The charging infrastructure growth is based on the number of BEVs on the road, while maintaining the ratio of charging infrastructure with E4W and E2W around 1:15 and 1:17.

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