7. Various pathways for decarbonising the road transport sector in the Global South

—Efforts and challenges towards BEV and biofuels deployment—

It is undeniable that the battery electric vehicle (BEV) plays a key role in decarbonising the road transport sector while delivering secondary benefits such as reducing air pollution and oil imports. Many countries and regions are enhancing their BEV production policies to strengthen their industrial competitiveness for the future. However, the decarbonisation pathways of countries and regions vary greatly depending on their individual circumstances, and the road transport sector is no exception. From this perspective, IEEJ Outlook 2025[29] compared various types of vehicles with different powertrains (internal combustion engine vehicles [ICVs], hybrid electric vehicles [HEVs], plug-in hybrid vehicles [PHEVs] and BEVs) in terms of their greenhouse gas (GHG) emissions and total cost of ownership (TCO) using life cycle assessments (LCAs) for different regions (Advanced Europe, Brazil, Association of Southeast Asian Nations [ASEAN] and India), to demonstrate that the optimal powertrain for decarbonisation varies depending on the individual circumstances of countries and regions.

IEEJ Outlook 2026 takes a more comprehensive approach to optimal decarbonisation pathways in the road transport sector by focusing on the diverse pathways taken by key Global South countries, namely Indonesia, Brazil and India. Specifically, the report uses a case study of Indonesia to analyse various social challenges hampering the spread of BEVs, including environmental burdens from the production and use of BEVs, infrastructure upgrades necessary for their wider adoption, and the impact on critical mineral supply and demand. It likewise uses case studies of Brazil and India to evaluate the secondary policy effects, potential and challenges of biofuels as a promising fuel option for decarbonisation.

7.1 Indonesia's initiatives for wider domestic production and use of BEVs

Indonesian government policies

Indonesia is the second-largest car producer in ASEAN (1.197 million in 2024) only after Thailand and has the largest unit sales of new vehicles in ASEAN (866 thousand in 2024)[30]. Indonesia also produces 51% of the global supply of nickel, a mineral essential for BEV batteries (as of 2023) and is striving to become the global hub for BEV production. In 2022, the Indonesian government withdrew its domestic low-emission vehicle production target that had been set in 2020 (BEVs, PHEVs, HEVs and FCEVs) and set a fresh, BEV-only target to produce 1 million domestically in 2035 (Table 7-1).

[29] https://eneken.ieej.or.jp/data/12092.pdf

[30] "Automobile production and sales trends in major countries and regions" by Japan External Trade Organization (2025) https://www.jetro.go.jp/ext_images/_Reports/01/6f831adb699b3451/20250016.pdf

Table 7-1 | Indonesia's domestic BEV production: actuals and targets

(1 000 units)

	2024 actual	2050 target	2030 target	2035 target
BEV production volume	42	400	600	1 000
[Reference] Previous target				
Total domestic production volume	1 197	2 000	3 000	4 000
Of which: LCEVs only	112	400	750	1 200

Note: LCEV stands for low carbon emission vehicle (BEV, PHEV, HEV and FCEV).
Source: The target for BEVs is based on Indonesia's Ministry of Industry Regulation of 2022 and the targets for total production volume and LCEVs are based on that for 2020; the actuals are from the Association of Indonesia Automotive Industries (GAIKINDO).

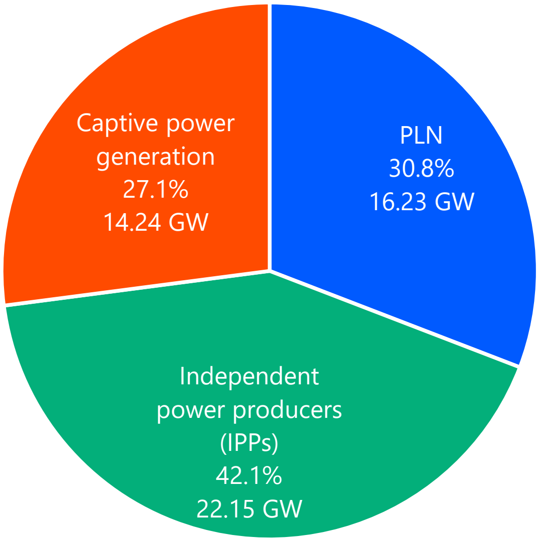
The targets for domestic BEV ownership are 2 million four-wheel vehicles in 2030 (passenger and commercial vehicles, at around 76 thousand as of the end of 2024) and 13 thousand for motorcycles. This can be seen as an ambitious industrial policy that leverages critical mineral reserves as well as the existing domestic industrial infrastructure.

Evaluation of environmental aspects

As described above, Indonesia is working on expanding the domestic production and use of BEVs by leveraging its abundant nickel resources. Meanwhile, the energy used in the nickel refining process comes mostly from coal (as a heat source) and coal-fired captive power generation, which is said to be increasing carbon dioxide (CO_2) emissions. In 2021, the Indonesian government declared that it would halt new coal-fired power plant construction from 2023, but with exceptions that include allowing new coal-fired captive power plant construction for nickel refiners and industrial complexes. Coal-fired captive power generation is also exempt from the early retirement support project for coal-fired power plants led by the Just Energy Transition Partnership (JETP), of which Japan is a member. In fact, coal-fired captive power plants account for 30% of Indonesia's coal-fired power plant capacity in operation but two-thirds of the coal-fired power capacity in the construction and planning stages (Figure 7-1 and Table 7-2).

Furthermore, in Indonesia's nickel refining sector, alongside deforestation associated with mining and ongoing impacts on marine ecosystems, there is a risk of local air pollution unless appropriate emission regulations are introduced to control the sulphur dioxide (SO_2) emissions from processing nickel sulphide ores into nickel sulphate.

Figure 7-1 | Composition of Indonesia's operating coal-fired power plants by supplier [July 2025]



Note: The figures for PLN include power plants wholly owned by PLN as subsidiaries.
Source: Created based on the Global Coal Plant Tracker and the RUPTL electricity supply business plan (2025–2034).

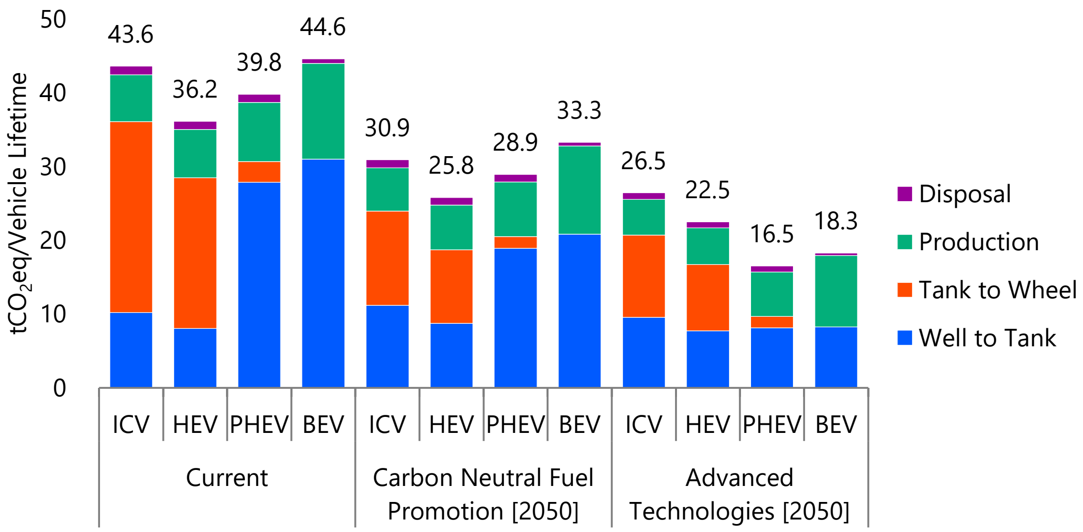
Table 7-2 | Characteristics of Indonesia's coal-fired power plants by suppliers

	PLN	Independent power producers (IPPs)	Captive power generation
In operation (GW)	16.2	22.1	14.2
In construction/ planning (GW)	1.7	4.2	11.7
Suspended (since 2021 or later) (GW)	7.0	12.0	4.1
Purpose	Supply to consumers	Sell to PLN	Power supply for the industry
Ownership/ management	State-owned	Domestic companies,	Local smelters, Chinese companies, etc.
Applicability of policy/ regulation	Early retirement and freeze on new builds by JETP apply	Early retirement and freeze on new builds by JETP apply	JETP does not apply

The current situation is thought to be due mostly to the influence of Chinese companies. The Indonesian government has been driving a policy to limit nickel ore exports and promote refining in the country. As a result, Chinese and other companies have begun planning and operating numerous refineries domestically, and approximately three-fourths of Indonesia's nickel refining capacity is said to belong to Chinese companies. These refineries are built on remote islands in conjunction with small, low-efficiency coal-fired power plants. The Chinese government announced that it would end support for new coal-fired power plant construction outside China in 2021, but this does not apply to captive power plants of industrial complexes related to the Belt and Road Initiative. BEVs, by nature, are a countermeasure against climate change and air pollution, but there will be little point if CO_2 emissions from producing BEVs increase and generate other environmental burdens, particularly for the benefit of Chinese companies. The environmental burden should be considered on a comprehensive basis that includes entire supply chains.

Are BEVs' GHG emissions smaller than the emissions of other powertrains on an LCA basis in Indonesia? As of 2023, coal-fired power generation accounts for two-thirds of Indonesia's power supply, driving up the country's carbon emission factor for electricity to 829 gCO_2/kWh, 1.4 times as large as the global average of 575 gCO_2/kWh. As such, a BEV has higher emissions than an ICV on an LCA basis, and this trend will not change in the future (2050) unless electricity is decarbonised as seen in the Advanced Technologies Scenario (Figure 7-2).

Figure 7-2 | GHG emissions from vehicles in Indonesia on an LCA basis



Note: The Carbon Neutral Fuel Promotion Case is a combination of the Reference Scenario and the carbon neutral fuel ratio of the Advanced Technologies Scenario.

The former Joko Widodo administration greatly expanded the country's power generation capacity, mainly using coal-fired power generation, in its first term through a capacity expansion project called the 35-Gigawatt Power Plant Project. As electricity demand did not grow as many as expected, Indonesia's coal-fired power generation capacity is currently said to be in overcapacity[31]. Indonesia's carbon emission factor for electricity, described earlier, is an all-day average of all power sources, and CO_2 emissions could rise further if BEVs spread and drive up the operation of coal-fired power capacity currently in excess.

The impact of the increase in BEVs greatly depends on the regional power generation mix and charging behaviour (Table 7-3).

[31] https://www.transitionzero.org/insights/indonesia-net-zero-curve

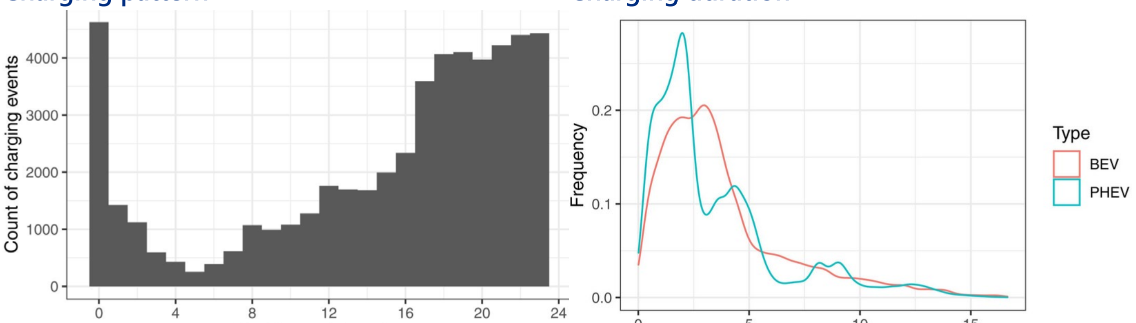
Table 7-3 | BEV charging hour patterns and impact on the annual demand curve

BEV charging hour pattern	Impact (annual demand curve)	Implications on the grid and power sources
Charging at night-time after 10 p.m. is the most common	The valleys in night-time demand in winter and summer will rise	The utilisation of wind and baseload power source will improve. Additional power by thermal power generation will be needed during shortages
Charging soars from around 5 p.m. when people come home	Summer and winter evening peaks will rise further	Grid burden will increase as excess thermal power plants go into operation
Daytime charging	Day-time demand will rise from spring through autumn	Beneficial for absorbing solar photovoltaics

For example, in Norway, where BEVs are the most widespread in the world, electricity demand did increase due to BEVs, but this has led to effective use of baseload power sources, as more than 90% of Norway's power generation mix consists of hydro. Meanwhile, in California, the United States, where BEVs are spreading rapidly, charging mostly starts around 5 p.m., when people come home, usually takes two to three hours and thus tends to overlap with the evening peak demand hours (Figure 7-3). The state's solar photovoltaic-dependent power generation mix carries a risk of increased CO_2 emissions due to BEVs because while solar photovoltaics often produce excess electricity in the daytime, additional demand arising during night-time is supplied using thermal power generation.

Figure 7-3 | California, the United States: charging pattern and duration

Charging pattern **Charging duration**



Source: Alan J., Jake H., (2022) Distribution grid impacts of electric vehicles: A California case study, iScience 25 1-16.

Solar photovoltaics may become a key power source in Indonesia in the future as well, if the decarbonisation of electricity is pursued. However, even if the all-day average carbon emission factor for all power sources decreases, cheap coal-fired power plants may continue to operate as a marginal power source, limiting the emissions reduction effect. As a result, the BEV's well-to-tank emissions shown in Figure 7-2 may increase by 1.3 times currently and by 1.8 to 3.6 times by 2050. As such, it is essential to urgently decarbonise coal-fired power generation and introduce renewable energy. Moreover, considering the characteristics of renewables and consistency with

BEV charging times, BEV owners should be encouraged to charge their cars during the daytime when electricity generated by solar photovoltaics is available, or during off-peak hours. Specifically, appropriate policy design—such as shifting charging hours through time-based tariffs and promoting smart charging technologies, is essential. If this is achieved, BEVs may become flexible grid-balancing resources rather than a source of increased CO_2 emissions.

Estimation of infrastructure costs

To put more BEVs on the road, it is essential to meet the resulting increase in electricity demand by securing power sources and reinforcing transmission networks. In particular, the spread of rapid chargers, while improving user convenience, is expected to raise peak demand and increase transmission network loads in cities where demand is concentrated. If BEVs increase to meet the Indonesian government's 2030 BEV target (2 million four-wheel vehicles) and adoption accelerates thereafter to reach 10 million in 2040, and half of these BEVs are charged between 4 p.m. and 10 p.m., this can generate at least 15 GW of additional electricity demand. The Indonesian government is planning to increase installed power generation capacity from 106 GW in 2025 to around 242 GW in 2040; however, an additional demand of 15 GW is by no means negligible. Furthermore, reinforcement of battery storage, power generation facilities and transmission infrastructure will likely be necessary to address regions and seasons with tight electricity supply. Unless smart charging is widely adopted, substantial additional infrastructure investment will be required.

Development of charger infrastructure calls for national budget allocation. Indonesia plans to install one charger for every 15 BEVs by 2030 and sets a goal to boost the number of chargers from the current 3 202 medium-speed chargers to 62 918 chargers by 2030 (30 796 medium-speed, 19 538 high-speed and 12 584 ultra-high-speed). This is estimated to cost 23 trillion rupiah (approx. 200 billion yen) in total over the next six years, which, at a 50% government subsidy rate, would equal 0.05% of Indonesia's national budget. Japan has a similar plan to install 300 000 chargers by 2030, which is estimated to cost 0.03% of the national budget under comparable assumptions, and given that the cost of BEV chargers is broadly similar worldwide, the costs represent a relatively larger burden for developing economies.

Needless to say, introducing BEVs requires certain policy costs alongside infrastructure costs. These policy costs include:

1. Incentives for BEV buyers (in Indonesia, value-added tax reduction (from 11% to 1%, applicable to models with a domestic production rate of 40% or higher), exemption from luxury goods sales tax (around 15%)),
2. Reduction of running costs for BEV owners (in Indonesia, 30% discount on electricity tariffs for BEV owners from 10 p.m. to 5 a.m.), and
3. Incentives for BEV producers (in Indonesia, corporate tax reduction for BEV, BEV battery, and motor producers, etc.).

While it is difficult to accurately estimate total fiscal costs, measures 1 and 2 above are estimated to require a national budget allocation of Rp5 trillion–Rp6 trillion (¥43 billion–¥52 billion) annually.

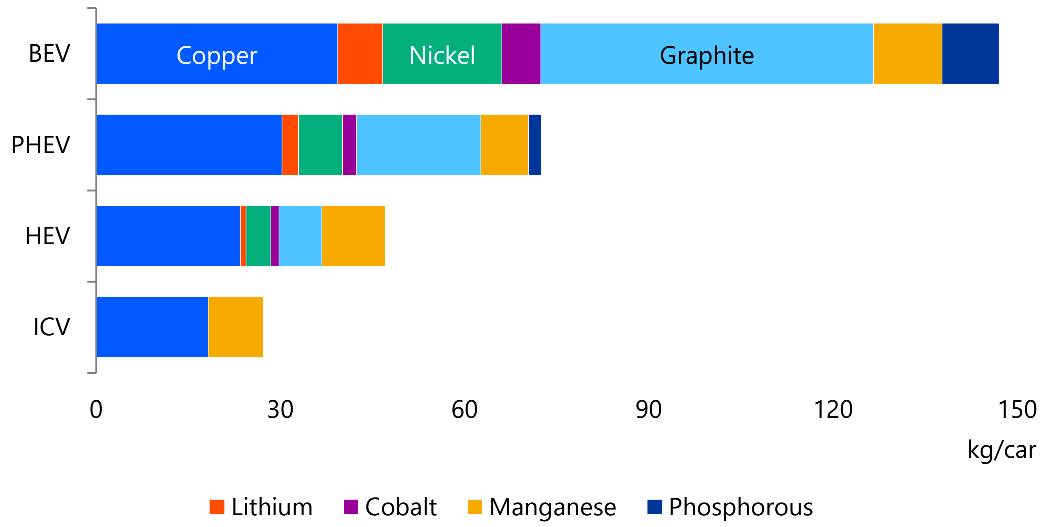
Other

It is also important to note the temperature-related deterioration of battery performance in tropical countries. A survey that collected data from 30 000 BEVs shows a 17%–18% drop in a

BEV's driving range at a temperature of 100°F (37.8°C) relative to ideal conditions[32], and a difference of 5%–6% in remaining battery capacity was observed after four-year use between moderate- and high-temperature regions[33]. Many original equipment manufacturers (OEMs) also advise users to avoid parking their BEVs at high temperatures with a full battery or charging at high or low temperatures.

Another issue for BEVs is their extensive use of critical minerals, which may affect the supply-demand balance of those minerals as BEV adoption increases, pushing up BEV prices. Also, the supply of critical mineral products depends heavily on China and is subject to the risk of supply disruptions triggered by export controls. BEVs are estimated to consume five times more critical minerals than ICVs, three times more than HEVs, and twice as much as PHEVs (Figure 7-4). Compared with the analysis in IEEJ Outlook 2024[34], the gap between BEVs and other powertrains has narrowed thanks to the wider adoption of lithium iron phosphate (LFP) batteries; nevertheless, the impact of the spread of BEVs must continue to be monitored.

Figure 7-4 | Critical mineral usage per passenger car



With the spread of BEVs, decreasing gasoline tax revenues are becoming an issue in various countries. In the United States, for example, a draft of the One Big Beautiful Bill Act (OBBBA) that passed the House of Representatives proposed imposing a surcharge of $250 per year on BEV owners. The proposal was ultimately removed from the final OBBBA, but many states do impose an annual surcharge of around $100–$200 on BEV owners. This issue is expected to be discussed in many countries, including Japan, going forward.

7.2 Use of bioethanol in Brazil

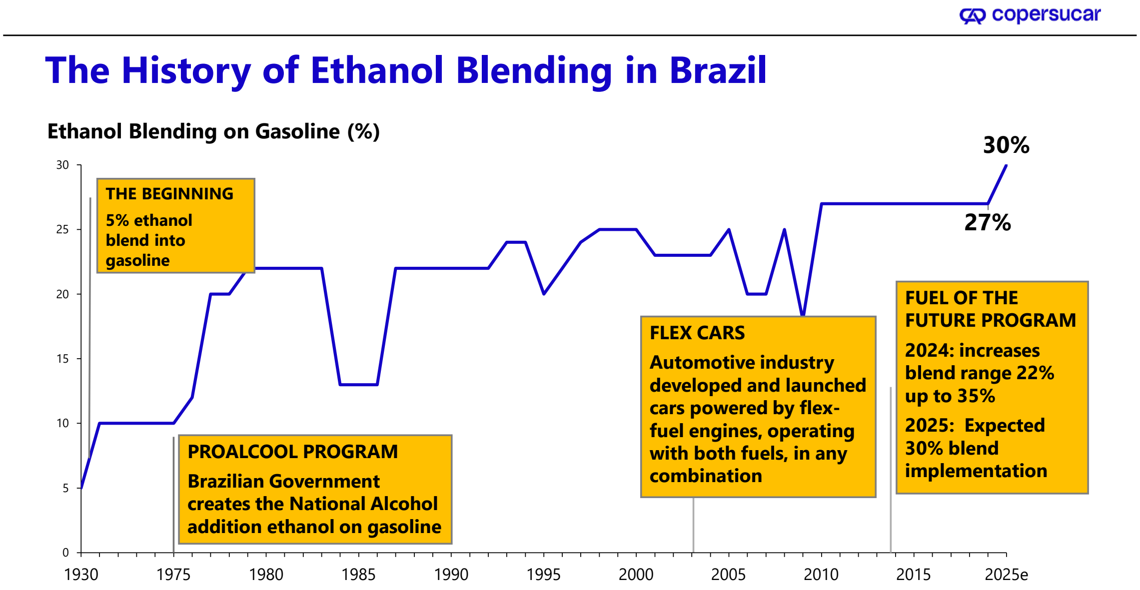
Brazil is the world leader in blending bioethanol into gasoline. The blending ratio, which had already been high at 27%, was raised to 30% in August 2025. This blending ratio in gasoline is a

[32] Blake Hough and Liz Najman, How Hot Summer Weather Affects EV Range, Recurrent, June 2025. https://www.recurrentauto.com/research/what-a-c-does-to-your-range
[33] Charlotte Argue, How long do electric car batteries last? What analysing 10,000 EVs tells us..., GEOTAB, July 2025. https://www.geotab.com/blog/ev-battery-health/
[34] https://eneken.ieej.or.jp/data/11380.pdf

regulatory threshold, and in fact, a ratio as high as 45% has been achieved. This has been made possible by the following historical background, in addition to the spread of flex-fuel cars, which can run on gasoline with any bioethanol blend from 0% to 100% (they accounted for 78.4% of new cars sold in Brazil in 2023) and government subsidies for bioethanol fuels.

Blending bioethanol into gasoline has a long history in Brazil and goes back about 100 years to 1931, when a 5% blend was introduced. Before climate change became a major policy issue, bioethanol was initially used in the transport sector as a means to support the sugarcane industry. Full-fledged production of bioethanol eventually began during World War II to conserve crude oil, and the blending ratio was raised to 10%. The blending ratio was raised further to 20% during the oil crises in the 1970s, and from the 2000s onwards, progress was made in the development and introduction of flex-fuel cars, leading to the present situation (Figure 7-5).

Figure 7-5 | History of bioethanol blending in Brazil

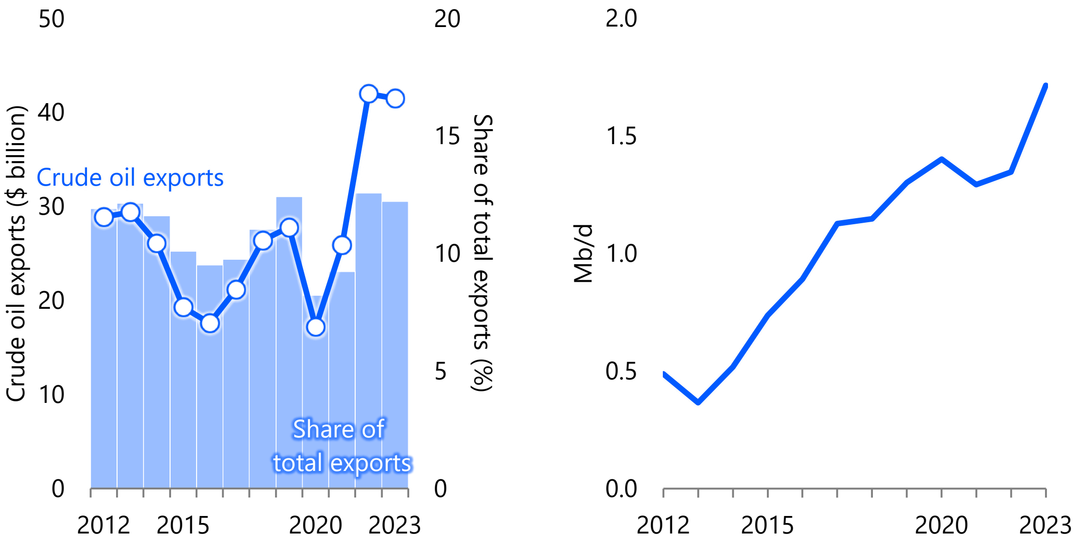


Source: Copersucar

Bioethanol production has made a major contribution to the country's energy security to date. Brazil's energy self-sufficiency rate reached 116% in 2023, and biofuels, including ethanol, account for 33% of the country's primary energy supply. Brazil is an oil producer, but it is reducing domestic gasoline consumption through bioethanol blending to help increase oil exports. Specifically, Brazil's oil exports have grown fourfold in the last 10 years and now account for 12%–13% of total exports, contributing to the country's foreign currency earnings (Figure 7-6). Domestic energy consumption grew by 470 PJ in 2023, of which crude oil accounted for 110 PJ and biofuels 320 PJ. The growth in Brazil's oil exports of 550 PJ (250 kb/d) that year would not have been possible without an increase in biofuel production.

Brazil's bioethanol policy is also helping to make its automobile industry competitive. As mentioned earlier, around 80% of the 2.5 million new cars sold each year in Brazil are flex-fuel cars, and the share of domestically produced vehicles in total new-car sales remains at 80%–90%, suggesting that the widespread use of flex-fuel cars, which are unique to the Brazilian market, is helping to maintain this high domestic share. The share of workers on sugarcane farms in agriculture has also increased from 4% to 8% in the 2000s, indicating that bioethanol is playing a role in agricultural development and job creation in the region.

Figure 7-6 | Brazil's crude oil exports



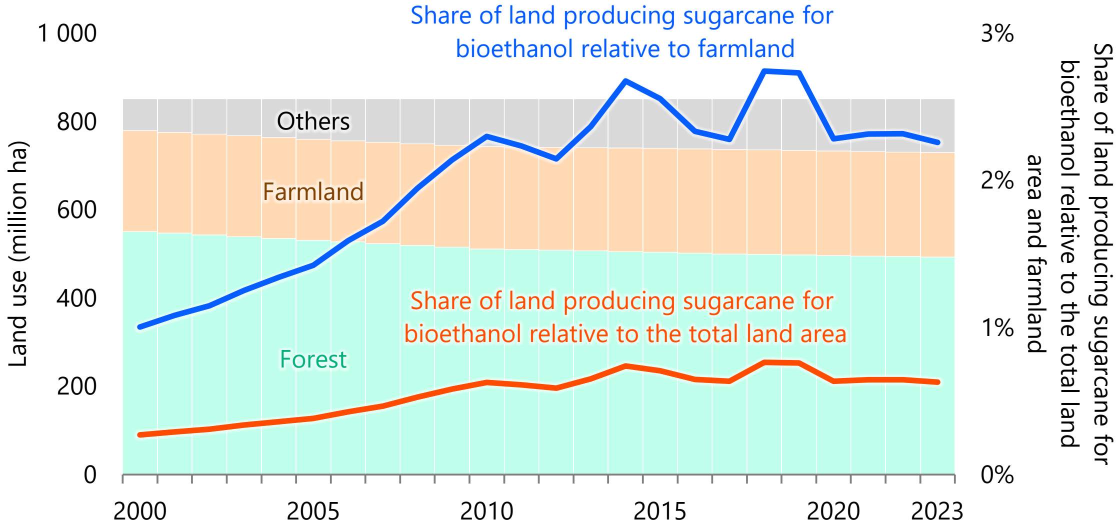
Source: Created based on data from Trendeconomy, the Organisation for Economic Co-operation and Development (OECD) and Federal Reserve Economic Data.

On the other hand, issues have been noted with utilising bioethanol, not only in Brazil, but also in any country. One of the persistent concerns about the expanded use of biofuels is land-use change, which may lead to deforestation through the expansion of arable land. However, as far as Brazil is concerned, the percentage of land producing sugarcane for bioethanol has remained stable relative to the total land area and farmland, and the impact of land-use change appears limited, at least for the time being (Figure 7-7).

Brazil's sugarcane industry is also working to reduce the carbon footprint (CFP) associated with bioethanol production. IEEJ's field study in 2024 also noted innovative efforts such as the production of biogas from bioethanol by-products for transport trucks, use as fertilisers, double-cropping sugarcane with maize, use of sugarcane residue (bagasse) for second-generation bioethanol production and power generation, and even consideration of introducing BECCS[35]. While working to expand bioethanol exports, Brazil is aware that reducing the CFP is essential for competitiveness in international markets. Brazil's challenges going forward include improving the transparency and credibility of CFP calculation and advancing related technologies.

[35] Bioenergy with carbon capture and storage. This is the capture and storage of CO_2 from biomass power generation and is one of the negative emission technologies.

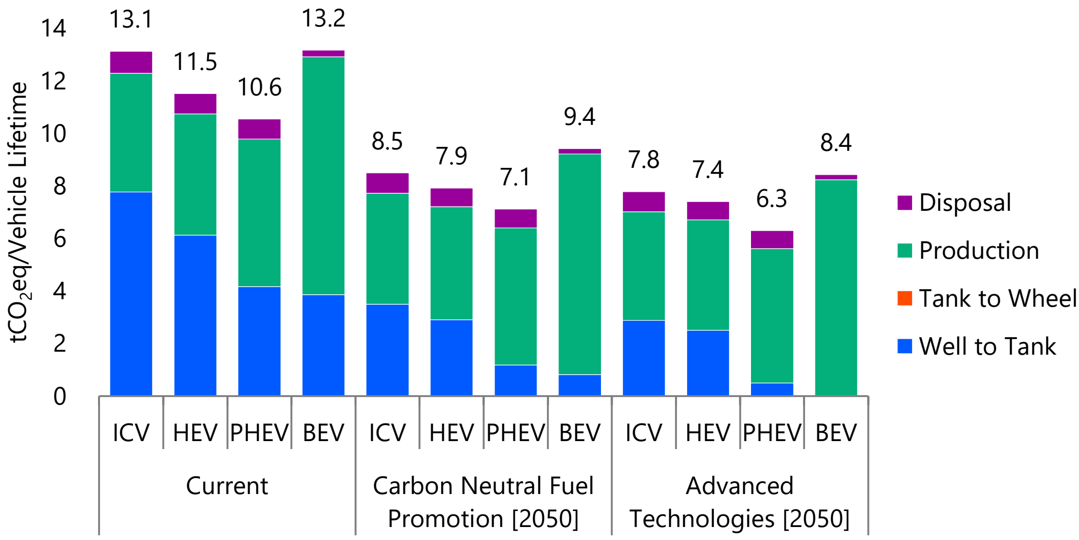
Figure 7-7 | Use of land in Brazil and share of sugarcane farmland for bioethanol



Source: Created based on the World Bank database.

An cycle assessment (LCA) of greenhouse gas (GHG) emissions in Brazil showed that compared with battery electric vehicles (BEVs), which generate high carbon dioxide (CO_2) emissions in the battery production phase, the CFP of internal combustion engine vehicles (ICVs), hybrid electric vehicles (HEVs) and plug-in hybrid vehicles (PHEVs) that run on 100% bioethanol fuel is lower than that of BEVs, and this ranking is not expected to change in the future (Figure 7-8). Brazil's carbon emission factor for electricity is extremely low at 79 gCO_2/kWh relative to the global average of 576 gCO_2/kWh, as its power generation mix consists mainly of hydro, which gives the country a significant advantage for BEVs; but even then, bioethanol was shown to be lower in carbon than BEVs on an LCA basis.

Figure 7-8 | Automobile GHG emissions on an LCA basis in Brazil



Note: The Carbon Neutral Fuel Promotion Case is a combination of the Reference Scenario and the carbon neutral fuel ratio of the Advanced Technologies Scenario.

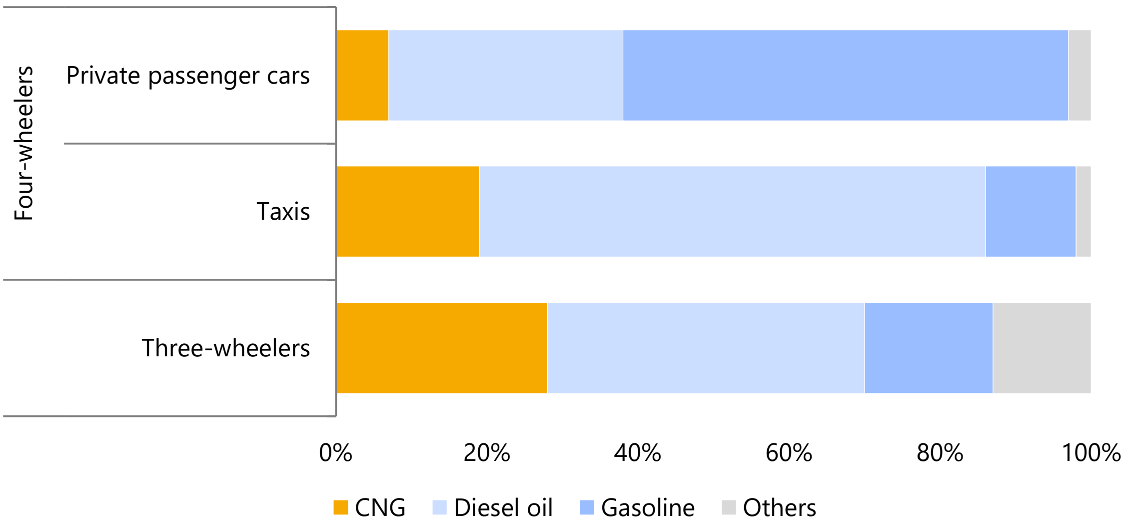
As described above, the expanded use of bioethanol in Brazil is being pursued from a wide range of perspectives including climate change, energy and economic security policies, as well as industrial policies such as automotive and agricultural policies, all while leveraging the country's abundant bioresources. Bioethanol is considered to have higher environmental performance than BEVs when combined with HEVs and PHEVs and can be seen as an excellent example of diverse decarbonisation pathways for the road transport sector.

In April 2024, the leaders of Japan and Brazil launched the Initiative for Sustainable Fuel and Mobility or ISFM, which combines sustainable fuels such as biofuels with high-performance mobility equipment such as HEVs, and in September 2025, the two countries co-hosted the first Ministerial Meeting on Sustainable Fuels in the Kansai region of Japan. There are high expectations for expanding bilateral cooperation into multilateral international cooperation.

7.3 Utilisation of biogas in India

India is also actively promoting the use of bioethanol, raising its ethanol blending ratio over the past decade from just 1.5% in 2014 to the current 20%. Meanwhile, what is even more noteworthy is that, to the extent identified in our study, it is the only country with a mandated blending ratio of biogas in compressed natural gas (CNG). In India, the use of CNG vehicles is widespread to address air pollution and because of low fuel costs, and CNG vehicles have an extremely high share of 28%, 19% and 7%, respectively, for three-wheelers, taxis and private passenger cars, respectively (Figure 7-9).

Figure 7-9 | Composition of registered vehicles in India by fuel type



Source: Created based on data from the Energy and Resource Institute (TERI).

In India, biogas policies have been reinforced to utilise abundant domestic bioresources such as agricultural residues, livestock manure and other wastes, as well as to draw on the vehicle composition described above, aiming to promote the agricultural and livestock industries, reduce liquefied natural gas (LNG) imports, save foreign currencies and contribute to a circular economy. Specifically, the Sustainable Alternative Towards Affordable Transportation (SATAT) initiative was launched in 2018, introducing voluntary biogas blending targets that would be made mandatory and gradually raised from 2025 (Table 7-4). This initiative is also part of the measures to promote agriculture.

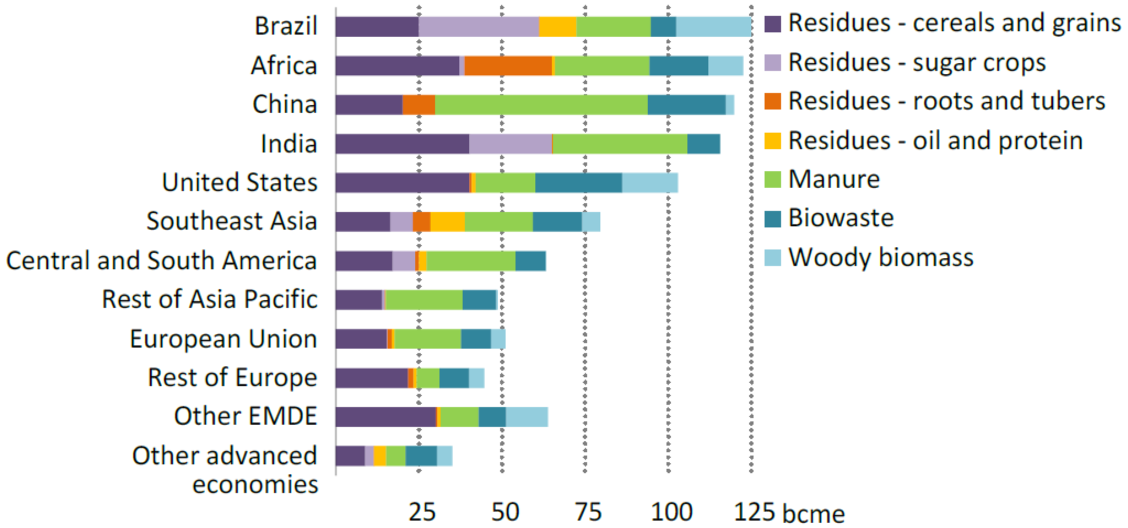
Table 7-4 | Biofuel blending ratio targets in India

	Target year	Blending ratio		Target year	Blending ratio
Bioethanol	2025	20%	Biogas	Through 2024	Not specified
				From 2025	1%
Biodiesel	2030	5%		From 2026	3%
				From 2027	4%
SAF	2028	2%		From 2028	5%

Source: Ministry of Petroleum and Natural Gas

According to the International Energy Agency (IEA), biogas production in India is built on its agricultural sector, which accounts for 18% of its gross domestic product (GDP) and 45% of employment and has a history of more than 100 years. India's biogas potential is among the world's largest, alongside Brazil and China (Figure 7-10), and its biogas policy, underpinned by this long history and abundant domestic resources, has no equivalent in any other country. It is also interesting that the title of the initiative stresses affordability as well as sustainability.

Figure 7-10 | Biogas potential of major countries and regions

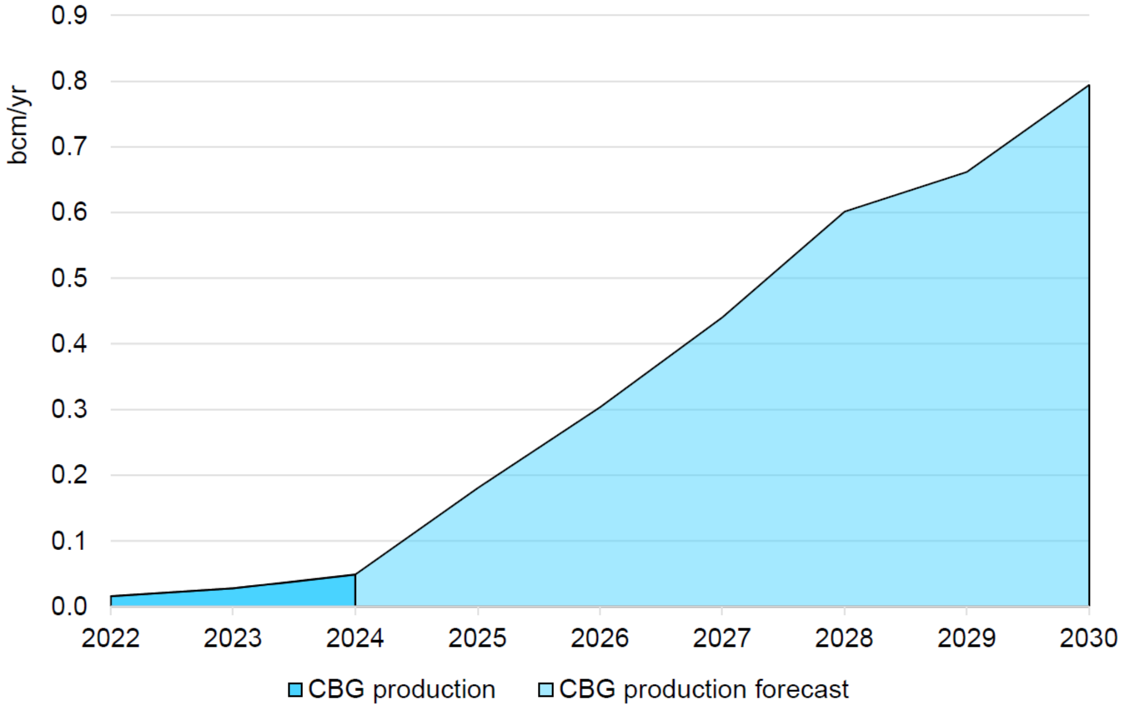


Source: IEA "Outlook for Biogas and Biomethane"

According to the IEA, India is still utilising only 5% of its vast biogas potential and a major production expansion (16 times the level by 2030) is expected (Figure 7-11).

Expanding the use of biogas in India has its challenges, as with the rollout of BEVs in Indonesia and bioethanol in Brazil. First is procuring biofeedstock, including managing seasonal fluctuations such as the concentration of agricultural residue generation immediately after harvesting, and the underdeveloped logistics infrastructure for feedstock collection in rural and other areas. Difficulty in investment decisions and financing due to non-transparent pricing and insufficient development of human resources and certification systems is also a challenge. Due partly to these challenges, according to the IEA, there are only 90 biogas production plants as of September 2024, compared with the SATAT target of 5 000 by 2024.

Figure 7-11 | Outlook for compressed biogas production volume towards 2030 in India



Source: IEA "India Gas Market Report Outlook to 2030"

As with Brazil's bioethanol, India's biogas utilisation has benefits such as reducing dependence on imported LNG and promoting agriculture, as well as contributing to carbon neutrality, and can be seen as one of the diverse decarbonisation pathways for the road transport sector that vary depending on the circumstances in each country. Suzuki Motor Corporation, a Japanese automaker, is also working with local dairy farmers to establish five biogas production plants in the state of Gujarat starting in 2025. However, we cannot say that India's biogas utilisation is supported by sufficient private-sector business incentives, unlike Indonesia's nickel refining and Brazil's bioethanol production. It is necessary to offer more carrots (support measures) alongside the stick (blending ratio regulations). While intergovernmental cooperation on climate change tends to lack variety and to focus on expanding renewable power sources and the early retirement of coal-fired power plants, going forward, it will be important to provide international assistance for more grass-rooted initiatives of this kind. With respect to Japan, utilising the bilateral Joint Crediting Mechanism (JCM) might be an option.

7.4 Conclusion

Key Global South countries such as Indonesia, Brazil and India are engaged in decarbonising the road transport sector by drawing on their regional resources and industrial strengths, from a broad perspective that transcends climate change and encompasses industrial policy and energy security. While all three countries are pursuing electrification and the broad adoption of biofuels, there are major differences in their priorities. There are a few insights we can draw from the above case analyses. First, the decarbonisation of power sources is a prerequisite for countries pursuing electrification of their road transport sector and battery electric vehicle (BEV) production. Reducing the environmental burden of production and other processes, shifting peak power demand, and developing social infrastructure should follow. Biofuels provide an alternative decarbonisation pathway alongside electrification and also contribute to agricultural development. Furthermore, blending biofuels into conventional fuels may reduce the costs of developing new infrastructure. In summary, the cases of the three Global South countries clearly show that not only electrification but also diverse pathways must be examined from a comprehensive perspective when decarbonising the road transport sector.