Asian Transport 2035 Outlook:

Investment Needs of Low- and Middle-Income Economies

Asian Transport Observatory

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Executive Summary

As incomes rise, the population demands better roads, faster trains, more reliable ports, and modern airports. The question is not whether Asia needs more transport infrastructure. The question is: how much, and at what cost?

This report provides answers. The Asian Transport Observatory (ATO), a joint initiative of the Asian Development Bank (ADB) and the Asian Infrastructure Investment Bank (AIIB), has assembled the most detailed forward-looking estimate of Asia-Pacific transport investment needs ever produced.

The Core Finding - Annual investment needs across all transport modes will climb from roughly US$800 billion per year during 2000–2025 to approximately US$2.6 trillion per year between 2025 and 2035. That is equivalent to 2.3% of LMIC GDP per year. This projection is conservative. It reflects observed trends and current pipelines, not aspirational targets. Actual needs, accounting for the full cost of the energy transition, the climate adaptation backlog, and the SDG access deficit, are likely to be considerably higher.

Road investments dominate and will absorb 44% of all transport investment from 2025 to 2035, or about 1% of GDP annually. Asia's LMICs could add 3 million km of roads in the next decade, yet per capita road access will remain below a quarter of OECD levels. Nearly 396 million people still lack an all-weather road. Motorization outpaces infrastructure. Vehicle numbers may grow by 3% per year, while road networks expand by only 1.4%. This widening gap will worsen congestion, road damage, and accidents.

Photo: Rahadiansyah

Rail growth is uneven. Heavy rail could add 60,000 km by 2035, but two-thirds are in just two countries. For smaller LMICs, this decade sees little change. High-speed rail is expanding into income levels once considered too low, but the pipeline is thinning. Urban transit shows a similar trend. Although two-thirds of the world's mass transit was built in the past 20 years, Asia's LMICs will see only a slight increase in availability, from 8. 8.5 to 10.6 km per million urban residents by 2035. Cities are growing faster than their transit systems.

The port area is projected to grow by 24% by 2035, outpacing North America, Europe, and high-income Asia. Aviation is the fastest- growing mode by area, with aerodrome space expected to expand by 144%. In both cases, per capita availability remains significantly below OECD levels.

For the first time, two new dimensions are quantified. Road crashes cost around US$1.5 trillion annually in Asia alone. Closing the safety infrastructure gap would cost US$65 billion annually — only 3% of total road investment. EV adoption could rise from 144 million to 689 million in LMICs by 2035, requiring about 500 million more charging points and total infrastructure construction costs of around US$900 billion over the decade.

The financial challenge is as great as the need for infrastructure. Public-private partnership investments have decreased. Official development assistance has grown but is still focused in a few areas, and climate finance for transport adaptation is almost nonexistent, making up only 0.13% of commitments in 2022. As electric vehicles replace fuel-powered ones—possibly reaching 37% of all vehicles by 2035—the tax base that funds infrastructure will shrink just when investment needs are highest. New solutions are needed to close this gap.

The question is not whether Asia needs more transport infrastructure. The question is: how much, and at what cost?

Background

"How much could low and middle-income economies in Asia invest in transport infrastructure over the next decade?"

While the question sounds simple, the answer is not.

No single database consistently tracks transport-sector infrastructure spending across Asian low- and middle-income economies (LMICs), and reporting practices vary widely. Data quality differs by country and mode of transport. Without a credible historical database, creating reliable estimates requires building a data system from scratch and combining official statistics, secondary sources, project databases, and published national targets to fill the gaps.

That is precisely what we do. Initiated by the ADB and supported by the AIIB, the Asian Transport Observatory (ATO) is an open-access platform that covers 52 Asia-Pacific economies and over 600 national transport indicators. It assists governments in planning, monitoring progress toward the 2030 Sustainable Development Goals, the UN Decade of Sustainable Transport, and aligning investments with the Paris Agreement commitments.

This report represents the ATO's most comprehensive investment study to date. It extends and revises the 2022 Outlook, broadens the sectoral scope, and introduces new estimation frameworks for road safety and electric mobility — two dimensions that were missing in regional assessments.

1. Building on Prior Work

This is not the ATO's first investment outlook. In 2022, we published our inaugural major investment report, the Asian Transport 2030 Outlook (Gota and Huizenga 2022). That study covered 51 economies and focused on three sub-sectors: roads, railways, and urban transport. It projected a total investment requirement of US$6.8 trillion from 2022 to 2030, equivalent to about 1.6% of regional GDP.

Photo: J

The scene has shifted considerably since then. COVID-19 disrupted economic trajectories, altered long-term mobility patterns, and delayed or cancelled investment programs. New data, particularly on ports and airports, have emerged. The pressure for climate action had intensified, and new academic research has refined the methodological tools available for this kind of estimation.

The 2025 edition (ATO 2025b) responded to those shifts. It broadened coverage to eight sub-sectors, incorporated revised post-COVID growth trajectories, and projected a total investment need of approximately US$43 trillion between 2020 and 2035 or about 2% of regional GDP.

This updated study extends the analysis. It focuses exclusively on LMICs within Asia and the Pacific. It incorporates infrastructure costs related to road safety and electric mobility, domains where significant data gaps had previously constrained quantification.

2. Methodology: A Bottom-Up Approach

Our modeling framework is grounded in a robust bottom-up methodology. We built individual models for eight sub-sectors: roads, heavy rail, high-speed rail, metro systems, light rail transit, bus rapid transit, maritime ports, and airports.

Each model works in one of two ways. Either it draws on historical relationships between infrastructure supply and key economic and demographic drivers— e.g., GDP per capita, population density, and urbanization rates— or it combines those historical relationships with current infrastructure projects in the investment pipeline and published national policy targets.

The strength of the framework lies in its calibration against real data. Two decades of ATO time-series, collated from multiple official and secondary sources, form the foundation. Thousands of documented infrastructure projects and published national policy targets provide the forward-looking layer. These results are cross-referenced with peer-reviewed academic results, where available. We have elaborated more on the modeling process in the final chapter.

Infrastructure demand projections are then multiplied by unit cost estimates drawn from the ATO's cost database, based on income-group-specific, inflation-adjusted figures derived from historical project reports.

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3. What This Study Does Not Do

Transparency requires acknowledging boundaries. There are seven major limitations of our study.

1. Policy continuity is assumed. Projections reflect current trends; not optimal investments aligned with SDG or Paris Agreement targets. The gap between projected and needed remains substantial.

2. In most cases, historical relationships are assumed to hold. If major structural shifts occur, e.g., demographic shocks, new technology disruptions, or commodity price volatility, estimates could diverge from outcomes. We try to calibrate these historical assumptions with the upcoming policy targets, investment pipelines, and academic research, where feasible.

3. Climate adjustment is partial. A 7% increment for climate resilience is applied, drawn from Coalition for Disaster Resilient Infrastructure (CDRI) data. The full cost of climate change, including indirect and cascading impacts, is not captured.

4. Full energy transition costs are not included. The energy transition in the transport sector will reshape infrastructure needs. These are not yet fully quantified here. We have accounted only for the costs of electric charging infrastructure construction and maintenance. We have neglected grid transformation costs.

5. Financing is not accounted. Infrastructure can only be built if adequate, accessible, and affordable finance exists. Only supply-side investment needs are estimated, and financing sources are mentioned but not elaborated.

6. Infrastructure is treated as supply (historical construction rates) and demand-driven. Infrastructure also generates induced demand, which is neglected. This simplification is a necessity for modeling.

7. Vehicle operation costs are neglected. Only the infrastructure construction and maintenance costs are considered. Infrastructure and vehicle lifecycle operation costs, which can be substantial, are not included.

These limitations do not diminish the value of the analysis. Within this defined scope, the study offers one of the most comprehensive evidence-based estimates of transport infrastructure investment needs for Asia-Pacific LMICs.

Infrastructure Expansion in Asia

1. Are LMICs Closing the Road Infrastructure Gap?

The road sector tells a story of rapid expansion against a still-massive structural gap. LMICs in the Asia-Pacific region have been growing rapidly. Their road networks expanded significantly between 2000 and 2025, accounting for 96% of Asia's road construction over that period. The upward trend is projected to continue through 2035. However, the gap with the Global North is not closing on either a per-capita or on a per-land area basis. Road Infrastructure density (720 meters per sq km) in Asia's LMICs currently sits barely above the OECD average of 680 meters per sq km. However, per-capita road availability is severely depressed: 4.4 km per thousand people in Asia LMICs and 17 km per thousand people in OECD countries. The disparity is expected to remain significant through 2035.

LMICs added 3 million kilometers between 2000 and 2010. This increased to 5.5 million kilometers between 2010 and 2025. Between 2000 and 2025, 45% of road growth was in upper-middle-income economies, and 55% in low- and lower-middle-income economies.

Road construction pace is not linear. Construction growth rates are highest at lower-income levels. As GDP per capita rises, the growth rate tapers. A country does not keep adding roads indefinitely as it grows economically. It reaches a saturation point where maintenance, rather than new construction, becomes the primary investment driver. We estimate a slowdown in road infrastructure construction as most LMICs in Asian economies reach a threshold of economic growth and infrastructure density.

Based on our estimate, **LMICs could add 3 million kilometers** over the next decade i.e. same as we built over the decade 2000 to 2010.

The composition of that network, however, will shift. Primary roads will rise from **13% to 14%** of the total. The share of paved roads could increase from **66% in 2025 to 73% by 2035.**

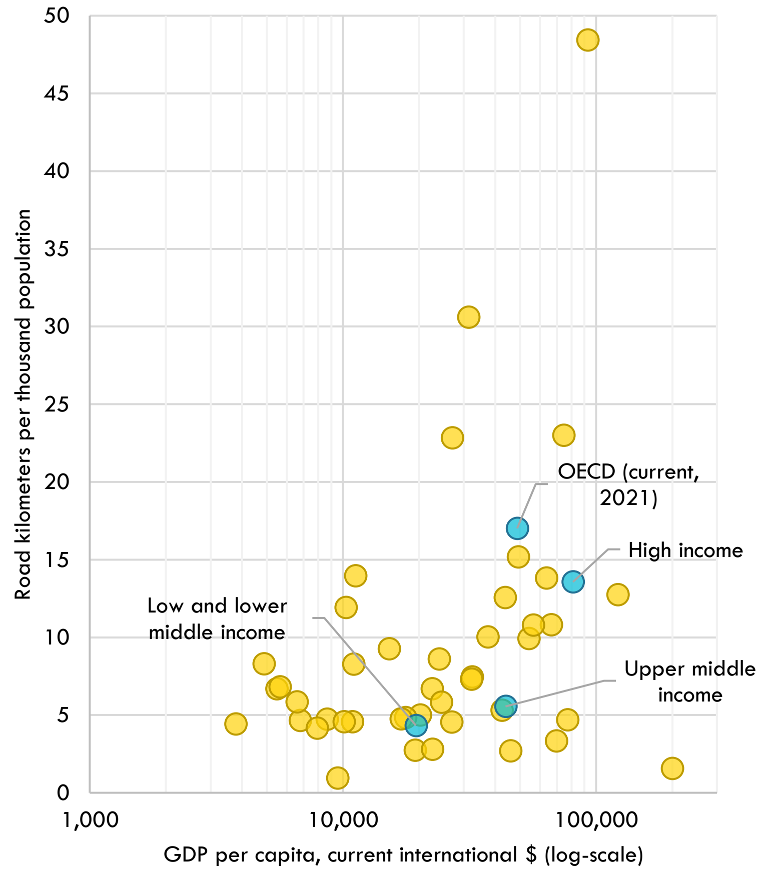

Figure 1. Road infrastructure availability (km per thousand population)

Note: All figures are for 2035 unless specified.

The aggregate picture masks sharp differences. Between 2025 and 2035, 61% of road growth will occur in upper-middle-income economies, and 39% will occur in low- and lower-middle-income economies. By 2035, the infrastructure gap with OECD counterparts will remain.

The ATO's estimated annual growth rate of 1.3% for the LMICs between 2025 and 2035 is more conservative than other international assessments. For example, the AIIB study projects 1.9%; Fisch-Romito and Guivarch (2019) estimate a range of 0.5% to 4.2% for 2020-2030. Our figure reflects observed patterns rather than aspirational targets.

2. Historic Road Maintenance Gap

The road sector in LMICs has long suffered from chronic underinvestment in road maintenance. Evidence (van Dissel 2024) suggests that in countries such as Bangladesh, Cambodia, the Kyrgyz Republic, Mongolia, Nepal, Pakistan, Papua New Guinea, Timor-Leste, Uzbekistan, and Vanuatu, spending on maintenance falls short of estimated needs by more than half. The average budget-to-needs ratio across the group lands below 35%.

Maintenance spending as a share of GDP ranges from 0.1% to 0.6% in most countries, while estimated needs range from 0.5% to 1.3% of GDP. Thus, there is a significant maintenance gap.

Further, the shortfall is not evenly distributed nationally. Lower-level roads managed by regional and local governments tend to suffer the most. These are often the roads that rural populations depend on for daily needs, e.g., connecting farms to markets and clinics to communities. Local governments lack a revenue base and rely heavily on transfers from the center, which flow unpredictably. Currently, close to 396 million people in LMICs lack access to all-weather roads, as defined by the SDGs. With poor maintenance, more people could lose access and connectivity. Road maintenance, thus, is a rural access issue, not only an asset management issue. When roads deteriorate, the physical road may remain in the inventory, but its functional value declines. Poorly maintained sections may become impassable, vehicle speeds fall, transport costs rise, and communities that were previously connected can become effectively disconnected. In this sense, under-maintenance can lead to a loss of usable road-kilometers and network connectivity, especially on lower-level rural roads. This issue is revisited in Section IV.2, where maintenance is framed as an asset preservation challenge.

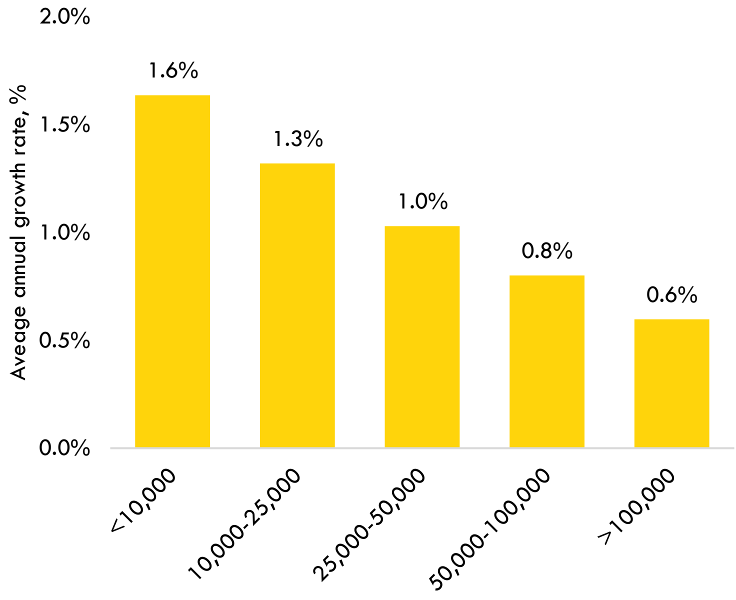

Figure 2. Road infrastructure average growth rate from 2025 to 2035, by GDP per capita in 2035 (USD)

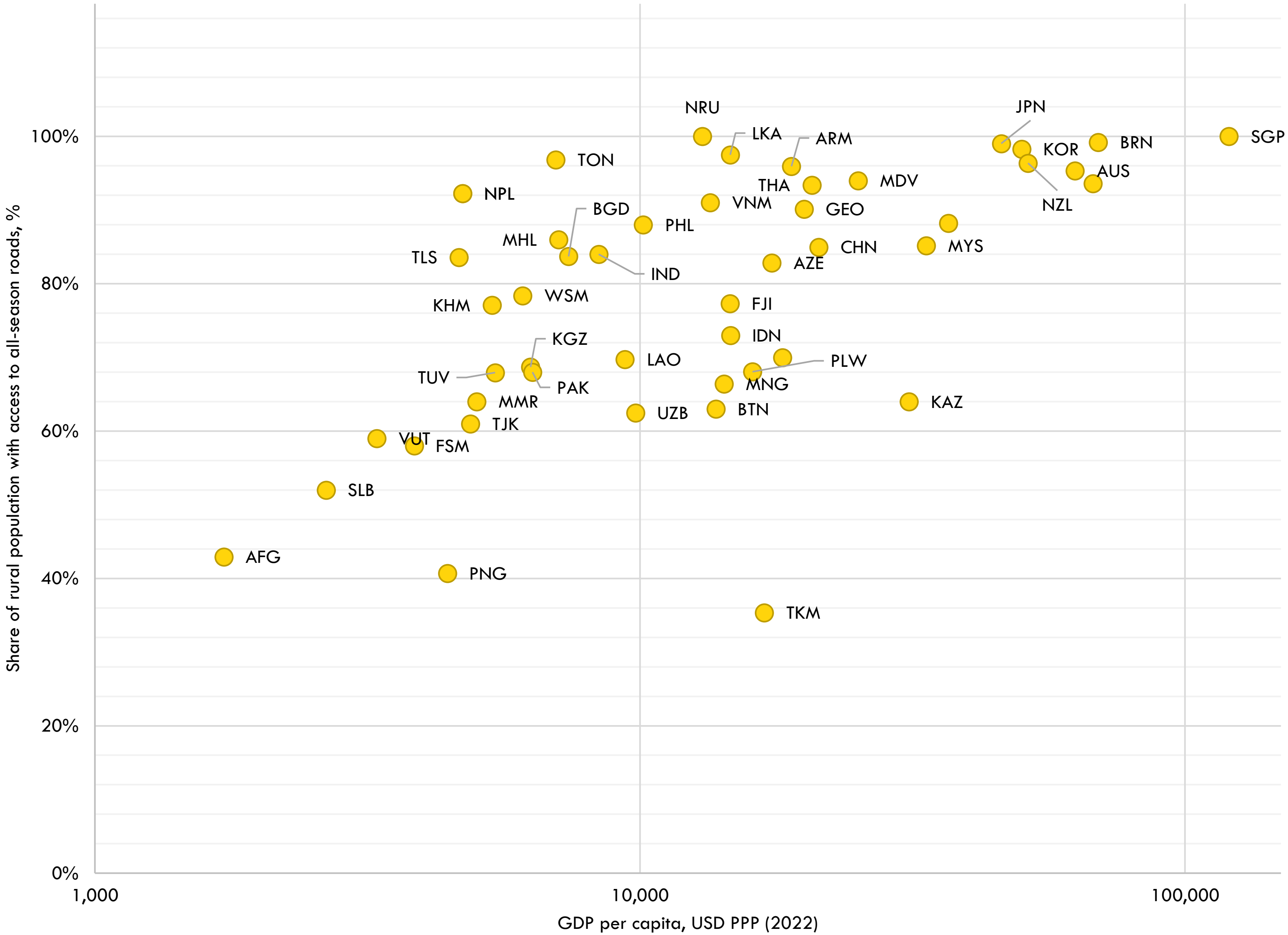

Figure 3. Share of rural population with access to all-season roads by 2035 (%)

3. How fast could motorization happen?

From 2000 to 2025, over 1 billion new vehicles entered the roads of Asia's LMICs. Vehicle ownership grew by 9.3% annually, nearly four times the 2.3% annual growth in road infrastructure. Infrastructure development lagged vehicle growth, and we expect this trend to continue. Between 2025 and 2035, road infrastructure might expand by only 1.4% per year, while vehicle numbers could grow by 3% annually. This will widen the gap between network capacity and vehicle demand. Nonetheless, the rate of motorization will decelerate. As infrastructure expansion slows, we anticipate the growth rate of vehicle numbers to decrease from 9% over the past two decades to 3% in the coming decade, primarily because countries reach a certain level of socioeconomic development and motorization. By 2035, LMICs could have about 410 vehicles per 1000 people.

The motorization story here is not a replica of what happened in high-income economies. Motorization growth was more pronounced in Asia's LMICs. Further, what often goes unnoticed is the compositional reality. The passenger car is not the dominant mode here. Two- and three-wheelers are. One in two vehicles is a motorcycle, scooter, or auto-rickshaw. In fact, since 2015, in more than half of LMICs in Asia, two-wheeler registrations have outpaced car registrations. This matters enormously for infrastructure design, safety investment, and emissions policy.

The evidence (Google 2025) on two-wheeler motorization is definitive. From 2018 to 2023, in **147 cities** across low- and middle-income countries, there was a nearly universal decline in public transport and active mobility modes. **About 95% of these cities saw a decrease in the share of active transport (mainly walking), while 93% experienced an increase in private motorization.** The active mode share dropped by an average of 3.3 percentage points, while private modes grew by about 3.4 percentage points, indicating near full substitution. Public transport proved more resilient overall, with slightly over half of the cities experiencing losses and an average decline of just 0.04 percentage points.

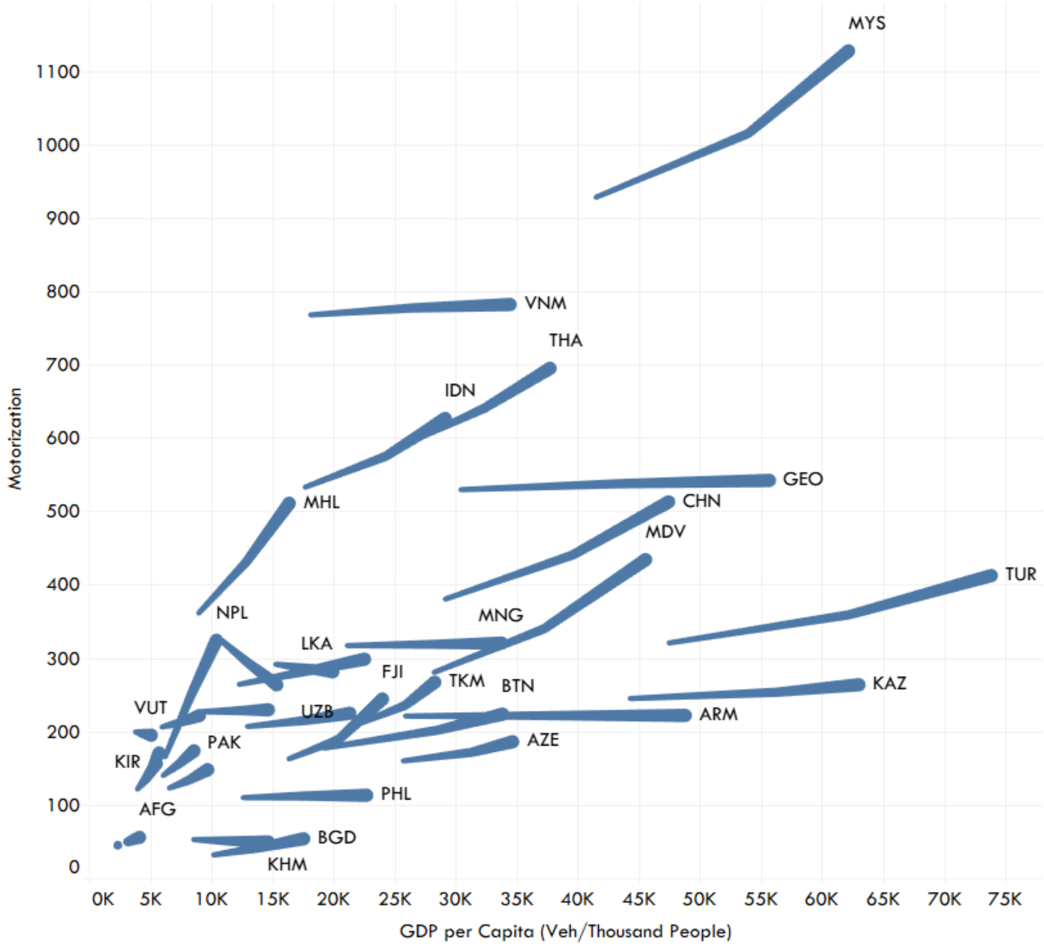

Figure 4. Motorization Rates Estimates for 2025 – 2035 (vehicles per thousand population)

However, there is substantial regional variation: the largest losses in active transport occurred mainly in South and Southeast Asia, which account for 135 of the 147 cities, with declines of 3.6 and 2.8 percentage points, respectively. Public transport in these regions remained relatively stable, indicating that trips previously done on foot mostly shifted to private vehicles. This matters enormously for policy.

The future motorization trajectory is worrisome. With motorization growing more than twice as fast as infrastructure and GDP, transport externalities could increase significantly without mitigation policies. **The IMF (2024) estimates that the external costs associated with road crashes, congestion, and road damage in LMICs could increase from USD 331 billion in 2025 to USD 424 billion in 2030.**

The future trajectory is a function of policy choices. Countries that invest in urban form, public transit, active mobility infrastructure, and demand management will follow a different path of motorization than those that do not.

4. Are We Closing the Heavy Railway Infrastructure Gap?

Unlike roads, historical railway expansion in LMICs has been modest relative to both the road sector and to the scale and the pace of the region's economic transformation. The future trajectory of heavy rail will be shaped less by economic growth than by deliberate political and institutional choices. We find that Rail is where Asia's development ambitions are most visible. Governments across the region have made rail, in its various forms, a centerpiece of their long-term connectivity strategies. The numbers reflect both the ambition and its limits.

LMICs in Asia's heavy rail network totaled approximately 340,000 kilometers in 2025. By 2035, the ATO estimates that this will reach 400,000 kilometers—an additional 60,000 kilometers. That growth rate, 1.6% per year, slightly above the projected 1.4% annual growth rate for road infrastructure. While the difference is modest, it is significant because rail networks in many higher-income economies have expanded more slowly than road networks. The projected pattern suggests that several Asia-Pacific LMICs continue to pursue rail expansion as part of their long-term connectivity, freight, and passenger transport strategies.

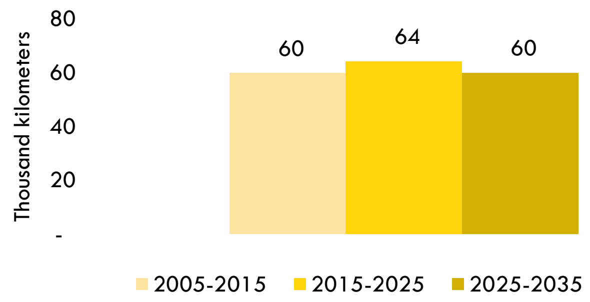

Figure 5. Heavy Rail Infrastructure Kilometers Added in LMICs (thousand km)

But total kilometer figures tell only part of the story. The per capita picture is more pessimistic. Rail availability in LMICs rises from just 78 to 87 kilometers per million people by 2035. Today, the OECD economies stand at 323 kilometers per million, i.e., 3 times higher, and Asian high-income economies are projected to average 528 kilometers per million by 2035, i.e., 5 times higher.

The network is growing. But the gap is not closing. Adding 60,000 kilometers across countries with hundreds of millions of people moves the per capita needle only marginally. The volume of construction is not the same as the adequacy of provision.

The other challenge is railway concentration. About two-thirds of the region's total railway growth between 2025 and 2035 is concentrated in two countries: the People's Republic of China and India. Upper-middle-income economies will account for 71% of railway expansion between 2025 and 2035. Low and lower-middle-income economies will contribute 29%. For smaller LMIC economies, many of which have negligible rail networks today, this decade will deliver little change. **Rail construction remains intensely uneven, even within the LMIC category.**

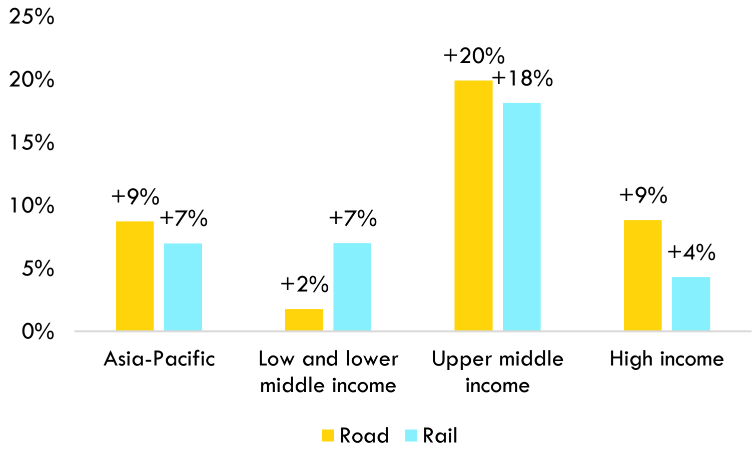

Figure 6. Improvement Infrastructure Availability (2025 to 2035), Road vs. Rail

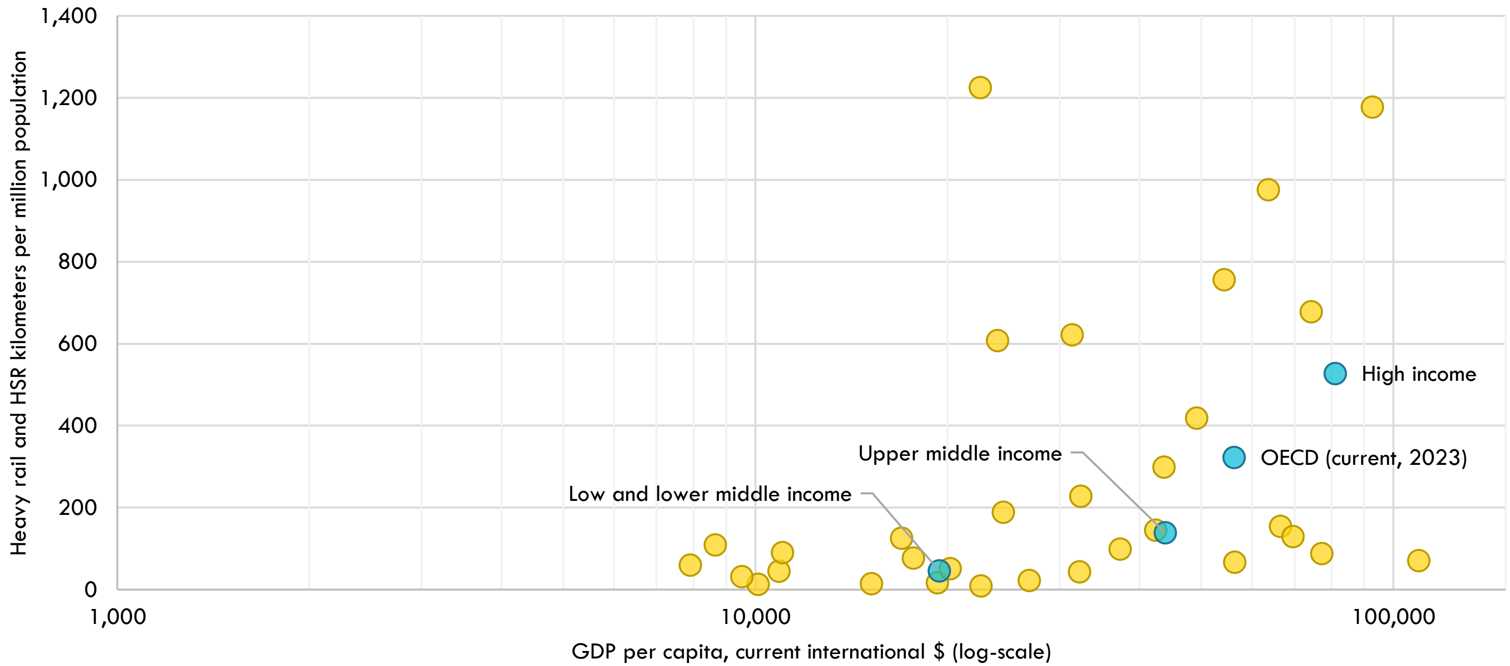

Figure 7. Heavy Rail Infrastructure Availability (km per million population) Note: All figures are for 2035 unless specified

Further, heavy rail carries a disproportionate maintenance burden among transport modes. Its maintenance cost-to-investment ratio is higher than that of roads. Yet in most LMICs, rail maintenance budgets are equally constrained. This is a structural risk to the functionality of existing networks.

The central challenge for heavy rail in Asia is not capacity. It is connectivity. Rail networks were historically built as national, not as integrated regional networks. Cross-border freight corridors remain underdeveloped. Operational costs are high, and **competition from other modes is intense.**

5. New Development Agenda - The High-Speed Rail

High-speed rail tells a different story. LMICs have expanded HSR networks at a pace unmatched anywhere in the world. Between 2000 and 2010, LMICs added 5,600 kilometers, and between 2010 and 2025, LMICs added 57 thousand kilometers. The People's Republic of China alone accounted for more than 96% of LMICs' share over the past two decades. In fact, PRC has added more kilometers than the rest of the world over the past two decades. The decade ahead will be different.

For projections, we rely on official commitments, current construction tenders, and the UIC database. **Between 2025 and 2035, LMICs could add 24500 kilometers.** This is significantly lower than what we constructed in the past decade. By 2035, LMICs could have an HSR network of 87,000 kilometers — up from roughly 63,000 in 2025.

By 2035, Five Asia-Pacific LMICs, Viet Nam, India, Malaysia, Thailand, and Myanmar, could start operating HSR services. To put the growth in perspective, High-speed rail will account for approximately 29% of all new railway construction in LMICs between 2025 and 2035. In comparison, in the decade 2015-2025, it accounted for 38%.

Figure 8. UNCTAD Freight Rates for 2021 (USD/kg)

High-speed rail does more than move passengers faster. It frees capacity on conventional rail for both passenger and freight movement. It intensifies competition in aviation on medium-distance routes up to 750 km, thereby reshaping the economic geography.

Our main finding is that countries aspire to HSR at lower income levels. Several countries are now building HSR at income levels well below those historically associated with such systems in Europe or Japan. Thus, HSR is no longer a policy tool for wealthy economies alone. It is becoming part of the development toolkit in LMICs.

However, ambition seems to be facing headwinds. The projected slowdown in LMIC HSR expansion after 2025 reflects tighter fiscal space and the recalibration of priorities in a post-pandemic, tighter investment environment. The HSR pipeline is thinner than it was a decade ago. Fewer projects are advancing from planning to construction. Whether this is a pause or a structural shift in LMIC HSR ambition remains an open question. Policy decisions in the next few years will answer.

6. Closing the Urban Rapid Transit Gap

Asia's cities are growing faster than their infrastructure. Over the coming decades, urbanization in Asia will occur mainly in LMICs, as the population living in towns and cities in high-income Asia begins to decline. Between 2025 and 2035, the population living in Asian LMIC towns and cities would increase by **220 million**. Thus, the pressure on urban transport systems, such as chronic traffic congestion, air pollution, and road safety crises, will only intensify. The transport sector's response has been fast by global standards but slower given the intensity of the challenge. **Over the last two decades, two-thirds of global mass transit construction has occurred in LMICs in Asia.**

From 2000 to 2025, LMICs in Asia developed 14,000 km of metro lines, 1,200 km of LRT lines, and 2,000 km of BRT. Between 2025 and 2035, projections suggest an additional 7000 km of metro lines, 600 km of LRT, and 1200 km of BRT. The **construction slowdown is the major finding of our study.** Fewer projects are advancing from planning to construction. fiscal constraints and the aftermath of COVID-era budget stress all play a part.

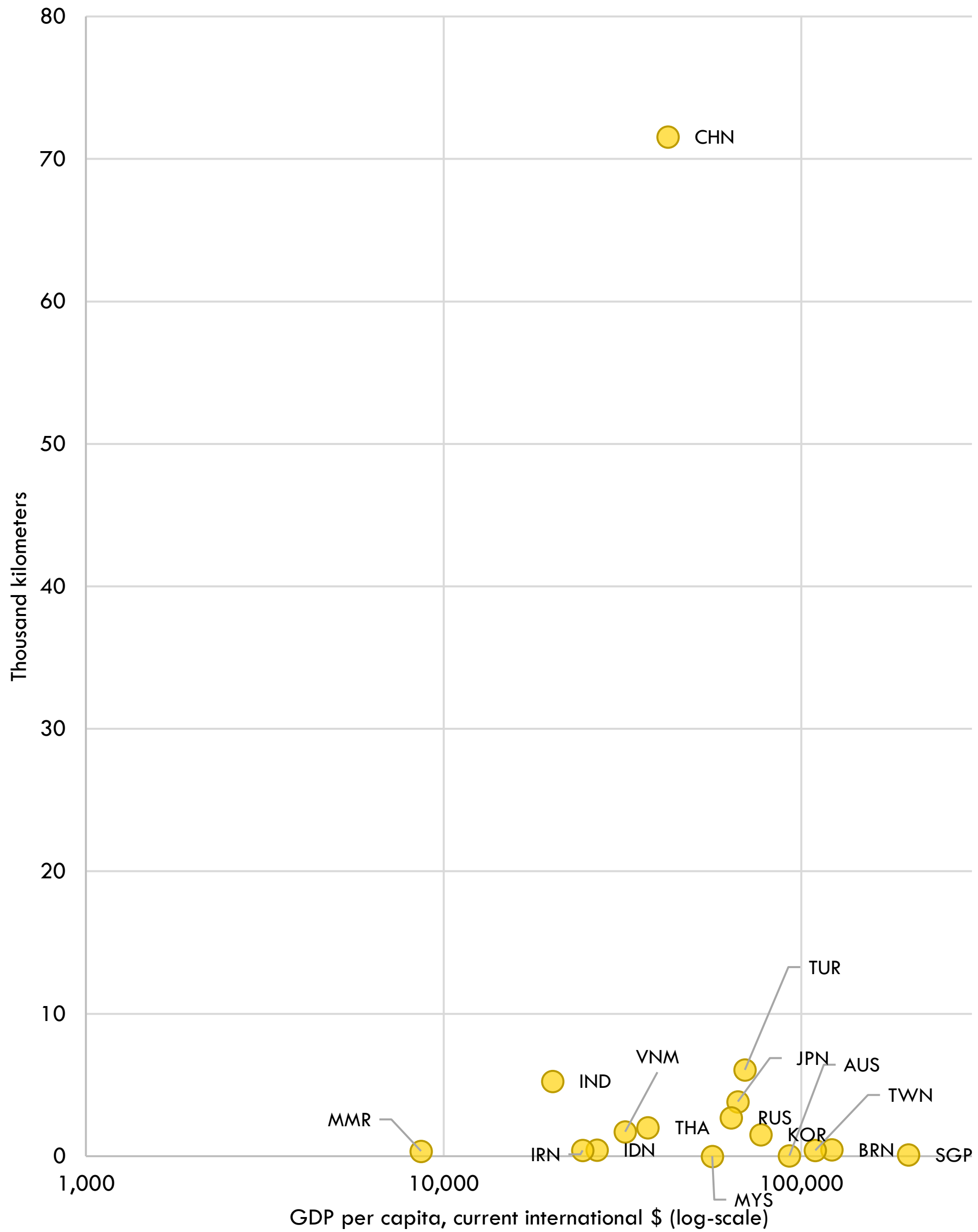

Figure 9. High Speed Rail Estimated Lengths by 2035 (thousand km)

Upper-middle-income economies will account for 69% of urban transit expansion between 2025 and 2035. Low and lower-middle-income economies will contribute 31%. The gains on a per capita basis are especially modest: LMICs' Asian economies will see urban transit availability rise from only 8.5 to 10.6 kilometers per million urban population by 2035—far below the current OECD average of 12.1 kilometers per urban million or the Asian high-income economy average of 23.1 kilometers per million.

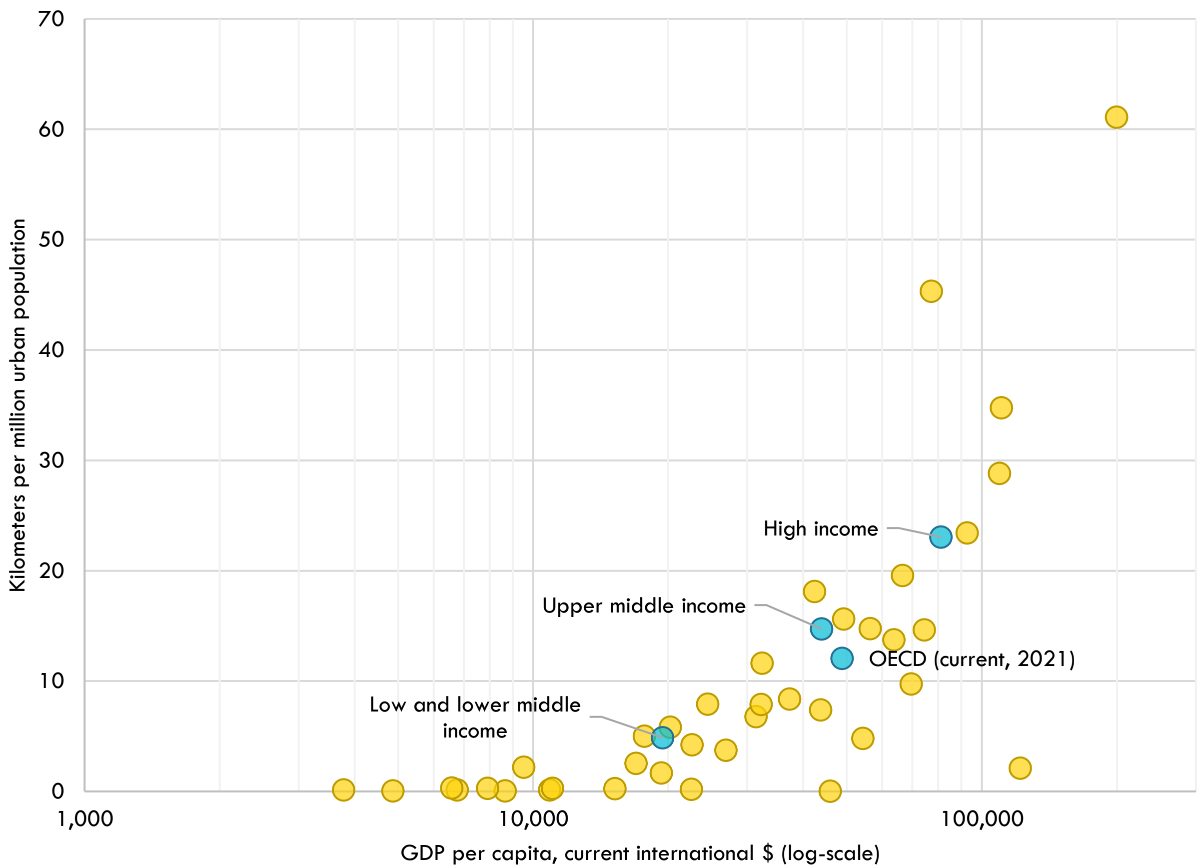

Figure 10. Urban rapid transit infrastructure availability per capita by 2035 (km per million urban population)

Note: All are estimates for 2035 unless specified

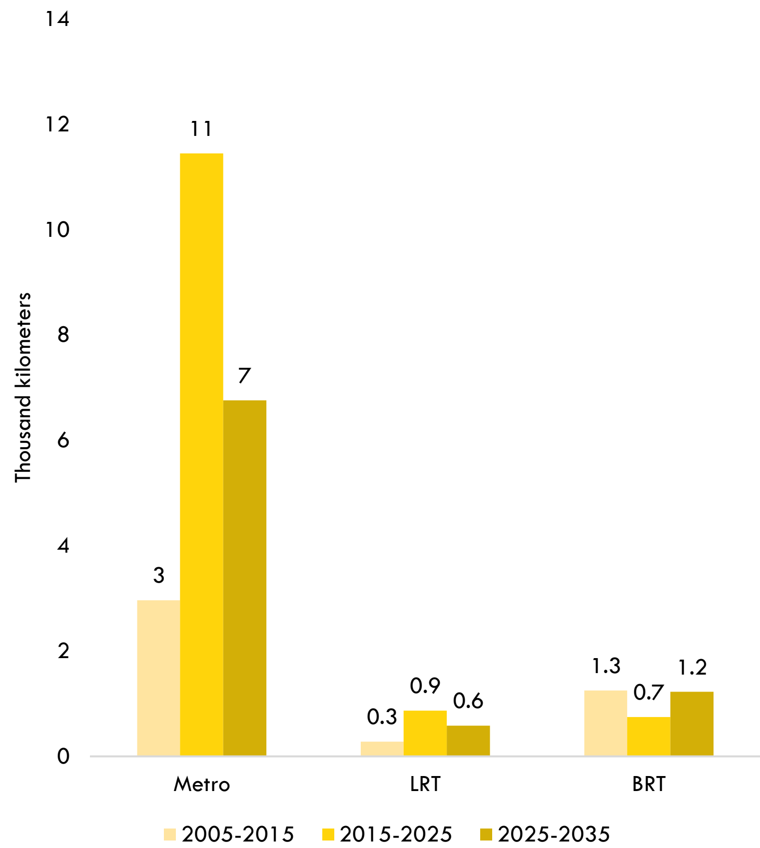

Figure 11. Urban Rapid Transit Kilometers Added (thousand km)

But the headline numbers also mislead. OECD countries reached their current level of urban transit supply at GDP per capita levels far higher (at $32,000 in 2006) than where Asia's LMICs will be by 2035. Upper-middle-income countries will reach current OECD levels as early as 2026 based on the record of rapid transit projects in the pipeline. Meanwhile, low- and lower-middle-income countries would remain below 5 kilometers per million in the urban population by 2035.

That comparison matters. **It means Asia's lower-income cities are building rapid transit at income levels far below those at which comparable systems were constructed elsewhere. The technology is being deployed earlier in the development cycle.**

Thus, **Asia is catching up, but it is running fast to stay behind**. The Asia-Pacific region includes nearly 3,300 urban centers with populations over 100,000. Currently, rapid transit covers only a small part of these cities. By 2035, despite expected growth, this coverage will only increase slightly in LMIC cities. Given this slow rate of development, rapid transit projects will have only a limited impact on closing Asia's urban access gap of 1.4 billion people (ATO 2025a). The limited impact of rapid transit expansion on the per-capita access gap does not diminish the importance of investing in metro, LRT, or BRT. It highlights the need to treat rapid transit as part of a broader accessibility strategy. Kilometers of metro, LRT, and BRT lines are only one part of the accessibility equation.

Asia's lower-income cities are building rapid transit at income levels far below those at which comparable systems were constructed elsewhere

7. Port Expansion in Asia and the Pacific

Maritime trade is central to Asia's economic identity. In 2023, Asian LMICs processed nearly 50% of the world's maritime cargo. The region accounts for half of the world's port capacity and handles two-thirds of container traffic. Eight of the ten most-connected ports globally are located here. Future trade projections suggest global freight demand could grow between three and seven times by 2050, with a wide range reflecting uncertainties about income growth, trade liberalization, and energy shifts.

So what is the outlook for ports in LMICs by 2035?

Port infrastructure projections are inherently complex, and they depend on the volume and composition of future trade, evolving handling technologies, and adjustments for sea-level rise. For this study, the ATO draws on projections by Hanson and Nicholls (2020), which model port expansion under different climate policy scenarios. Their projections rest on four core assumptions: trade expansion requires additional port area; climate policy shapes both the volume and mix of traded commodities; cargo type and handling techniques determine the physical footprint of port operations; and sea-level rise can be offset by raising existing port areas. For simplicity, we consider the average of the 2- and 4-degree middle-road scenarios.

The total port area in the Asian LMICs is expected to increase from roughly **580 sq km in 2025 to 720 sq km by 2035**, representing about 24% growth. This outpaces the growth rates of Asian high-income economies, Europe, and North America, which are projected to grow by approximately 17%, 14%, and 20%, respectively, during the same period. On average, LMICs currently provide only 132 square meters of port infrastructure per thousand people, which is a fifth of the OECD average (640 sqm per thousand). By 2035, it is predicted to have 156 square meters of port infrastructure per thousand people.

The projected port expansion is not uniform. The distribution reflects both investment capacity and the concentration of commercial port activity. LMICs in East Asia will account for the largest share of the regional port area by 2035 — approximately 344 sq km. Southeast Asian LMICs follow, at around 198 sq km. Upper-middle-income economies are estimated to account for 72% of the infrastructure expansion in Asia. Low and lower-middle-income economies will make up 28%. For low- and lower-middle-income economies, with already high logistics costs, improvements in port efficiency are especially consequential for trade competitiveness, given the new policy thrust toward industrial policies in many countries.

8. Airport Expansion in Asia and the Pacific

Domestic air travel in Asia is a growth story. Air travel demand shifts with income, urban growth, and critically, competition from railways. In the Asia-Pacific region, high-speed rail has already reshaped several medium-distance corridors that once belonged to airlines. Thus, no other mode of transport presents a forecasting challenge, quite like aviation. The projections here use aerodrome area as the measure of infrastructure stock, modeled against GDP, total population, and urban population as predictors (Nirandjan et al. 2022).

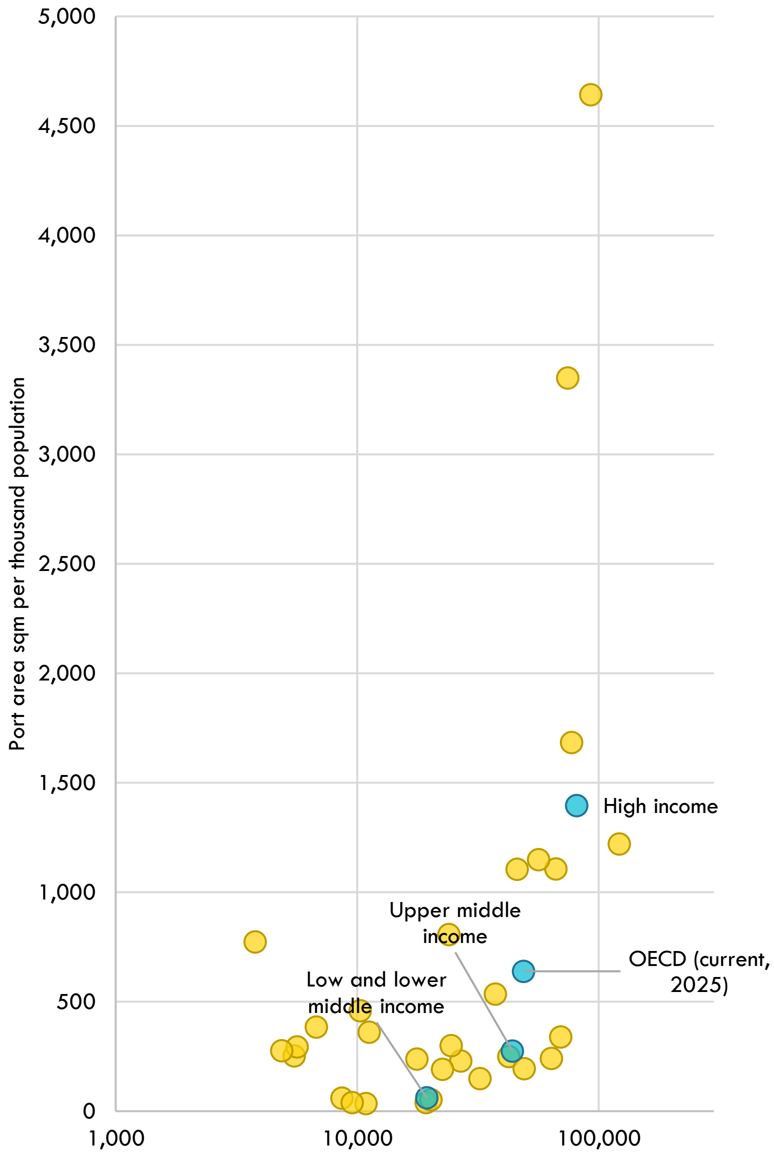

Figure 12. Port Area Availability Estimates in 2035 (m2 per thousand population)

Note: All are estimates for 2035 unless specified

The results indicate massive growth. Total aerodrome area in Asian LMICs is expected to grow from 7 thousand sq km in 2025 to 17 thousand sq km by 2035. That is a 144% increase in a decade. **No other transport mode in the region comes close to this rate of physical expansion.**

Even with this rate of expansion, LMIC Asia will not close the gap with high-income economies by 2035. The aerodrome area per million population in LMIC economies is projected to increase from 1.7 square kilometers in 2025 to 3.9 square kilometers by 2035. OECD economies currently sit at roughly twice that level. Current Asian high-income economies are at about 1.6 times.

The growth is highly uneven. Two countries drive the story. India is projected to expand its aerodrome area by 208% over this period. The People's Republic of China, despite already operating one of the world's largest airport networks, is on a trajectory of 161% growth. Together, they account for 71% of aerodrome area expansion in LMICs.

In LMIC small island developing states, where aviation is a lifeline, the aerodrome area is expected to rise by 13% between 2025 and 2035. In contrast, landlocked economies, where geography to some extent constrains demand, have moderate GDP growth. In these countries, railways play a very important role. The aerodrome area is expected to rise by just 20% between 2025 and 2035.

Among all modes, growth in airport infrastructure is the most intense. Is the growth realistic?

Our airport expansion projections are conservative when considering industry demand forecasts. Airbus predicts that aviation trips in Asian LMICs could double from 0.6 per capita per year in 2024 to 1.2 per capita per year by 2034, fueled by rising per-capita incomes, growing urban populations, and a still-untapped aviation market. The projections in this report may therefore be conservative.

Even with this rate of expansion, LMIC Asia will not close the gap with high-income economies by 2035. The aerodrome area per million population in LMIC economies is projected to increase from 1.7 square kilometers in 2025 to 3.9 square kilometers by 2035. OECD economies currently sit at roughly twice that level. Current Asian high-income economies are at about 1.6 times.

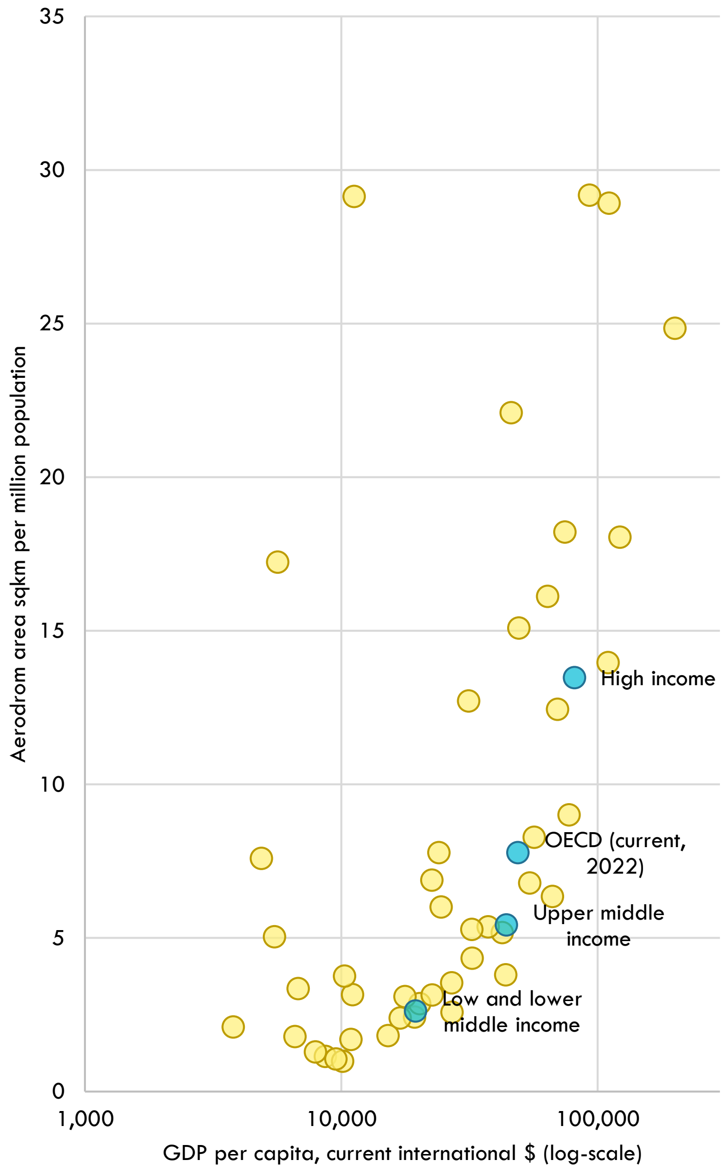

Figure 13. Aerodrome Area Availability Estimates in 2035 (km2 per thousand population)

Note: All are estimates for 2035 unless specified

The growth is highly uneven. Two countries drive the story. India is projected to expand its aerodrome area by 208% over this period. The People's Republic of China, despite already operating one of the world's largest airport networks, is on a trajectory of 161% growth. Together, they account for 71% of aerodrome area expansion in LMICs.

In LMIC small island developing states, where aviation is a lifeline, the aerodrome area is expected to rise by 13% between 2025 and 2035. In contrast, landlocked economies, where geography to some extent constrains demand, have moderate GDP growth. In these countries, railways play a very important role. The aerodrome area is expected to rise by just 20% between 2025 and 2035.

Among all modes, growth in airport infrastructure is the most intense. Is the growth realistic?

Our airport expansion projections are conservative when considering industry demand forecasts. Airbus predicts that aviation trips in Asian LMICs could double from 0.6 per capita per year in 2024 to 1.2 per capita per year by 2034, fueled by rising per-capita incomes, growing urban populations, and a still-untapped aviation market. The projections in this report may therefore be conservative.

Among all modes, growth in airport infrastructure is the most intense.

9. Electric Mobility Infrastructure Needs

The future is electric in Asia. Asia hosts roughly 82% of the world's electric vehicle stock. Nearly 94% of EVs sold across the region are electric two- and three-wheelers. Between 2019 and 2024, the share of EVs in the Asian vehicle trade measured in US$ rose from 4.4% to 16.6%. That is a significant shift.

What are the driving factors?

Three things: current policy and subsidy frameworks, growing infrastructure, and the utility of smaller electric vehicles in dense urban settings with short trip distances.

However, the headline figures mask a wide and growing spread. The People's Republic of China leads in EV adoption, with electric vehicles making up 50% of new car sales. In contrast, India is still in the early stages, with EVs at 2%. Viet Nam and Thailand have entered the "early majority" phase, each surpassing 10% of new sales. Meanwhile, Indonesia, the world's fourth most populous country and a rapidly expanding vehicle market, is at 7%.

In contrast to sales and trade, stock, i.e., vehicles on the road, tells a more conservative figure. Changing the composition of a fleet numbering in the hundreds of millions of vehicles takes time. A long vehicle life creates powerful inertia. Currently, only a handful of Asian LMICs have crossed the 5% EV stock threshold. Thus, the main question for policymakers is how many electric vehicles could be on the road by 2035 and what kind of charging infrastructure is needed?

Our quantifications reveal that the number of electric vehicles on the road in LMICs in Asia could increase from **144 million to 689 million by 2035**. This is an increase in the share of EVs in total vehicles from **10% to 37%**.

Based on published national EV targets across Asia-Pacific LMICs, we estimate that approximately 500 million additional charging points will be required between 2025 and 2035 to support projected vehicle electrification. This count includes private chargers, workplace chargers, public slow chargers, public fast chargers for LDVs and buses, and only public chargers for two- and three-wheelers.

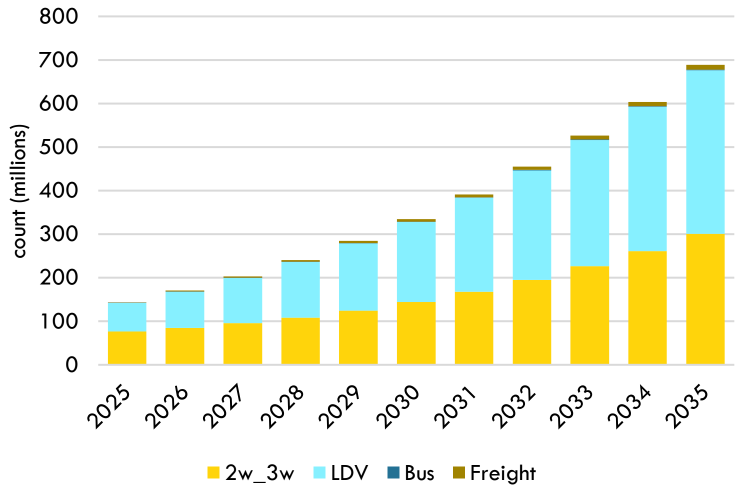

Figure 14. Estimated EV Stock by 2035 (million vehicles)

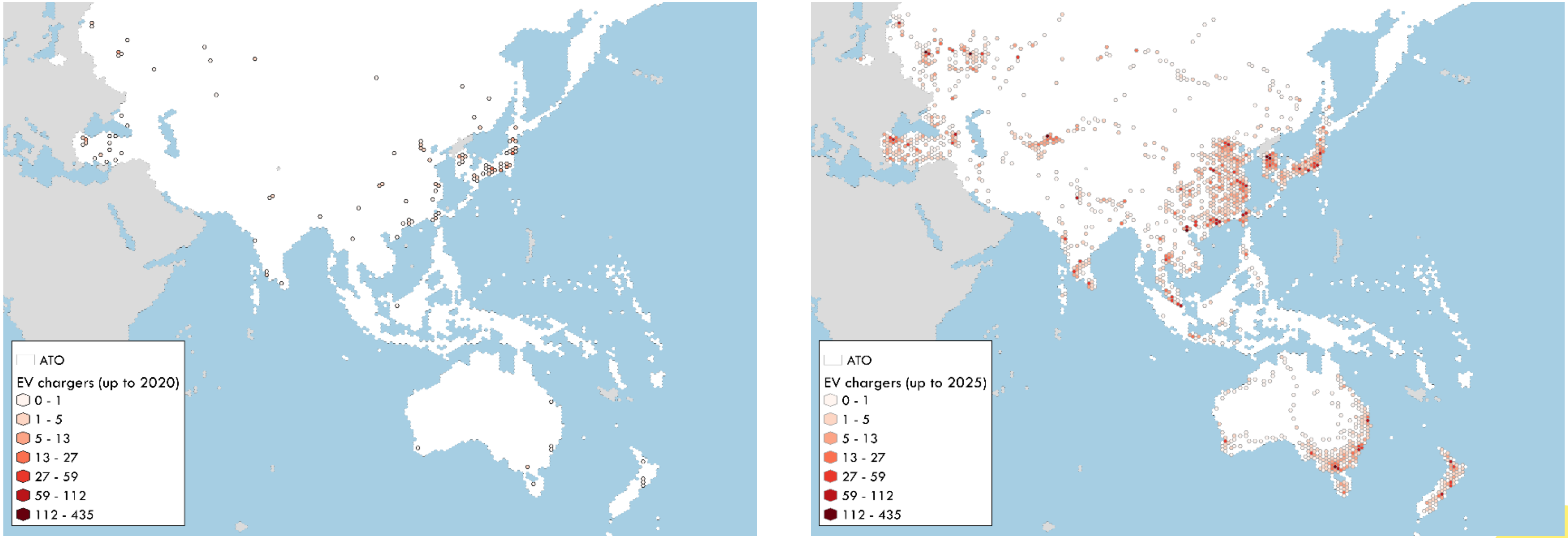

Figure 15. EV Charging Facilities Source: OSM Contributors (2025)

One trend in the electrification story that warrants attention is railway electrification in Asia, which serves as a cautionary example. While the share of electrified rail track has risen from 42% in 2010 to 66% in 2024, the emissions-reduction benefit has largely been muted because electricity grids in countries with high-density electric railways remain coal-intensive. EV adoption paired with coal-intensive grids produces smaller climate benefits than the vehicle deployment figures alone imply.

Our computations fill an important gap. Currently, no publicly available regional estimates capture the costs of electric mobility infrastructure in LMICs.

The future is electric in Asia. Asia hosts roughly 82% of the world's electric vehicle stock. Nearly 94% of EVs sold across the region are electric two- and three-wheelers.

Transport Investment Outlook

How much and for what? - These are the questions that investment officers often face. This section provides the numbers, disaggregated by mode, sub-region, and expenditure type.

Once infrastructure demand is known, translating it into investment requirements requires unit-cost multipliers. The ATO cost database provides income-group-specific multipliers for construction and maintenance costs across all eight sub-sectors, adjusted for inflation. These multipliers are calibrated using international benchmarks and validated with actual project data. It is important to note that the numbers in the report represent estimated demand, not guaranteed delivery. The difference between what is needed and what gets financed is where policy success ultimately lives.

Table 1. Unit cost multipliers by infrastructure type, including construction and maintenance

Mode	Type		ADB-2017	IEA-2013	AIIB-2018	Fisch-Romito et al. (2019)	ATO-2022 (PPP) Million $/km, assumed			ATO-2025 Million $ constant 2015/km, assumed		
							High Income	Middle Income	Low Income	High income	Upper middle income	Low and lower middle income
Road	Construction	Primary	0.6 Million $/km	1.2 Million$/lane-km	1.7 M$/km	1.1 Million$/lane-km	2.6	1	0.5	2-10	1-8	1-7
		Secondary								0.6-3	0.7-2	0.4-2.5
		Tertiary								0.1-0.6	0.2-0.6	0.08-0.6
	Annual maintenance (as % of construction)			2.50%		0.75%	1.00%	0.30%	0.10%	0.5%-1.6%	0.3%-1.0%	0.2%-1.0%
Heavy Rail	Construction		3.8 Million $/km	4.5 Million/track-km	9 M$/km	4.5 Million/track-km	20	12	6	14-22	2-12	3-10
	Annual maintenance (as % of construction)			1%			2.00%	1.00%	1.00%	0.5%-1.4%	0.2%-0.9%	0.3%-0.8%
HSR	Construction			24 Million $/track-km	50.5 M$/km	24 Million $/track-km	100	40	35	18-36	20-25	15-30
	Annual maintenance (as % of construction)			0.40%		0.40%	1.00%	1.00%	1.00%	1.0%-1.4%	1.0%-1.1%	1.0%-1.0%
Metro	Construction						250	150	100	140-160	90-120	60-90
	Annual maintenance (as % of construction)						1.00%	1.00%	1.00%	0.8%-1.4%	1.0%-1.1%	1.0%
LRT	Construction						100	75	50	100	50	35
	Annual maintenance (as % of construction)						1.00%	1.00%	1.00%	1.0%-1.4%	1.0%	1.0%
BRT	Construction			9 million per trunk-km		7 million per trunk-km	30	15	10	50	13	8
	Annual maintenance (as % of construction)			3%		1%	2.00%	1.50%	1.50%	2.0%	1.5%	1.5%
EV Chargers	Construction										0.06[1]	6[6]
	Annual maintenance (as % of construction)										5%	5%

[1] 2025 current million $

1. How Much Will Asia Invest Overall?

Annual infrastructure investment demand will rise steadily in LMICs. **From an average of US$800 billion per year in the 2000–2025 period, total investment needs to rise to about US$2.6 trillion per year for 2025-2035.**[2] This tripling is mainly driven by economic growth. From 2025 to 2035, required infrastructure investment is about 2.3% of GDP. In the last 25 years, it averaged 2.1% of GDP.

Road construction will represent 44% of total transport investment between 2025 and 2035 — approximately 1% of GDP per year. This reflects the continued expansion of vehicle fleets and the persistent demand for access and connectivity in developing Asia. The remaining investment breaks down as follows:

Table 2. Transport infrastructure investment demand

Mode / Category	Share	Annual (US$ bn)	Approx. % GDP
Road Construction	44%	~1,140	~1.0%
Road Maintenance	17%	~400	~0.4%
Road Safety	2%	~65	~0.05%
Electric Mobility Infrastructure	4%	~120	~0.1%
Heavy Railways	9%	~230	~0.2%
High-Speed Rail	7%	~180	~0.16%
Urban Rapid Transit	9%	~230	~0.2%
Ports	3%	~70	~0.06%
Airports	5%	~140	~0.12%
TOTAL	100%	~2,600	~2.3%

[2] The electric mobility infrastructure, port, airport and the road safety requirements estimates are only present for the projections and not accounted for in the 2000-2020/2025 period.

Infrastructure spending patterns are slow to change. Policy commitments, procurement cycles, and long asset lives lock in investments long before any policy shift reaches the ground. However, despite the inertia, we notice a slow shift in investment patterns over time. For example, urban metro investment shows a clear shift over time. Its share of total transport spending rose from 5% between 2000 and 2015 to 13% between 2015 and 2025, before easing to 8% between 2025 and 2035. Implementation of the Sustainable Development Goals and the Paris Agreement has shifted focus towards railways, including urban rail transit and HSR. That is a meaningful shift, even if modest in scale, i.e., from 23% in 2000 to 2015, to 33% over 2015 to 2025, and to 24% between 2025 and 2035.

Airport infrastructure estimates and corresponding investment projections begin only in 2022. Nevertheless, the cumulative investment required increases from 620 billion between 2025-2030 to almost 1 trillion between 2030-2035. Similar to port infrastructure estimates that only began in 2020, the investment increases from 300 billion to 520 billion over the same period.

LMICs continue to invest in rail systems, but the pace of growth has slowed considerably, and momentum varies across asset types. From 2015 to 2025, Asia's LMICs invested a total of 5 trillion in rail development, and this is projected to increase to 7 trillion by 2025-2035. During 2015-2025, investment in High-Speed Rail (HSR) and urban rail systems surpassed that in heavy rail, reflecting regional priorities. By 2025-2035, investment in heavy rail will pick up, aligning with urban rail investment levels.

Within LMICs, the investment needs of landlocked and SIDS countries vary. The subregional investment split by asset class illustrates structural differences across Asia. Central and West Asia is expected to invest half in roads, but a significant share will be allocated to rail infrastructure (12% each for heavy railways and HSR), the highest among subregions. A quarter of the Pacific region's investment will flow into port infrastructure development. Among the subregions, South Asia has the highest share of metro infrastructure investment. Southeast Asia's portfolio shows it will invest $2 on high-speed rail for every $1 investment on heavy rail.

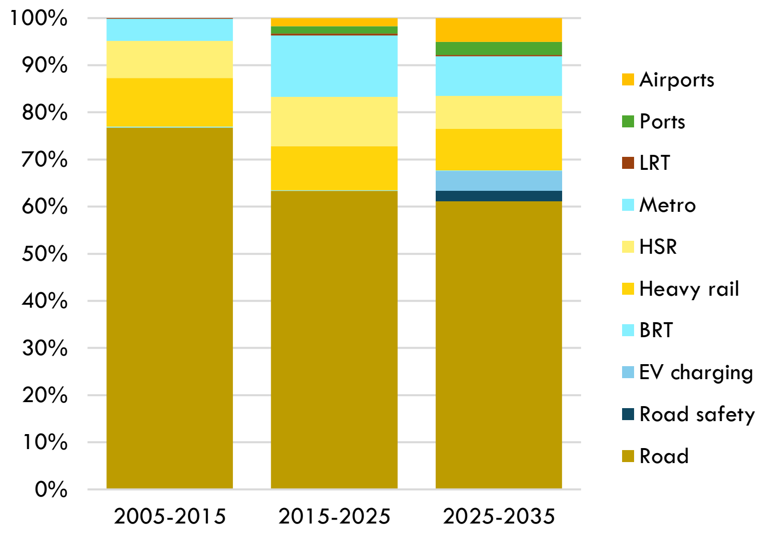

Figure 16. Transport infrastructure investment, share by mode (%)

Note: EV charging and road safety increment is only considered for 2026-2035. Port estimates start from 2020. Airport estimates start from 2022

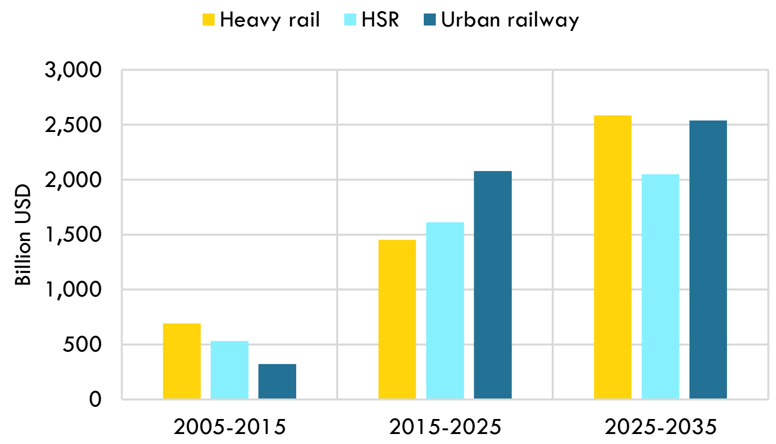

Figure 17. Heavy rail vs. metro infrastructure investment in LMIC (billion USD)

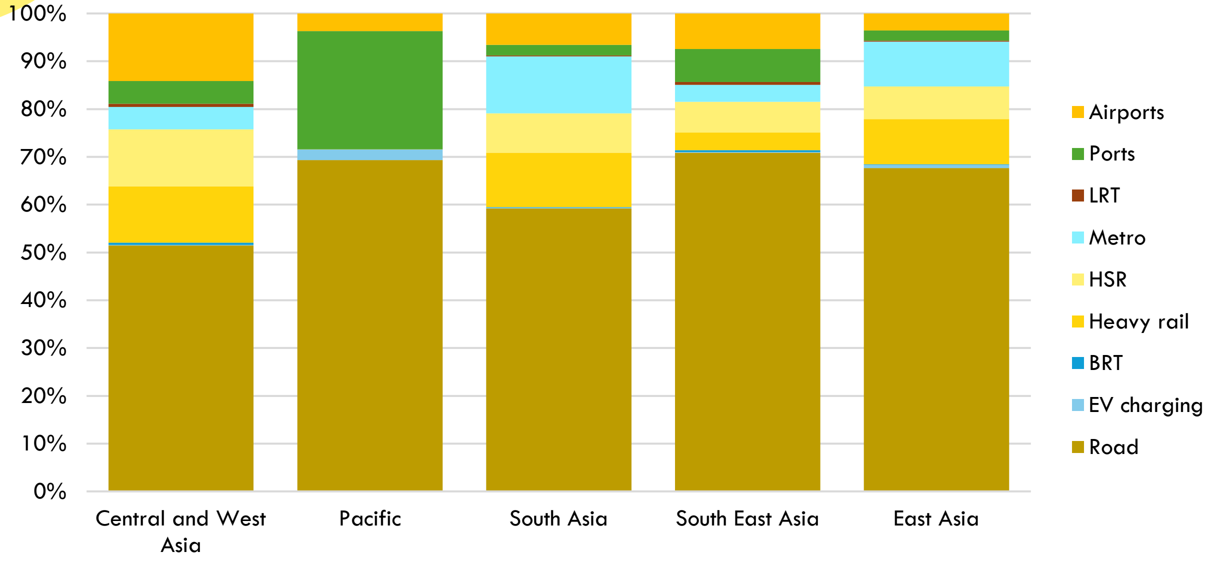

Figure 18. Transport infrastructure investment in LMIC per subregion between 2025 to 2035 (%)

2. The Maintenance Deficit

Across LMICs, maintenance spending is projected to account for approximately 24% of total transport investment between 2025 and 2035. The modal variation is significant. Heavy rail carries the highest maintenance share — 31% of sub-sector investment. Road maintenance, by contrast, accounts for only about 23% of total road investment. We assume electric charging infrastructure maintenance accounts for 25% of total charging infrastructure investment. Thus, the coming decade is not only a challenge to close the infrastructure gap. It is an asset preservation challenge. Without a major increase in maintenance spending, new investment will expand the network while the quality and reliability of existing assets continue to deteriorate.

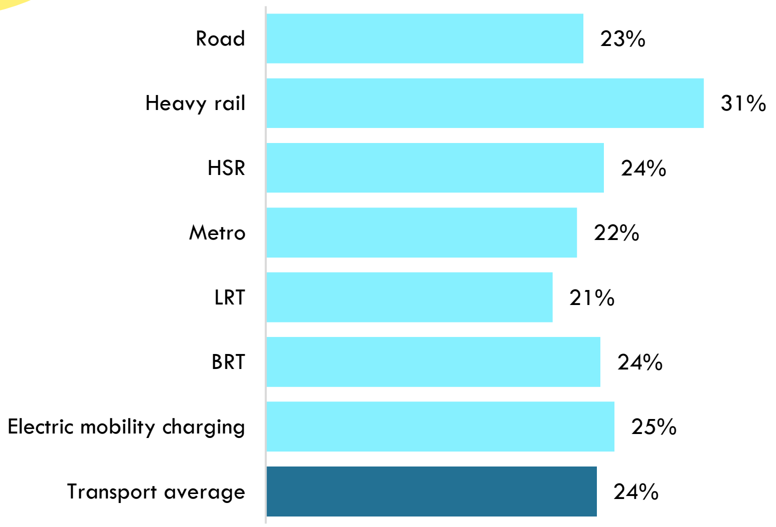

Figure 19. Share of maintenance in total transport infrastructure investment in LMIC, per asset type between 2025-2035 (%)

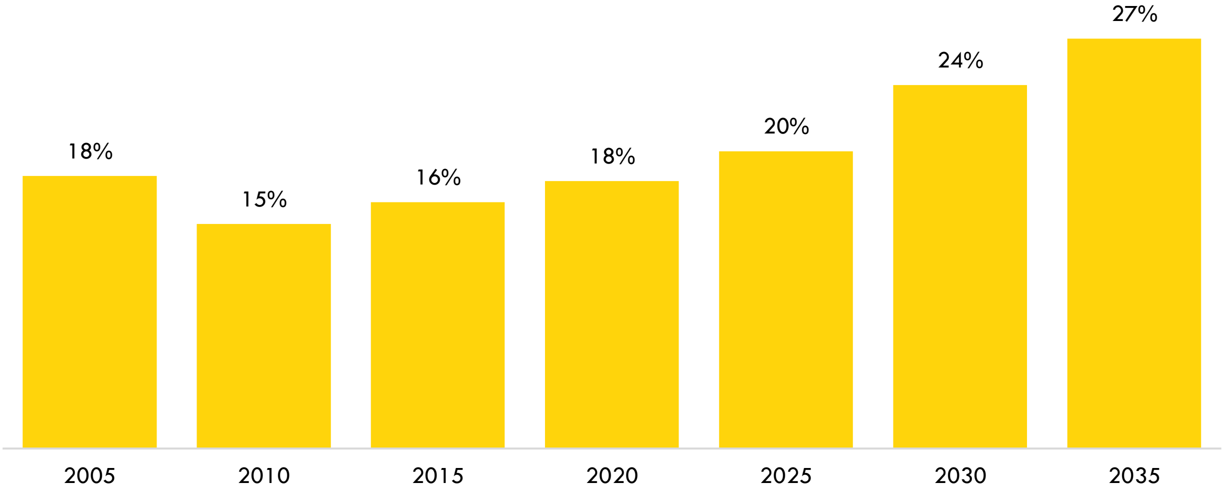

Figure 20. Share of maintenance in total transport infrastructure investment in LMIC (%)

3. Road Safety Investments

iRAP assessments covering roughly 220,000 kilometers of roads in the region show a significant road safety gap. Only 41% of the roads surveyed are rated three stars or higher for vehicle occupants, with lower percentages for more vulnerable users: 26% for motorcyclists, 29% for bicyclists, and just 14% for pedestrians. Each figure remains below the global average for vehicle occupants, motorcyclists, and pedestrians, and is far below OECD levels for vehicle occupants and pedestrians.

The WHO (2023) highlights that road traffic injuries impose substantial macroeconomic costs, estimated at around USD 3.6 trillion worldwide. These costs surpass direct productivity losses, as a World Bank (2017) study suggests that reducing road traffic deaths and injuries by half could generate welfare benefits equivalent to 6–32% of a nation's GDP over 24 years.

In low- and middle-income economies, these impacts are especially significant, totaling approximately USD 1.7 trillion annually—more than 4.8% of GDP in 2021. In Asia alone, the yearly burden is about USD 1.5 trillion, with at least 11 Asian countries facing crash costs above 5% of GDP. In some, such as Afghanistan, Niue, and Thailand, costs reach 7%. These expenses reduce health budgets, diminish household incomes, and hinder the socioeconomic growth expected from transport infrastructure.

Around USD 65 billion per year would be required for road safety components in LMICs in Asia and the Pacific between 2026 and 2035. This is equivalent to about 3% in annual road infrastructure investment needed over the same period.[3] This estimate is broadly consistent with the World Bank's 2022 assessment that around 3% of road infrastructure costs would be needed to reach the SDG target on road safety. Around 70% of the 65 billion per annum requirement is for the infrastructure, while the remainder is for the soft measures.

4. Electric Mobility Transformation

Based on published national EV targets across Asia-Pacific LMICs, we estimate that approximately 500 million additional charging points will be required between 2025 and 2035 to support projected vehicle electrification.

Meeting this demand for charging infrastructure would require approximately $900 billion in cumulative investment over the same period. This corresponds to an annual investment requirement of approximately $90 billion, equivalent to about 0.07% of total LMIC GDP per year.

In addition to these upfront capital requirements, the projected charging network would also entail recurring maintenance costs. From 2025 to 2035, cumulative maintenance costs are estimated at approximately $314 billion, equivalent to an annualized expenditure of about $31 billion. Combined with capital investment, this implies a total annualized infrastructure funding requirement of approximately $121 billion per year to support the transition to electric mobility on roads.

Approximately 500 million additional charging points will be required between 2025 and 2035 to support projected vehicle electrification.

[3] The estimate assumes the retrofitting of 25% of existing roads and the road safety-proofing of all new roads, using per-kilometer cost assumptions based on the FIA Foundation (2025) report. It also includes soft components, such as planning, capacity building, enforcement, data systems, and integrated implementation measures

[4] The estimated 500 million additional charging points refers to the full charging ecosystem, not only public EV charging.

How do our transport infrastructure investment estimates compare to other estimates?

Our projected annual investment need of **US$ 2.6 trillion, or 2.3% of GDP**, aligns with historical estimates by institutions such as the Asian Development Bank (ADB), the Asian Infrastructure Investment Bank (AIIB), the Global Infrastructure Hub (GI Hub), and the UNESCAP.

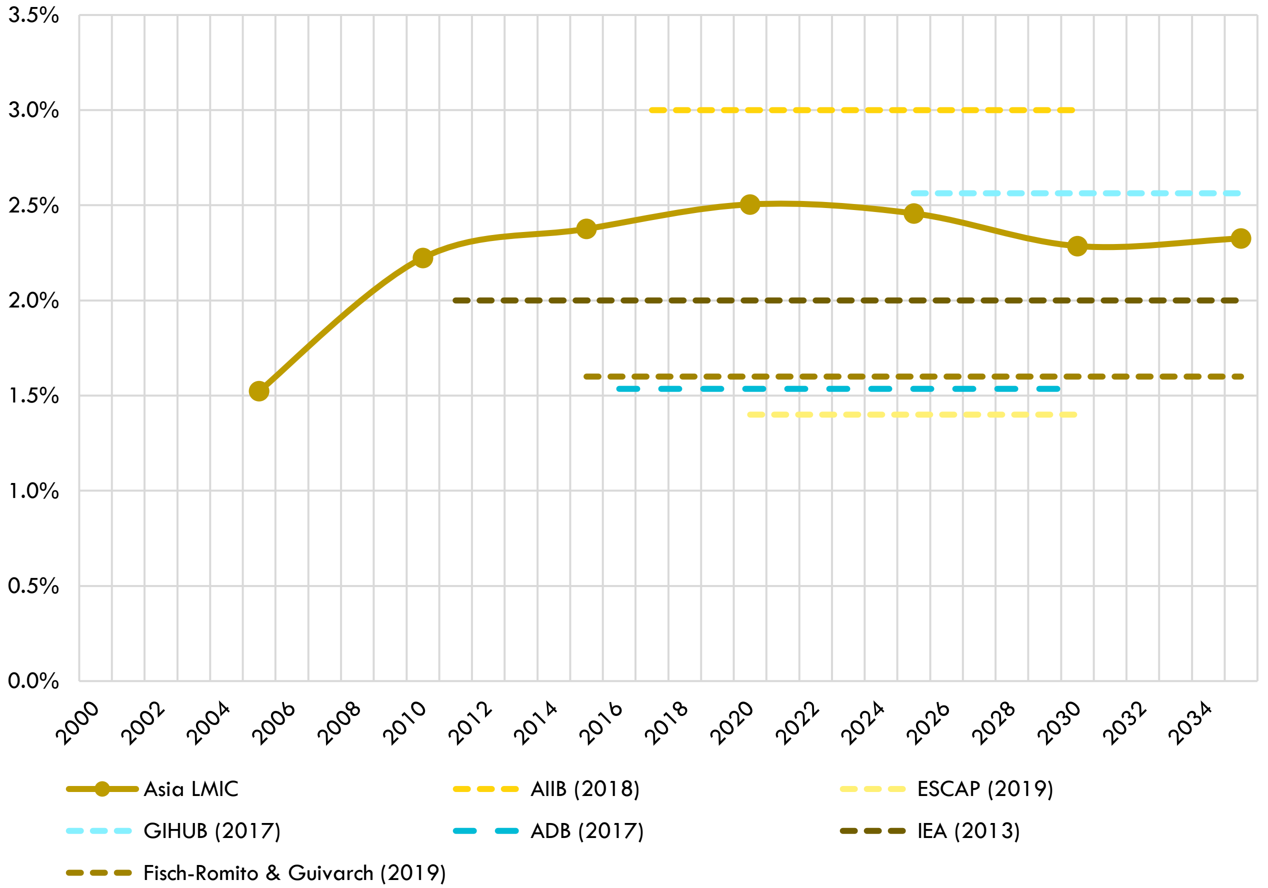

Figure 21. Transport infrastructure investment estimates vs. other estimates (% of GDP)

The G20-commissioned Global Infrastructure Outlook (2017) projected Asia at 54% of global infrastructure investment needs to 2040. McKinsey's 2025 Infrastructure Moment report (Green et al. 2025) places Asia at USD 70 trillion of a global USD 106 trillion total to 2040, with USD 36 trillion of that destined for transport globally. The directional picture is consistent across studies. **Asia is the center of the world's infrastructure investment story.**

Significantly, while absolute investment in transport infrastructure increases, its share of GDP is projected to decline between 2025 and 2035, as GDP growth is expected to outpace infrastructure spending. This trend is reflected in the projected decline in transport infrastructure investment as a share of LMIC GDP from 2.5% between 2015 and 2025 to 2.3% between 2025 and 2035. Sustaining an annual investment rate of 2.3% of GDP is a substantial task. Who will be providing that investment is another complicated question.

Projected annual investment need - US$ 2.6 trillion, or 2.3% of GDP

Where Will the Money Come From?

Annual infrastructure investment demand will rise steadily in LMICs. From an average of US$800 billion per year in the 2000–2025 period, total investment needs to increase to about US$ 2.6 trillion per year for 2025-2035. That is not adequate. The scale of what is needed overshadows what current fiscal systems can deliver. Post-COVID budget pressures have made this worse. Debt levels in many countries have risen sharply. For countries with high debt levels, adding large infrastructure commitments is difficult. The maintenance deficit, which we discussed earlier, illustrates the challenge. For every dollar of investment required, many countries spend 35 cents on maintenance.

Our past findings have also revealed that official development assistance (ODA) and public-private partnerships (PPPs) remain small relative to the investment deficit. However, they are strategic only when targeted and deliberately sequenced, i.e., ODA preparing the ground for innovative projects with high societal benefits, PPPs following where risk has been reduced enough to attract private commitment.

Our analysis reveals that ODA and PPP flows into LMICs are limited and diverging.

Since 2000, official assistance to transport, comprising both ODA and official aid, has grown steadily. Annual commitments swing sharply year to year, so the data is grouped into three periods: 2000–2010, 2010–2020, and post-2020. We notice changes in both volume and direction. The shift in priorities is clear. Roads once dominated. Their share of committed support fell from 58% in 2000–2010 to 46% in 2010–2020, and further to 37% since 2020. Rail moved in the opposite direction, i.e., from 21% to 29% to 41% over the same periods. Railways now receive more official assistance than the road sector. Water and aviation each attracted larger absolute commitments in the later periods as well. Donors are rebalancing away from roads and toward rail and connectivity infrastructure. However, what has not changed is concentration.

Nine economies, i.e., India, the Philippines, Bangladesh, Türkiye, the People's Republic of China, Indonesia, Kazakhstan, Pakistan, and Viet Nam, absorbed 78% of official assistance in 2000–2010. By 2021–2024, their share had risen to 84%. The countries with the deepest infrastructure deficits and with fragile fiscal capacity receive minimal support. Official assistance is growing, but it is also narrowing.

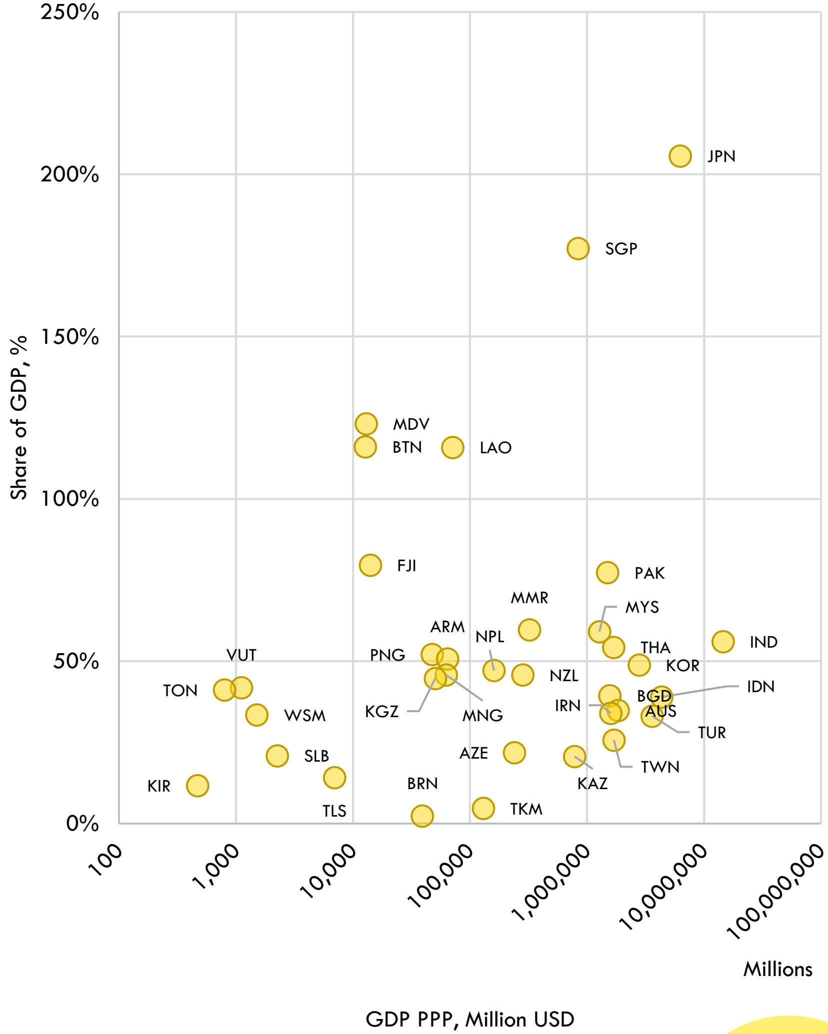

Figure 22. Central government debt in Asia-Pacific countries, as a share of GDP in 2023 (% share of GDP)

In contrast, private investment through PPPs shows a different pattern. After peaking in 2015-2019 at USD 173 billion, transport-related private investments halved to USD 82 billion between 2020-2024. In terms of share, port projects, which accounted for 27% of transport PPP activity from 2000 to 2010, fell to just 5% in 2010-2024. Over the same time periods, roads have absorbed this shift, increasing from 47% to 61% of transport PPP investment in 2010-2024. Rail share also increased from 9% to 16%.

The main issue is governance-related: low-income countries attract the least private capital, with a significant bankability gap that COVID-19 has further widened. Asia's share of global transport PPPs declined from 78% in 2015-2019 to 61% in 2020-2024, even as ODA flows to the region rose from 59% to 65% of the global total during the same periods. These two instruments are moving in opposite directions. ODA and PPP are not interchangeable. They serve different functions.

Investing in a port or an airport in a country with high climate exposure is not the same proposition as it was a decade ago. Flood risk, storm damage, and heat effects change the asset's long-run economics. Climate finance for transport adaptation remains almost entirely absent. Only 0.13% of committed transport climate finance in the Asia-Pacific in 2022 was earmarked for adaptation (ATO 2025c).

Fuel excise duties form a major part of tax revenue in many Asian economies. Allocating a portion of these funds to infrastructure maintenance and development is straightforward, and several LMICs have implemented road funds financed significantly by fuel levies. However, their success varies based on governance, ring-fencing rules, and disbursement discipline. The shift to electric vehicles introduces a new challenge for fuel tax revenues. With an expected 37% of vehicles on LMIC roads to be electric by 2035, fuel tax income will decline. According to the IEA's net zero scenario (IEA 2025), global oil tax revenues may drop sharply during the 2030s. For countries that depend heavily on fuel excise as a primary revenue source, this presents a significant fiscal risk, especially since infrastructure investments are most needed at this time. This underscores the importance of carefully planning funding and financing. User-based charges may form part of the long-term funding mix, particularly where they support asset maintenance, demand management, or the replacement of declining fuel-tax revenues. Transport infrastructure generates wider public benefits which need to be reflected in project appraisal, prioritization, and budget allocation. The case for increased transport funding would ideally rest on multi-criteria appraisal and budget processes that capture public value, not only on narrow financial cost recovery.

Our major finding is that ODA is limited, PPPs are selective, and public budgets are constrained.

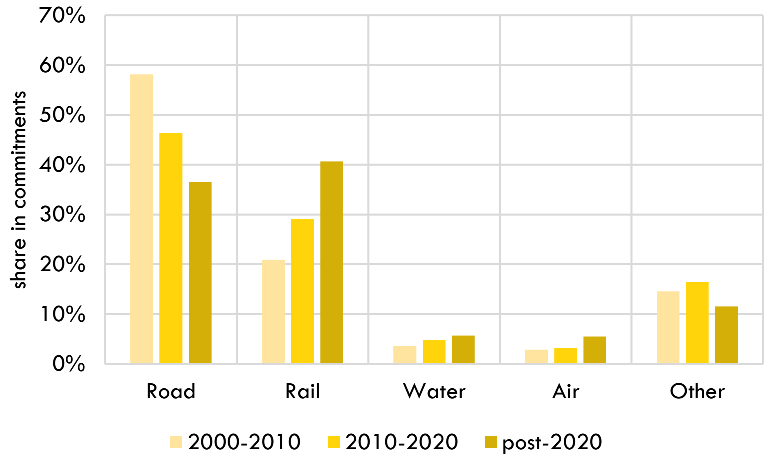

Figure 24. Share in commitments per transport subsector

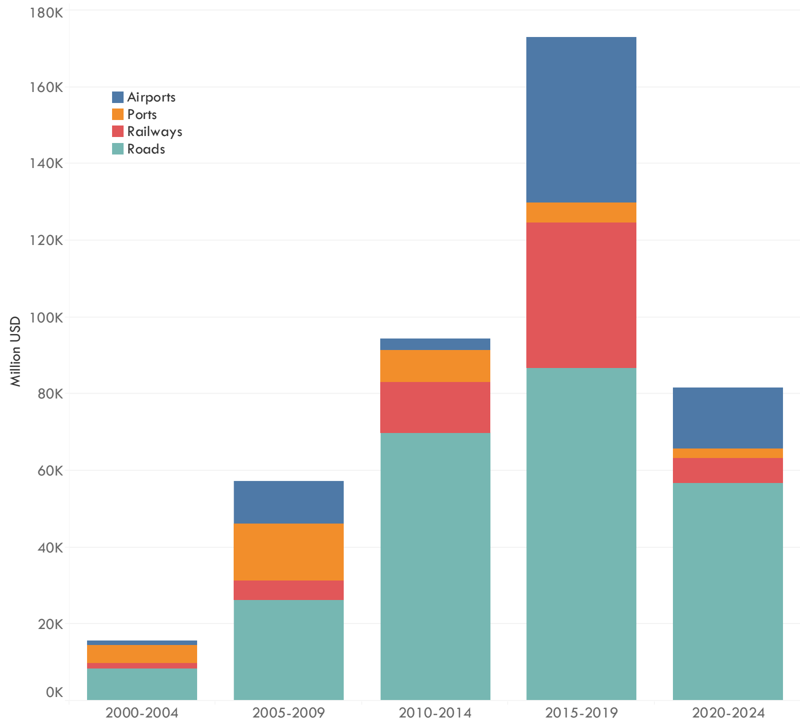

Figure 26. Public-private partnership investments in the transport sector of Asia LMICs

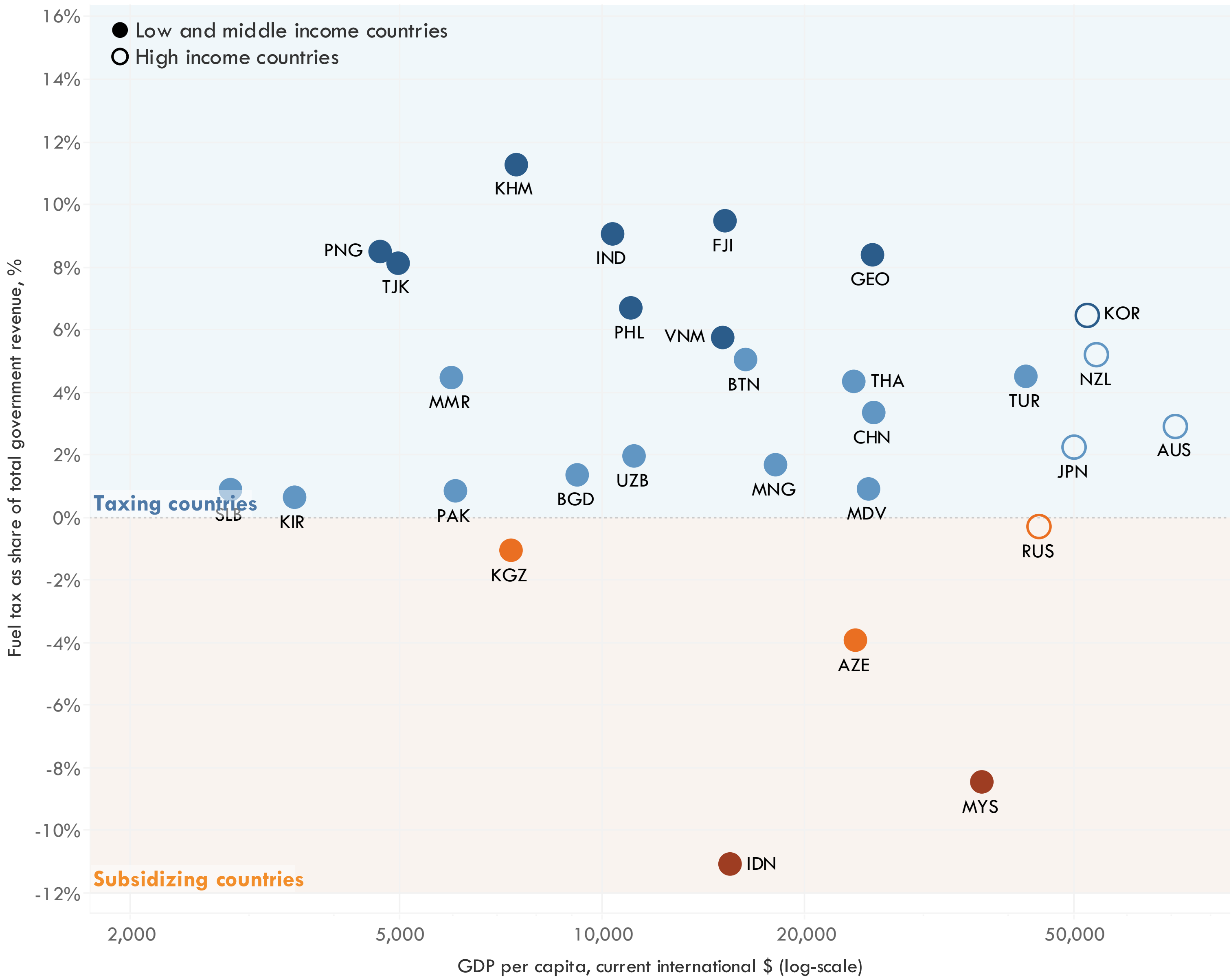

Figure 27. Fuel Tax Revenues as A Percentage of Total Government Revenues

Conclusions

The US$2.6 trillion annual figure in this report is a supply-side projection. It measures the investment demand with existing policies. It does not measure whether that investment produces safe, reliable, affordable, and clean transport for the people who need it. That gap between construction and outcomes is where policy and investment failure live. Five findings are critical.

1. First: **Scale**. Transport investment demand in Asia's LMICs is not just an incremental improvement. It is a structural step-change. Annual investment needs will triple over the next decade. Responding to that requires governance transformation, which requires radical changes in institutional and fiscal frameworks.

2. Second: **Urgency.** The annual external costs of the transport sector in LMICs are above the investments. Deferring investment decisions does not defer costs; it compounds them.

3. Third: **Composition**. Despite a decade of record investment, a significant gap persists in investment levels and infrastructure benchmarks relative to OECD standards across roads, rail, urban transit, ports, and airports. The composition of investment matters as much as the volume. What gets built, where, and for whom matters as much as the aggregate total.

4. Fourth: **Maintenance**. Assets built now need to be in service in 2050. Several LMICs have piloted road funds financed by fuel levies with dedicated ring-fenced rules. Where governance is sound, these mechanisms work. The model needs to be extended to all transport modes, adapted to the EV transition, and applied to all transport infrastructure. Fuel levy revenues will erode precisely as maintenance demands peak.

5. Fifth: **Need**. The current concentration of ODA and PPP flows in a few LMICs is partly a function of risk. Concessional financing is increasingly flowing to areas where it is easy to deploy. Development banks can address this by increasing the use of blended finance and expanding project development facilities in lower-income countries. The costs and benefits of investing in infrastructure are greatest when the infrastructure deficit is at its deepest.

Finally, the investment gap is large. It is also, in part, an opportunity. Development banks can do things commercial investors cannot — blend concessional and market-rate lending, absorb early project risk, and attach technical assistance to pipelines that would otherwise stall at the feasibility stage. They can finance the data systems that enable better decision-making. But there is a limit to what external finance can do. The long-run answer to Asia's transport financing gap is stronger revenue systems and public finance reform. We are not just facing an infrastructure gap, but also an investment and governance gap.

The central question of this report, how much will Asia invest in transport infrastructure over the next decade? — has been answered. The harder question is: will it be enough?

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Technical Notes

Unless specified otherwise, all data in this report originates from the Asian Transport Observatory (ATO) platform. The ATO encompasses 52 Asia-Pacific economies and compiles more than 600 national-level transport indicators from government sources, international agencies, and secondary research.

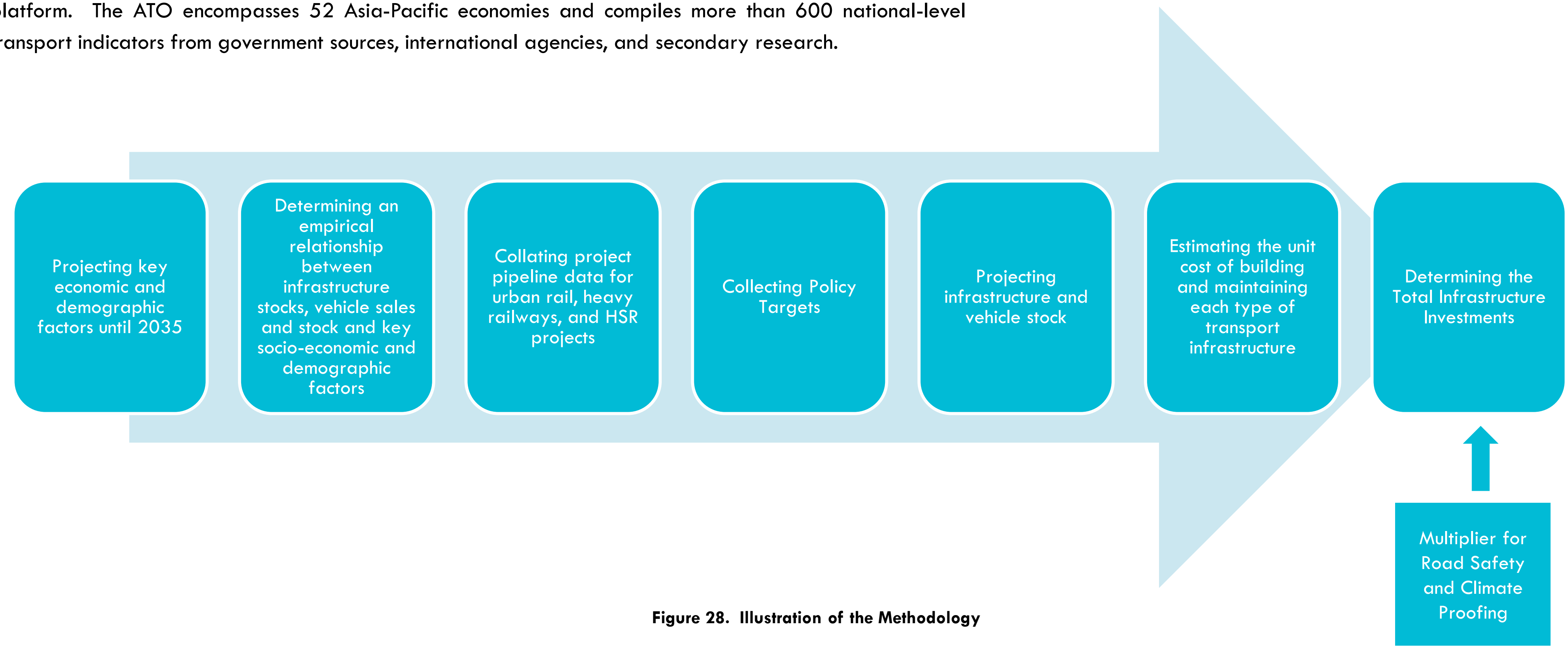

Figure 28. Illustration of the Methodology

Infrastructure projections here draw on socioeconomic trajectories from several authoritative sources: the UN DESA Population Division, the IIASA Shared Socioeconomic Pathways, the IMF World Economic Outlook, the DNV Energy Outlook, the IEA EV Outlook, and the ITF Transport Outlook. Most prior regional studies assumed strong, sometimes unrealistically high, economic growth. This study does not. Growth assumptions are deliberately conservative, grounded in post-COVID realities. Infrastructure forecasts here are, as a result, lower than those in earlier regional work.

Investment projections are developed using a bottom-up approach calibrated with historical ATO time-series data. Models for subsectors such as vehicles, roads, heavy rail, high-speed rail, metro, light rail transit, bus rapid transit, ports, and airports are built separately and then combined.

Roads: For road network expansion, two approaches were considered: extending historical construction rates into the future or deriving relationships between road stock and socioeconomic variables such as per capita income and population density. We tried both global and Asia-specific regression-based approaches. Adding more kilometers at the rate implied by historic construction rates is neither realistic nor desirable. Thus, we used the regression approach with validation from policy targets. A clustered linear regression model was developed, using changes in population density as the explanatory variable to estimate the relative expansion of road density. IRF Data Warehouse and Nirandjan, et al. provides the baseline road infrastructure. The countries' population density was used as a basis for establishing clusters for the models.

Investment needs vary sharply by road type, so disaggregation by road hierarchy is necessary. A compositional regression model was developed with GDP per capita as the independent variable to analyze the relationship between a country's economic status and its road infrastructure distribution. By applying the model to the 2021 dataset, correction factors were calculated for each country and road type, ensuring a consistent hierarchical distribution of road categories between historical and projected. These calculated proportions for each road type were then applied to forecasted total road lengths, resulting in estimates for the lengths of primary, secondary, and tertiary roads.

Railways: Several sketch estimates informed the 2035 outlook for heavy rail: historical network expansion rates, construction rate bounds across country typologies, and an Asian regression of rail network length against GDP. The regression results, though technically coherent, appeared implausible on inspection. Project-level data from the IRJ Pro database were therefore used instead. That database contains roughly 500 conventional rail projects at various implementation stages — under construction, planned, or in long-term planning — along with detailed information on proposed lengths and expected start years. These data were combined with policy targets sourced from the ATO policy database.

High-speed rail projections rest on a different logic. They rely exclusively on published construction plans from the International Union of Railways. No income or density relationships are used. When governments have announced HSR projects with defined timelines, those plans carry more information than any cross-country regression we can do.

Metro and LRT. Two inputs are combined: current metro and LRT network from ITDP and live project pipeline data. The IRJ Pro database underpins this last component — it contains approximately 1,000 metro and LRT projects at various stages of implementation. Using this data, we projected the future length of each urban rail category for every country in the region. Lead times are long. Globally, cities take an average of 10 to 12 years from line approval to first operations. Where information regarding the starting year is not indicated a linear interpolation was applied from 2030 to 2050 to estimate the expected growth of infrastructure.

Urban Bus Rapid Transit projections use a regression of global BRT network length on GDP per capita and urban population density. National policy targets from the ATO policy database are layered on top. Where targets exist, they constrain and inform the regression-based estimates.

Motorization: Vehicle ownership follows a well-documented non-linear income curve. At low per capita incomes, ownership grows slowly. Between roughly USD 3,000 and USD 10,000 per capita, it accelerates, sometimes growing about twice as fast as income. Growth then plateaus as markets approach saturation. Asia, however, diverges from the standard curve. Two- and three-wheelers dominate across much of the region. At roughly one-tenth the cost of a passenger car, two-wheelers respond to income growth faster and at lower income thresholds. Disaggregated vehicle ownership data covering 2000 to 2020 across Asian economies is used to model vehicle-per-capita trajectories separately for each vehicle type.

Electric Vehicles: The EV framework links four dimensions: fleet growth, charging infrastructure expansion, charging infrastructure maintenance, and employment effects. Motorization pathways tied to GDP growth provide the demand. These combine with base-year vehicle stocks, vehicle lifetime parameters, and nationally declared EV targets from the ATO policy database. For economies with neither published EV targets nor observable base-year EV stock, a conservative assumption is that the EV share starts at 0.5% of the vehicle fleet and rises to 5% of annual sales by 2035. Adoption follows logistic diffusion curves calibrated by income group and vehicle type. Charger density assumptions draw on World Bank estimates — expressed as chargers per thousand EVs — differentiated across vehicle categories from two-wheelers to freight trucks.

Maritime Ports: Port infrastructure projections use the climate-scenario analysis by Hanson and Nicholls (2020), which models how different emissions pathways affect the type and volume of future maritime trade for 184 countries. The study was selected for its explicit treatment of climate policy as a structural variable rather than a sensitivity. The estimates already consider climate-proofing in the form of additional cost to increase port elevation in anticipation for sea-level rise. For our analysis, we selected the Middle

Road 2°C and Middle Road 4°C scenarios as the reference scenario of port area expansion and to obtain the unit cost for each country.

Airports: Airport expansion is hard to predict. Travel demand is heterogeneous. Competition from rail — and high-speed rail in particular — complicates the picture in countries where that competition is real. A linear regression model is used here, with global aerodrome area data from Nirandjan et al. (2022) as the response variable with country GDP, total population, and urban population as predictors. Compared to the other assets which used unit cost scaling, airport investment was modelled using a regression grouped by flight activity (i.e. flight per capita). Baseline investment data was based on Global Infrastructure Hub estimates.

Costs and Climate Adjustment: Unit costs come from the ATO cost database, adjusted for income group and inflation. Infrastructure investment estimates include a 7% climate adjustment. This figure is based on (CDRI 2023), which reports that climate hazards cause an average annual loss of about 7% to transport infrastructure. When compared to average regional transport investment from 2000 to 2020, the loss is also about 7%. ADB's projections for 2016 to 2030 show a similar pattern: USD 520 billion per year for transport, plus another USD 37 billion for adaptation (ADB 2017), which is again close to 7% of the baseline. The 7% figure is a cautious, lower-end estimate. It only covers the direct costs of replacing and repairing damaged assets. Indirect losses and wider disruptions from climate events are not included and have not been considered.

Road Safety: The cost estimates for improving road safety assumes that 25% of the existing road network would be retrofitted with road safety improvements, while additional roads would be road safety-proofed. The said infrastructure costs are estimated on a per-kilometer basis, differentiated by country income classification, using cost benchmarks from Symons and Sweeney (2021). The estimate also includes the integrated implementation of soft measures, such as planning, enforcement, institutional strengthening, awareness, and monitoring activities. These soft-measure costs are estimated using GDP-based multipliers from Chisholm et al. (2012) and Chisholm and Naci (2008), as cited in from Symons and Sweeney (2021).

Scope and Limitations: Individual models cover each subsector. In some cases, all countries are pooled in a single regression. In others, separate models are built by income group, by transport activity, or by geographic configuration (e.g. landlocked), where data quality and country heterogeneity warrant it. Around 2,300 existing projects are included in the analysis, alongside two decades of historical data. Policy targets from the ATO policy database are included wherever they exist and are credible. One limitation is worth highlighting. This study treats socioeconomic growth as the primary driver of infrastructure demand. Infrastructure can also drive growth. The causation runs both ways.