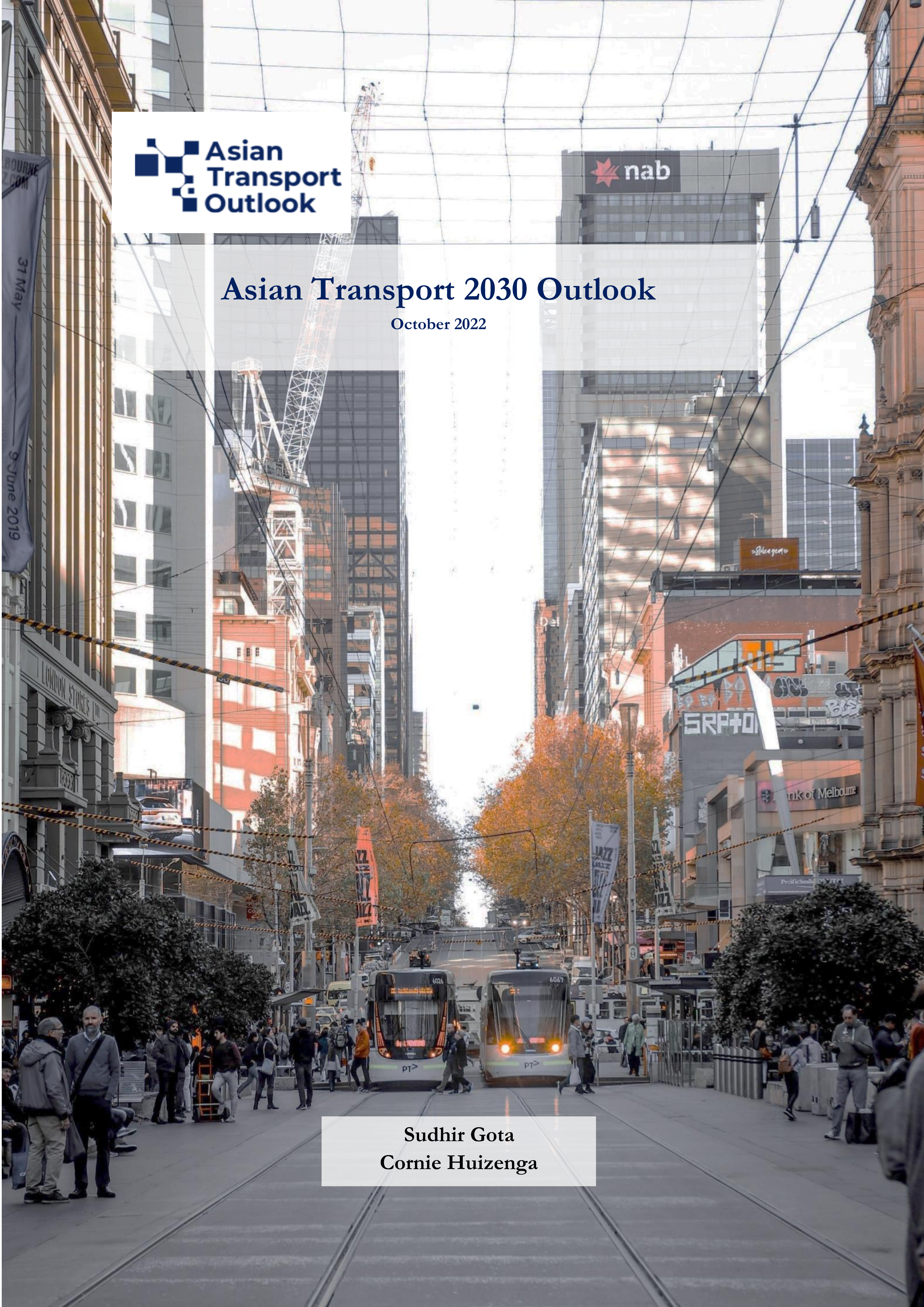
Asian Transport Outlook

Asian Transport 2030 Outlook

October 2022



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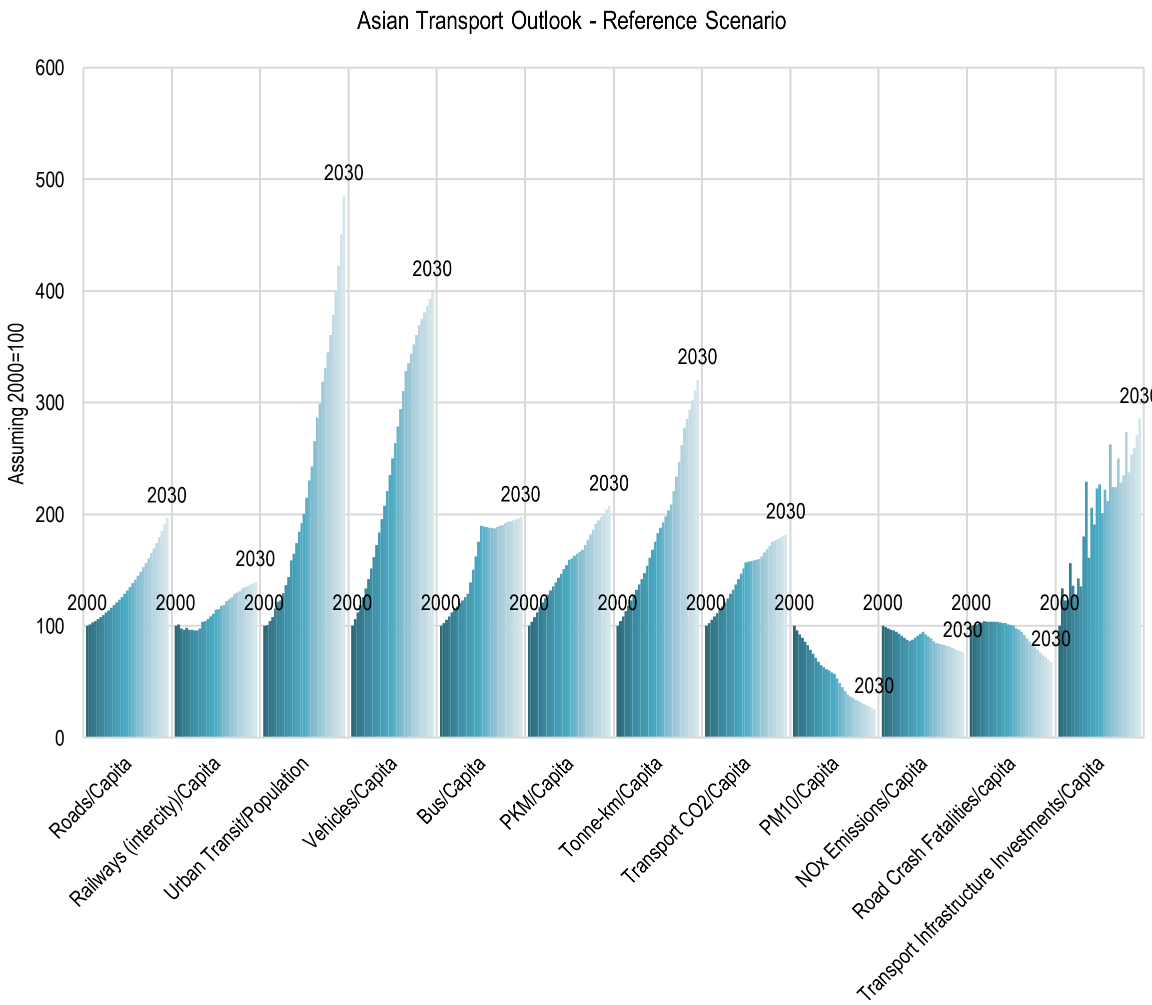
List of Abbreviations

ADB	Asian Development Bank
AIIB	Light Commercial Vehicles
ASIF	A (activity), I (energy intensity) F (Fuel/carbon intensity), and modal shares (S)
ATO	Asian Transport Outlook
BC	Black Carbon
BRT	Bus Rapid Transit
CO2	Carbon Dioxide
COVID	Corona Virus Disease
ForFITS	For Future Inland Transport Systems
GDP	Gross Domestic Product
Gt	Gigatonne
HHDT	Heavy heavy-duty trucks
HSR	High Speed Rail
ICCT	International Council on Clean Transportation
IEA	International Energy Agency
ITDP	Institute of Transportation and Development Policy
ITF	International Transport Forum
km	kilometre
LCV	Light Commercial Vehicles
LDV	Light Duty Vehicles
LHDT	Light heavy-duty trucks
LRT	Light Rail Transit
MHDT	Medium heavy-duty trucks
NOx	Nitrogen Oxides
PM	Particulate Matter
PPP	Purchasing Power Parity
RAI	Rural Access Index
SafeFITS	Safe Future Inland Transport Systems
SDGs	Sustainable Development Goals
SND	Sharable National Database
SOx	Sulphur Oxides
TRL	Transport Research Laboratory
UIC	International Union of Railways
UN	United Nations
UNECE	United Nations Economic Commission for Europe
USD	US Dollars
WHO	World Health Organisation

Executive Summary

The ATO 2030 Outlook is a reference scenario that extrapolates historical development trends into the future. It uses the 2030 timeline to cover all modes of domestic transport and 51 economies in the Asia Pacific region. The Figure below summarizes the projections developed as part of the 2030 outlook. We project that transport infrastructure, as well as passenger and freight activity will continue to grow (infrastructure by 40%, passenger activity by 30%, freight activity by 60% from 2020 to 2030). At the same time, while transport activity will increase considerably, air pollution associated with transport and road safety will decrease in absolute terms and improve relative to 2000 (decrease in PM emissions by 30%, road crash fatality by 20% from 2020 to 2030). This does however not apply to CO2 emissions from transport (increase by 20% over 2020 to 2030). Overall these will continue to grow and in our reference scenario it is not expected that these will peak before 2030.

Overall the trends indicate that the transport sector will continue to grow. However, the relative size and performance of the sector will still need to catch up to the global north. While the negative impacts of air pollution and road crashes will decrease, it is not likely that related SDG targets will be met. Although CO2 emissions from transport continue to grow, the intensity of growth is expected to decrease.



CO2 = Carbon dioxide; NOx = Nitrogen oxide; PKM = Passenger kilometer; PM = Particulate Matter; Tonne-km = Tonne kilometer

Source : Authors

Asiag keeps building more roads and is doing so at a faster pace. We estimate that total road kilometres could increase from 21 million kilometres in 2020 to 29 million kilometres by 2030, an increase of 8 million kilometres.

Asia's road infrastructure still falls behind the developed world. By 2030, Asian countries are projected to have lower road infrastructure per capita when compared with other global regions, except Africa.

Heavy railway construction is slowing down. We estimate that between 2020 to 2030, Asian economies could potentially add 78,000 kilometres to the conventional railway network. However, this increase is significantly lower than the 91000 km increase realised from 2010 to 2020.

High-speed railways construction diversifies regionally. Based on existing construction plans, we estimate that by 2030, Asia could have a high-speed rail network length of 70,000 km, i.e., an increase of about 28,000 kilometres from 2020 to 2030. This means that about 25% of all railway expansion in Asia would consist of high-speed rail.

Metro expansions are set to intensify and dominates improvements in access to urban transit. Based on the metro and light rail projects under planning and construction, we predict that Asia could build about 158,000 and 13,000 kilometres of metro and LRT, respectively, from 2020 to 2030. This new construction over the next decade is the same as Asia's constructed over the last two decades.

No rail renaissance in Asia. If we compare total rail length per capita, Asia's rail access in 2030 could be 137 meters per thousand residents, up from 120 meters in 2020. In comparison, current railway infrastructure access in Europe and Northern America is about 480 meters per thousand residents.

Two-and-three wheelers continue to dominate the vehicle fleet. Between 2000 and 2020, the total vehicle ownership in Asia increased by about 1 billion vehicles. We estimate that with current trends, vehicle ownership levels could grow from 1.2 billion in 2020 to 1.6 billion in 2030. The most significant growth is in the two and three-wheelers segment. Currently, two and three-wheelers constitute about half of the total vehicle fleet and will remain so in the next decade.

Asia has not hit "peak motorisation". We project that Asia has not reached 'peak motorisation'. Our analysis suggests that the stagnant vehicle sales in Asia over the last five years will only be a temporary blip. Asia is set to motorise, albeit at a slower pace. However, the growth in vehicle ownership is expected to outpace the increase in the Asian population.

Travel demand is growing but slower, with freight transport dominating growth. Domestic passenger transport in Asia is expected to grow from 16 trillion passenger kilometres in 2018 to around 22 trillion in 2030. Domestic freight transport is expected to grow more than domestic passenger transport, from about 22 trillion freight kilometres in 2018 to about 36 trillion passenger kilometres in 2030.

Public transport and rail continue to lose out to road-based private vehicles. There is a significant mode shift away from public transport to personal transport in passenger travel and a change from railways to the road sector, both in domestic passenger and freight transport, leading to higher externalities. These shifts are in sync with other trends established in this reference scenario: – private vehicle ownership increasing faster than buses, stagnant ownership levels of buses, high increase in road infrastructure and slow growth in heavy railways and high-speed railways over the next decade.

Freight Modal shift policies make an impact on inland waterways and domestic shipping. Implementing mode shift and infrastructure improvement policies, inland waterways and domestic shipping freight mode share could potentially increase from 45% in 2020 to about 50% in 2030.

Transport Infrastructure development will enable growth in transport activity

Asia is still the process of catching up with more developed regions of the world and is putting emphasis on improving national connectivity, as well as better urban and rural access. It is apparent, based on our assessment that infrastructure development will be an important enabler for the development of transport demand in Asia and thereby wider range of social and economic interactions.

1.37 billion urban residents lack efficient access to urban public transit. Public transit access is still inferior in developing cities of Asia and Africa. Out of 10 people, only about 3 to 4 have the possibility of convenient access to urban public transit. In the case of Asia, this means that 1.37 billion urban residents lack efficient access to urban public transit. Moreover, urban rapid transit infrastructure varies significantly among Asian countries. In 2020, the low and lower-middle-income, upper-middle-income and high-income economies had urban access of about 2, 8 and 16 km per million urban population, respectively. By 2030, this ratio is expected to be about 4, 14 and 18 km per million urban population for low and lower-middle-income, upper-middle-income and high-income economies.

Marginal improvements in rural access. In 2019, close to 75% of the rural population in Asia and Pacific economies lived close to 2 kilometres from an all-season road. Taking into historical account trends and assuming that countries sustain existing policies and investments, we predict minor improvements in rural accessibility by 2030, i.e., the rural access index could increase from 75% to 76% by 2030. However, by 2030, close to 515 million rural inhabitants will be without rural access.

Road safety is projected to improve. We estimate that by 2030 road crash fatalities in the Asian and Pacific region could decrease from about 762,000 in 2020 to about 600,000 in 2030. This reduction of 20% is significantly lower than the required 50% reduction called for by the SDG's. However, ***the economic cost of road safety remains high.*** Despite the decline in road crash fatalities, the socio-economic cost of road crashes is projected to increase from 638 billion USD in 2020 to 850 billion USD in 2030 due to an increase in the value of statistical life.

Steady progress in relative decoupling of transport CO2 emissions from economic growth. Domestic passenger and freight activity is projected to increase by 2.6% and 4.4%, and passenger and freight transport-related CO2 emissions are only expected to increase by 1.1% and 1.8%, respectively. Thus, the net result is that CO2 emissions will rise less quickly than mobility and GDP. Accordingly, we predict that the current relative decoupling trends will continue.

Transport CO2 emissions will continue to grow and not peak by 2030. Therefore, we estimate that between 2018 to 2030, transport CO2 emissions could increase annually by 1.5%, i.e., from 2.9 in 2018 to 3.5 Gt in 2030.

Road freight is projected to become the most crucial source of transport-related CO2 emissions. In 2000, freight CO2 emissions in Asia constituted about 48% of transport CO2 emissions. By 2030, we estimate the freight share could increase to 57% of transport CO2 emissions.

Asia is making progress in Transport Decarbonisation but not sufficient for compliance with Paris Agreement. Benchmarking of quantifications of Asia's Transport CO2 emissions carried out over the last two decades suggests a steadily decreasing BAU projection of 2030 transport-related CO2 emissions for the Asian Pacific region. Our ATO projection confirms the slower growth in baseline transport CO2 emissions. Although moving in the right direction, our analysis also indicates that the reference scenario outlook for transport CO2 emissions is still incompatible with the Paris Agreement on Climate Change targets. Based on current trends, we do not see peaking of transport CO2 emissions before 2030.

Policies and investments are making an impact. Benchmarking of quantifications of Asia's Transport CO2 emissions by different institutions over the last two decades suggests a steadily decreasing BAU projection of 2030 transport-related CO_2 emissions for the Asian Pacific region. Our ATO projection confirms the slower growth in baseline transport CO_2 emissions. This continuous downward trend results from a growing penetration of low carbon technologies, more efficient infrastructure and increasing policy ambition. Although moving in the right direction, our analysis also indicates that the reference scenario outlook for transport CO_2 emissions is incompatible with the Paris Agreement on Climate Change targets.

Continued improvements in transport-related air pollution. While the critical drivers of transport-related air pollution: vehicle numbers and transport activity are projected to increase, we project that key transport-related air pollutants PM10, Black Carbon (BC), NOx and SOx will continue to decrease in the period up to 2030. This is due to the continued effects of tightening vehicle emission standards, which is enabled by improved fuel quality.

Transport infrastructure investments continue to grow but as smaller part of GDP. Based on historical trends, we estimate, based on current policies, that the transport infrastructure investments required to develop, maintain and repair inland transport infrastructure in Asia and the Pacific region from 2020 to 2030 could be about 14.5 trillion USD (in PPP, equivalent to 1.6% of GDP).

Road transport continues to dominate transport infrastructure investments. Roads will still remain the most significant investment area, i.e., about 66% of total investment. This is mainly to accommodate the projected increase in vehicle ownership and continued efforts to improve national connectivity. Improving urban and rural access also contributes to the continued emphasis on road building. As a result, we estimate that countries will continue spending majorly (86%) on road infrastructure expansion and less on maintenance, which is expected to be limited to 14%. whWe also project that urban rail transit would receive the same investment as heavy rail infrastructure for the first time.

Sustainable development goals and Paris Agreement on Climate Change not achieved in the transport sector. Our analysis concludes that the reference scenario investments in the infrastructure do not result in achieving the sustainable development goals or the Paris Agreement related transport targets. Progress will be made in improving infrastructure, access and connectivity. But, transport demand will grow faster than infrastructure; there is no significant modal shift towards railways and buses, leading to an increase in transport CO_2 emissions, and significant gaps in access and connectivity will remain. We do expect continued reductions in air pollutant emissions and road crash fatalities but also these will still not meet the targets set by the sustainable development goals. The adoption and implementation of more ambitious transport policies and mobilising additional investments in more efficient modes and infrastructure is therefore crucial for a more sustainable development of the transport sector.

I. Context and key questions

1. If Asia follows historical patterns of transport development – what could happen?

2. In the aftermath of the COVID pandemic crisis, Asian recovery has been uncertain and uneven. In such a disruptive environment, this Outlook provides a broad-brush description of the Asian transport sector and how it is likely to evolve in the next decade.

3. This paper originates from the transport data and policy information collected in the Asian Transport Outlook (ATO) initiative. The ATO is an initiative by the Asian Development Bank (ADB) to build a comprehensive knowledge base on transport in Asia and the Pacific region. The ATO is an open transport data and policy resource covering 51 economies using about 400 indicators (ADB, 2022). The ATO supports the planning and delivery of ADB transport support to the region, is a resource for governments in the region to plan their transport sectors and tracks the implementation of the 2030 Sustainable Development Goals (SDGs), the Paris Agreement on Climate Change, and other international agreements.

4. Based on the ATO many statistical stories can be told. In this first attempt, we have designed a "mini-Outlook", focussing on a comprehensive overview of trends and developments at a regional or sub-regional level up to 2030.

5. To lay out, what we consider likely trends and developments, we consider a "reference scenario". This reference scenario does not describe what will happen or what should happen; instead, it explores what could happen. Technically, the reference scenario is a baseline 'trend' scenario replicating past performance with historical development trends being extrapolated into the future. For example, if population and incomes grow roughly per our expectations, and if the historical relationships between the transport drivers and outcomes are more or less as captured in our reference scenario, then the transport sector could evolve in the direction we sketched. Our reference scenario acts as a point of comparison. It provides different stakeholders in the transport sector in the Asian transport sector with a comprehensive analytical foundation against which they can assess new policy packages or technological developments and track the sector's performance across the SDGs and the Paris Agreement.

6. Our reference scenario can be equated with a world where only incremental, mostly reactive; change occurs.

7. In this first Outlook, we measure transport as a system and attempt to answer the following questions to help stakeholders better understand the future of mobility and accessibility in Asia.

i. Is Asia closing the infrastructure gap?
ii. Is the future of rail bright?
iii. Has Asia hit "Peak Auto"?
iv. What is the future of travel in Asia?
v. Are Asian cities becoming more accessible?
vi. Will rural transport access in Asia improve?
vii. What is the future of Road safety in Asia?
viii. Transport Carbon Emissions in Asia: is the Glass half full or empty?
ix. Is the Transport sector a growing source of Air Pollution?
x. How much will Asia invest in Transport Assets?

II. Our Crystal Ball

8. There are many ways to forecast transport sector trends, and often several diverging views can be valid. We utilise a unique hybrid bottom-up sketch approach to model a 2030 reference scenario for the Asian region. The source data, defaults and relationships are mainly derived from several national and regional sources. Apart from data in the ATO Sharable National Database use was made of TRL-ADB Scenario Model, ICCT-Roadmap, ITF-Transport outlook, ITPS Study of Transport System in Low Carbon Society, UNECE SafeFITS and ForFITS model (UNECE, n.d.), (UNECE-B, n.d.), (ITF, 2021), (IPCC, 2018), (DNV, 2020), (ICCT, n.d.), (CAA, 2016), (CAI) as well as other regional, sub-regional and national forecasts and databases over the period – 2010-2022. Overall, we consider more than 300 studies, sources, or sophisticated model outputs to document the reference trajectories. Using regional and global defaults, we calibrate expected deviations from historic trends due to existing policies, socio-economic projections, and penetration of new technologies.

Why a 2030 timeline?

9. We report the outlook projections for 2030 to match the target year for realisation of the SDGs. While the approach is theoretically scalable for 2050, we prefer 2030 timeframe because uncertainty on adopted policies and technology development increases with time.

The ATO reference scenario

10. Our reference scenario considers multiple dimensions of the transport sector, i.e., infrastructure, transport activity, access, air pollution, road safety, climate change and inland transport infrastructure investments across all applicable modes of domestic transport, i.e., roads, railways, domestic aviation and shipping (**Error! Reference source not found.**). We consider 51 economies: all developed and developing e conomies in the Asia and Pacific region as well as Iran and Russia. The results are aggregated to allow a transparent, customisable estimation of regional growth in a reference scenario. While the estimates are developed at the country level, we report impact at the sub-regional and regional levels in this report. In future iterations, we will narrate country-specific stories.

Table 1: Outlook – transport modes and variables covered in the reference case projection

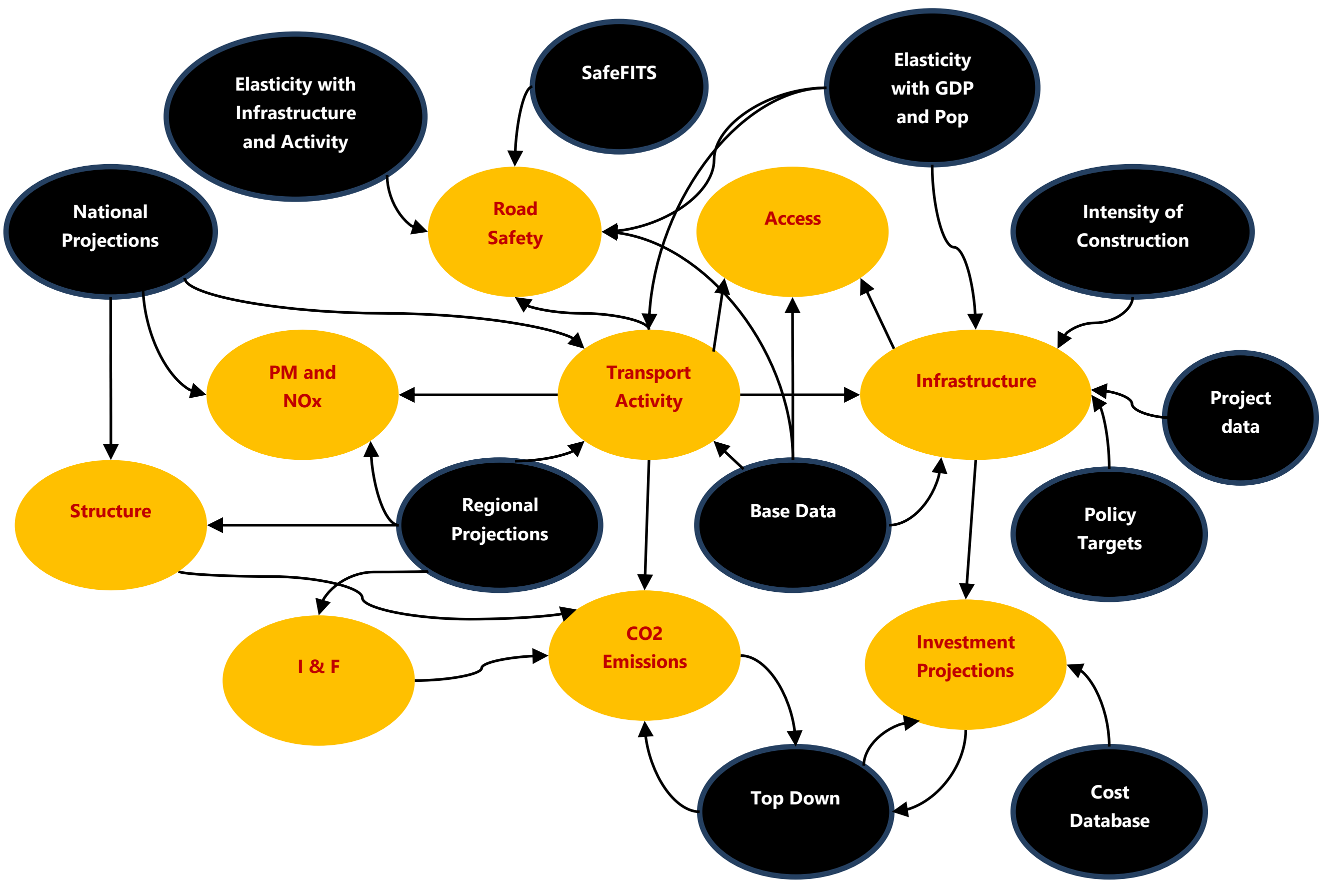
Modes		Infrastructure	Passenger Activity	Freight Activity	Urban Access	Rural Access	Climate Change	Air Pollution	Road Safety	Transport Investments
Road	Two-Wheeler									
	Three-Wheeler									
	Light Duty Vehicle									
	Bus									
	LHDT/LCV									
	MHDT/Medium Truck									
	HHDT/Heavy Truck									
Railway	Urban Rail									
	Heavy Rail									
	High-Speed Rail									
Domestic Aviation										
Domestic Shipping										

HHDT = Heavy, Heavy-Duty Truck ; LCV = Light Commercial Vehicle; LHDT = Light, Heavy-Duty Truck; MHDT = Medium, Heavy-Duty Truck

Source: Authors

11. The hybrid bottom-up sketch approach taken based on more sophisticated aggregated models and limited open-source data does creates several challenges. For example, the specific demands for non-motorised travel, informal transport, and urban freight are not estimated or disaggregated. Further, dependence on modelling outputs and historical relationships may not be realistic or may be uncertain and sensitive to current policy frameworks as well as the post-COVID triggers for transport supply and travel patterns. However, although our reference scenario does not comprehensively describe or address future uncertainty, it does provide a significant range of possible outcomes for the transport sector.

Fig. 1: Methodological approach hybrid bottom-up sketch model[1]



Source: Authors

12. Our reference scenario is based on the latest socio-economic projections by the ADB, UN Department of Economic and Social Affairs - Population Division, International Monetary Fund's World Economic Outlook (IMF-WEO) and the DNV energy outlook. We rely on modest economic recovery and its long-term consequences in Asia, as predicted by the IMF and ADB following the COVID pandemic. The most fundamental difference between our projections and any other historical transport projections in Asia would be the more modest growth in economic projections. Consequently, most of our forecasts in this Outlook are lower than historical estimates.

[1] More details on the methodology adopted can be found in the methodological sections in the respective chapters.

III. Is Asia closing the transport infrastructure gap?

Asia keeps building more roads and is doing so at faster pace

13. With rising income levels and growing motorisation, Asian economies are building roads faster over time. Road kilometres in Asia increased by 3.7 million (2000-2010) and 5.7 million (2010-2010). If we extrapolate historical national growth rates over the next decade - we estimate that total road kilometres could increase from 21 million kilometres in 2020 to 29 million kilometres by 2030, an increase of 8 million kilometres. 84% of the total increase in road kilometres is expected to be contributed by two regions – East Asia and South Asia (Fig. 2).

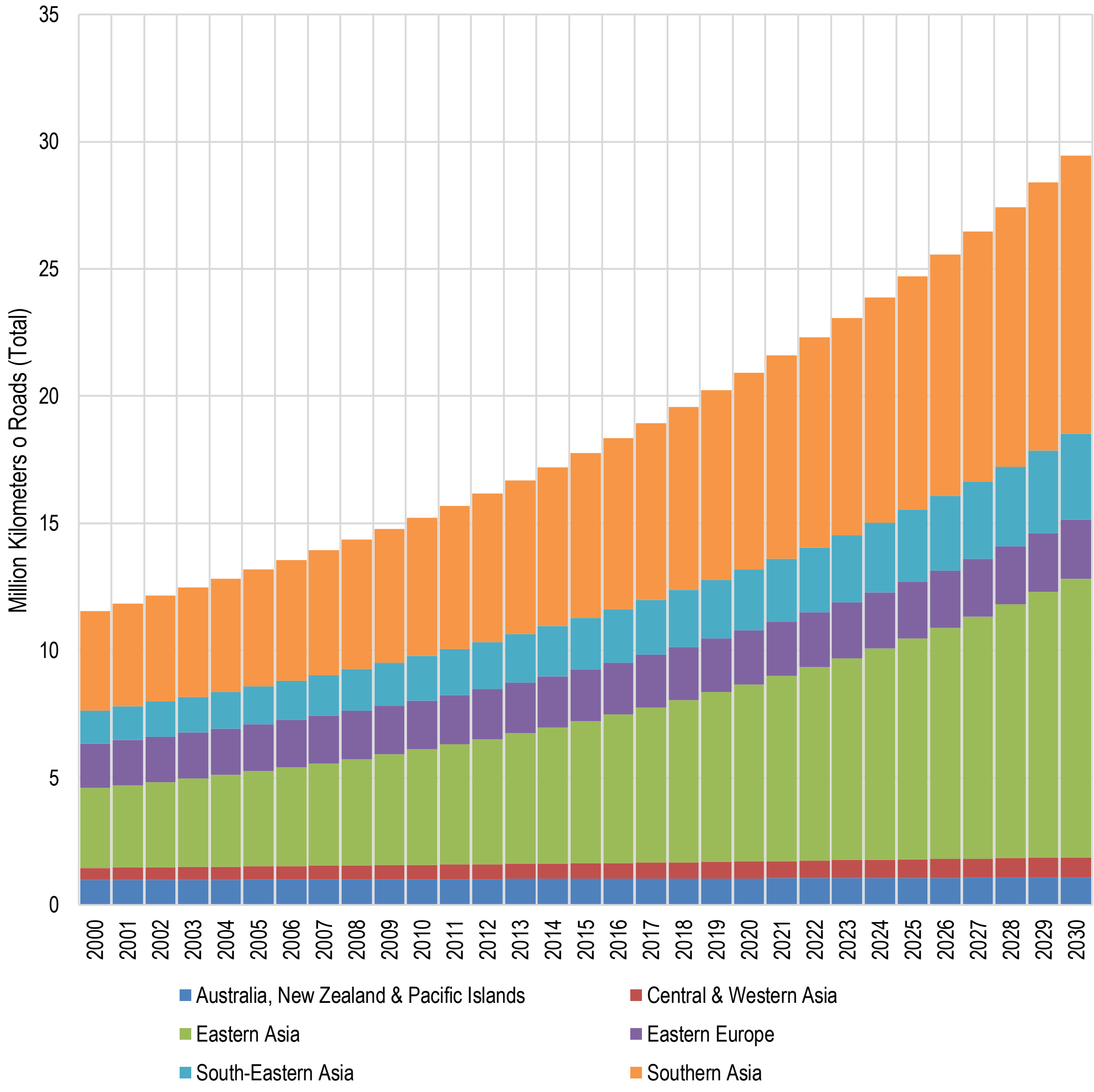


Fig. 2: Road infrastructure growth

Source: Authors , Asian Transport Outlook (2022) National Database INF-TTI-005

Asia's road infrastructure still falls behind the developed world

14. Our estimate of a 3.4% annual increase from 2020 to 2030 is in range with other international estimates from AIIB (1.9%) (AIIB, 2018) and Vivien Fisch et al. (0.5% to 4.2%) (HAL, 2020). Our predictions reveal that even after adding 8 million kilometres by 2030, the per-capita road access would be significantly lower than the current 2019 standards of other regions. By 2030, we estimate that all income groups of countries, including upper-middle-income and high-income Asian countries would continue to have lower road infrastructure per capita when compared with other regions, except when compared with Africa (Fig. 3).

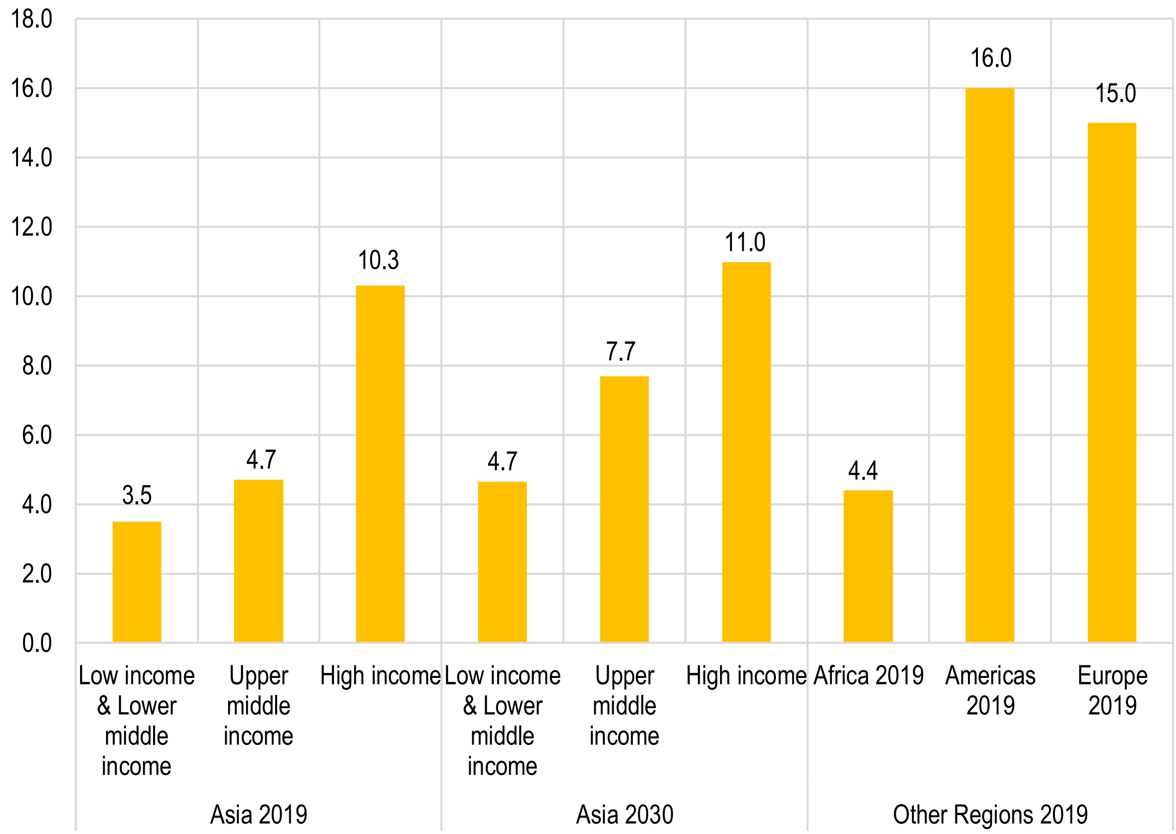


Fig. 3: Road length (meters/Capita)

Source: Asian Transport Outlook (2022) National Database INF-TTI-009

15. Our estimates suggests that all things being equal, a country's road infrastructure grows with raised income and vehicle motorisation levels[2], but the rate of growth in the network tapers off as GDP continues to grow, i.e., growth is intense in lower income levels compared with higher income levels.

16. Finally, there are two sides of the same coin – one where road construction enhances urban and rural access, connectivity and mobility, thereby enabling economic and social development as well as reducing poverty and second, where road building facilitates motorisation in Asia but is associated with growing negative externalities of road crashes, air pollution and climate change. How these two sides of the coin manifest themselves will vary hugely across Asia. Exploring these dimensions at the national or local level is crucial.

[2] Discussed in the later sections

Box 1:

Methodology for developing road projections

It is challenging to determine the total road kilometers in Asia by considering only a single type of source. Therefore, in the Asian Transport Outlook, we have considered multiple sources. For the projections, the historical time series of national data on road infrastructure are calibrated and converted into a consistent Asia Pacific roads dataset using country official statistics, existing publicly available georeferenced roads datasets, and development agencies reports (Fig. 4).

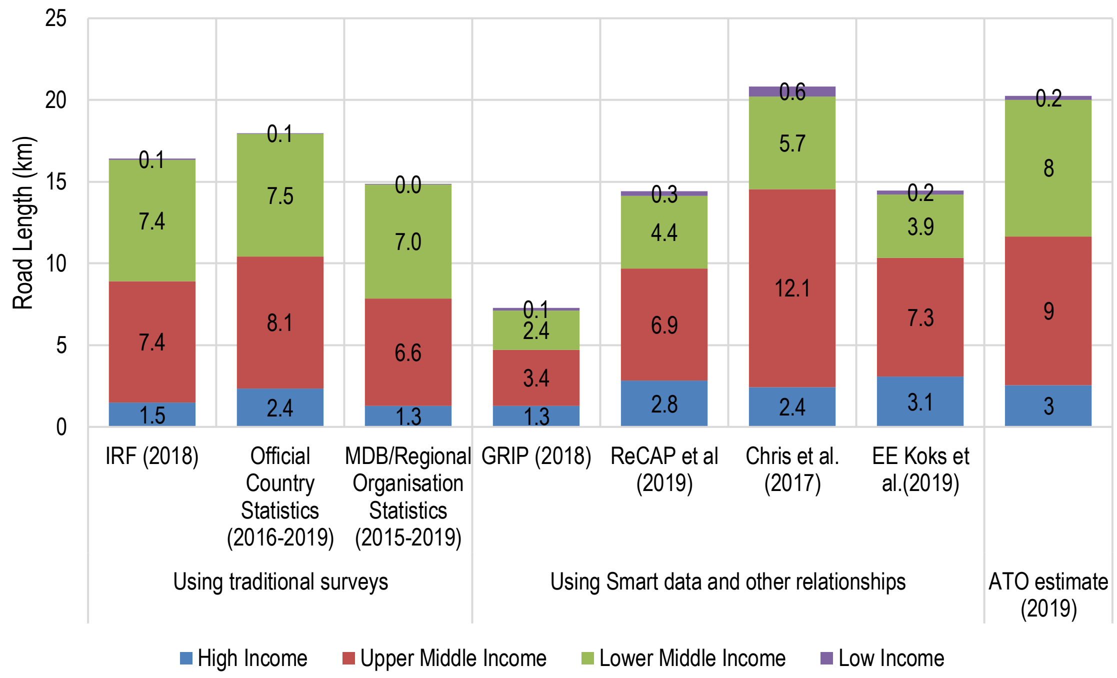


Fig. 4: Road infrastructure – from multiple sources

ATO = Asian Transport Outlook; GRIP = Global Roads Inventory Project; IRF = International Road Federation; MDB = Multilateral Development Bank; ReCAP = Research for Community Access Partnership

Source: Asian Transport Outlook (2022) National Database INF-TTI-005

For road kilometre projections under the reference scenario, we considered multiple options: using historical construction rates and extending them in future, using global relationships of road infrastructure with socio-economic drivers like income levels (GDP) and population density. However, we settled on using only the historical construction rates as the global relationship of road infrastructure with GDP and population density gives unrealistic estimates for several Asian economies, especially for high-income and upper-middle-income countries.

IV. Is the future of rail bright?

17. Globally, the International Energy Agency (IEA) has quantified that the rail infrastructure for passenger and freight rail services, not including high speed rail, have hardly grown over the past twenty years (IEA, 2019). However, in the Asian and the Pacific region, historical railway network data is not easily accessible. Therefore, in the ATO, to generate historical data from 2000 to 2020, we combined data from national statistics, the International Union of Railways (UIC) and the Institute for Transport and Development Policy (ITDP) and estimates from World bank to develop a consistent Asia Pacific railway dataset. We conduct analysis separately for heavy intercity, high-speed, and urban railways (metro and light rail transit (LRT)).

Heavy railway construction is slowing down

18. Overall, since 2000, the conventional railway network has expanded by 140 thousand kilometres i.e. from 350,000 to 490,000. We observe however that the growth in conventional railway networks was highly uneven among economies, with a significant increase in PRC, Russia, India and Turkmenistan and reductions in Japan, Australia, Armenia, and Azerbaijan. Thus, the future trajectory of heavy rail in Asia and the Pacific is not linear. It depends on several factors – would all economies grow the railway network, or have some economies reached peak railway?

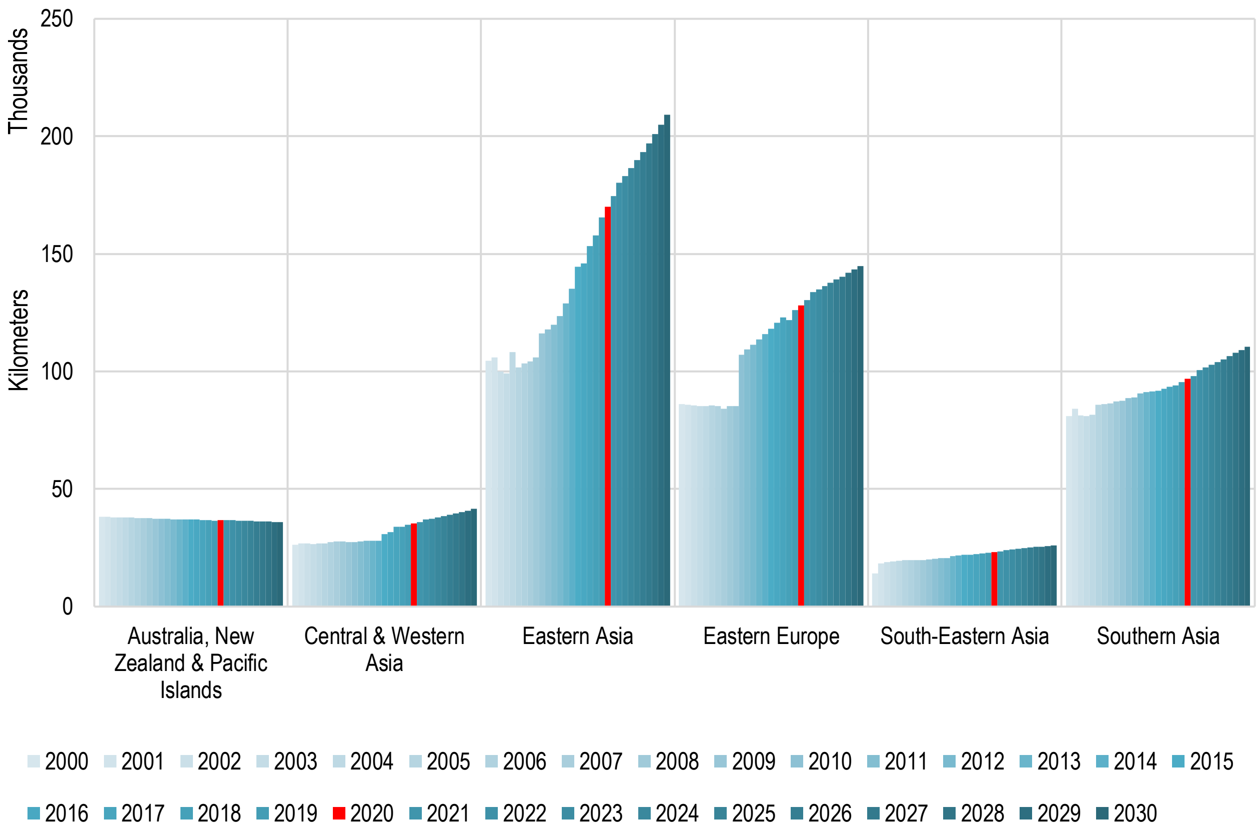


Fig. 5: Heavy rail infrastructure growth

Source: Asian Transport Outlook (2022) National Database INF-TTI-016

19. Overall, we estimate between 2020 to 2030, Asian economies could potentially add 78 thousand kilometres to conventional railway network (Fig. 5). However, this increase is significantly lower than the 91 thousand kilometres increase realised from 2010 to 2020, which was mainly due to rapid railway expansion in PRC. We consider this lower growth of 78 thousand kilometres realistic as only about fifteen economies have developed railway master plans, and only about 18 thousand kilometres of conventional railway are currently in advanced planning or construction (IRJ-PRO, n.d.) in Asia and the Pacific region.

High-speed railways construction diversifies regionally

20. Since the launch of Japan's first high-speed rail system in 1964, Asia has added 6,500 (2000 to 2010) and 33,300 km (2010-2020) of high-speed railway network over the last two decades, with PRC alone expanding more than 27 thousand kilometres, well more than the rest of the world combined. The availability of high-speed rail infrastructure and services broadens intercity travel mode options thereby providing competition to the aviation and road sector especially for medium distance trips up to 750 kilometres. Dedicated high-speed rail systems can also free up significant capacity on the conventional inter-city railway systems for passenger and freight services. Building on PRC and Japan's considerable experience in constructing and operating high-speed railway lines, several other Asian economies have started building or are planning to develop high-speed rail systems at significantly lower income levels than countries in the global North.

21. Based on existing construction plans, we estimate that by 2030, Asia could have a high-speed rail network length[3] of 70 thousand kilometres, i.e., an increase of about 28 thousand kilometres from 2020 to 2030 (lower than the 2010 to 2020 increase) (Fig. 6). This means that about 25% of all railway expansion in Asia until 2030 would consist of high-speed rail. Our estimate of 6.6% annual growth is in range with other international estimates from AIIB (3.2%) (AIIB, 2018) and Vivien Fisch et al. (3% to 6.7%) (HAL, 2020) .

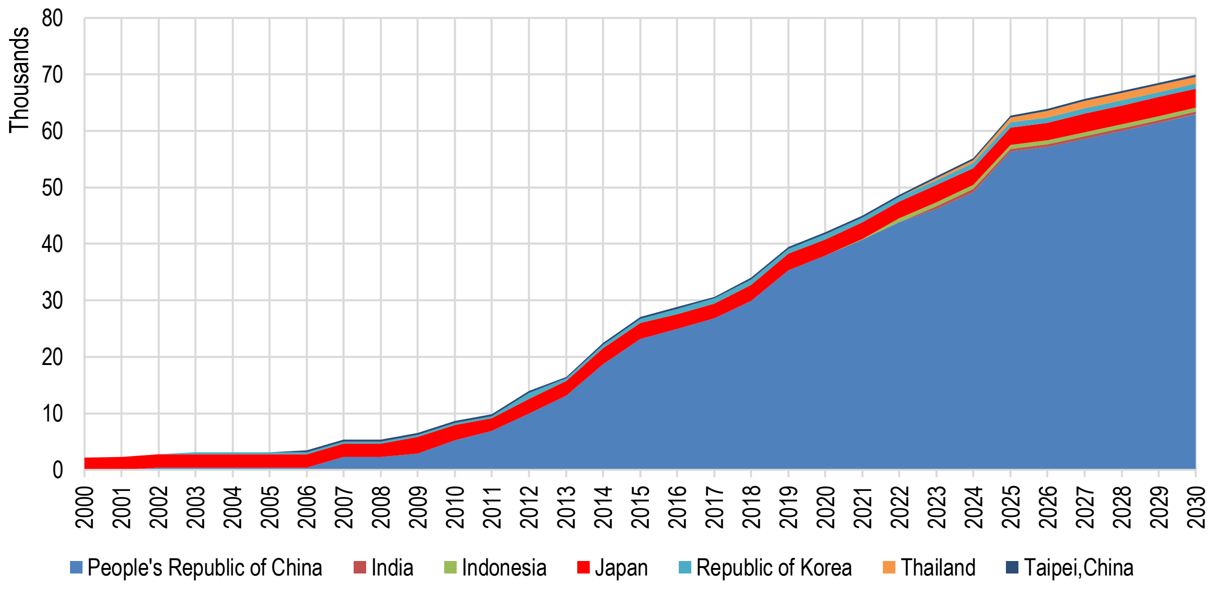


Fig. 6: High speed rail infrastructure growth

Source: Asian Transport Outlook (2022) National Database INF-TTI-019

[3] 12% of the conventional railway network

Metro expansions intensify

22. Based on the metro and light rail projects under planning and construction, we predict that Asia could build about 158 thousand and 13 thousand kilometres of metro and LRT, respectively, from 2020 to 2030 (Fig. 7). This new construction over the next decade is the same as what Asia constructed over the last two decades. Close to 80% of new urban railways are projected to be constructed in the upper-middle-income economies and a large part will be in the East Asia region.

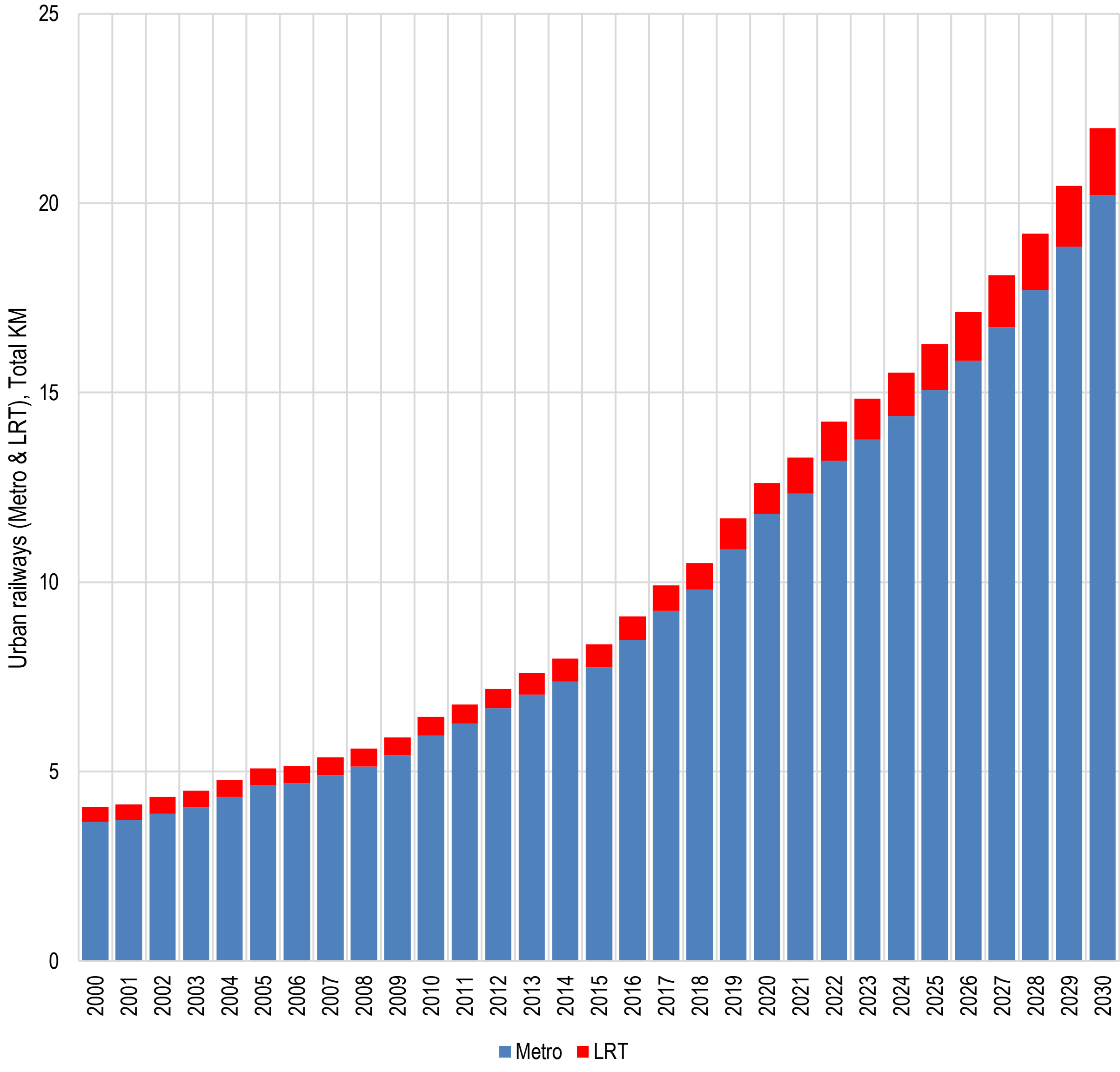


Fig. 7: Urban rail infrastructure growth

km = Kilometre; LRT = Light Rail Transit

Source: Asian Transport Outlook (2022) National Database INF-UTI-002, INF-UTI-003

No rail renaissance in Asia

23. Railways are one of the most efficient modes of transport in urban and inter-city passenger transport and long-distance freight transport. Rail transport outperforms road transport across various matrices:: energy consumption, efficiency, emissions, and safety. It is only in the cost of construction and maintenance that roads are more attractive than railways. In the past, rail expansion lagged the pace of road construction. We estimate the trend to continue till 2030, with the pace of road expansion twice the pace of rail. If we compare total rail length per capita, Asia's rail access in 2030 could be 137 meters per thousand residents, up from 120 meters in 2020.

24. In comparison, current railway infrastructure access in Europe and Northern America is about 480 meters per thousand residents. Clearly, Asia is far from a rail renaissance, and railway infrastructure needs to be substantially enhanced. Many Asian economies are trying to leapfrog with increasing access to rail infrastructures such as high-speed railways and metro railways at comparatively lower income levels. However, the effort needs to intensify as heavy railway construction has only increased at the pace of the population growth rate.

Box 2:

Methodology for developing Heavy Rail projections

For Heavy Railways - for deriving the 2030 outlook, we consider the following sketch estimates and derive an average growth:

- the historical rate of infrastructure expansion,
- maximum and minimum rates of infrastructure expansion for different typologies of countries to document the priority of railways or saturation levels, and
- global regression of rail network length with GDP to establish a relationship with income and transpose that relationship to Asian economies.

For High-speed railways, we rely exclusively on construction plans (based on UIC) and do not consider the relationship of the HSR network with income, population growth and density and other possible variables such as demand for aviation etc.

For Metro and LRT projections – we consider an average of:

- the historical rate of infrastructure expansion,
- maximum and minimum rates of infrastructure expansion for different typologies of countries to document the priority of urban rail or saturation levels,
- global regression of metro/LRT network length with GDP and urban population to establish a relationship with income and urban people and transpose that relationship to Asian economies, and
- current metro/LRT projects under planning, feasibility, tendering, design and construction data based on IRJ-Pro.

V. Have we hit "Peak Motorisation"?

25. Between 2000 and 2020, the total vehicle ownership in Asia increased by about 1 billion vehicles. In 2000, Asia had 85 vehicles for thousand population. By 2020, Asia had 278 vehicles for thousand population. Every second vehicle in Asia is a two or three-wheeler. Passenger cars share in total vehicle ownership is close to 41%. In 2000, it was 39% which indicates a marginal shift towards passenger cars.

Asia has not reached "peak motorisation"

26. We estimate that with current trends, vehicle ownership levels could grow from 1.2 billion in 2020 to 1.6 billion in 2030. Overall, we project that Asia has not reached the 'peak motorisation'. Our analysis suggests that the stagnant vehicle sales in Asia over the last five years will only be a temporary blip. Asia is expected to continue to motorise, albeit at a slower pace. The growth in vehicle ownership is expected to outpace the increase in the Asian population. At the same time, it is important to note that motorisation in the majority of Asian countries is not following the historical high motorization trends of the high-income economies. (Fig. 8).

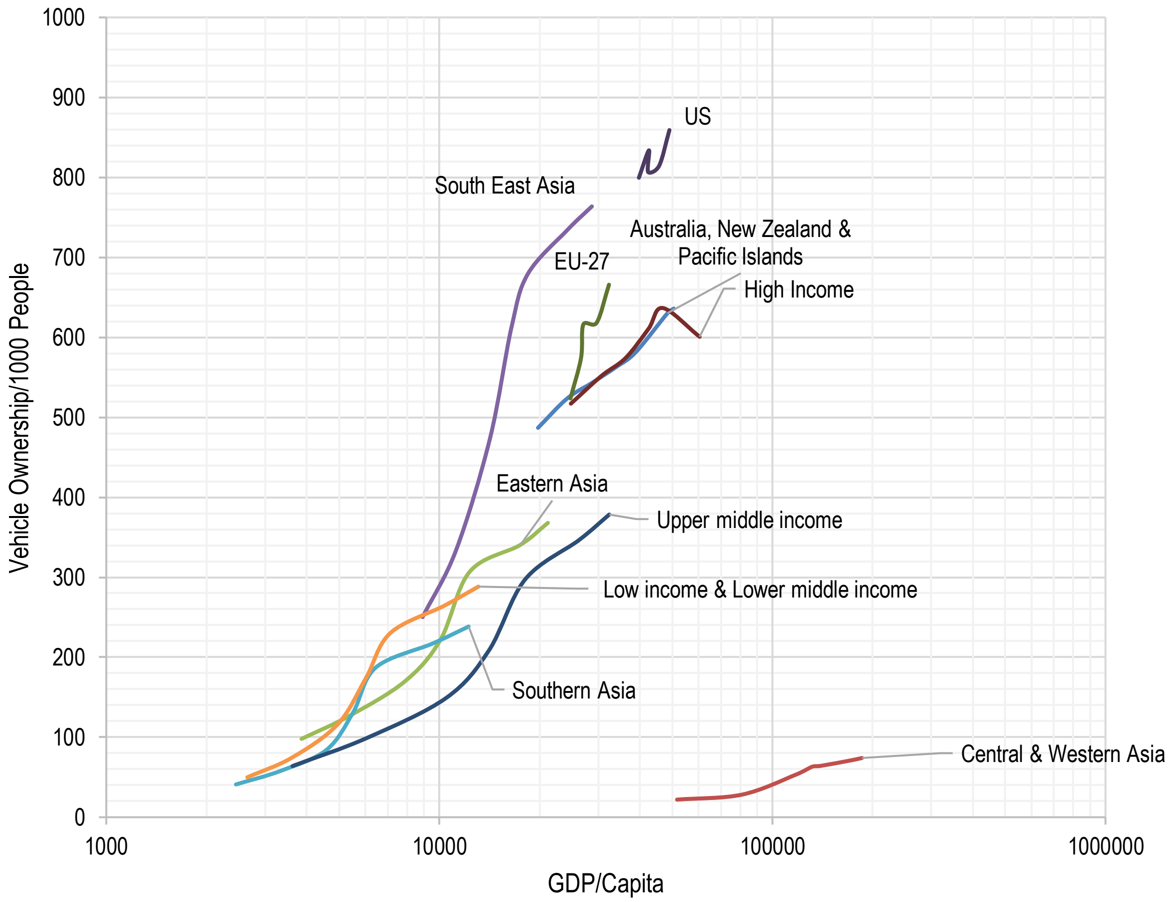


Fig. 8: Motorisation growth

GDP = Gross Domestic Product

Source: Asian Transport Outlook (2022) National Database TAS-VEP-038, SEC-SEG-002

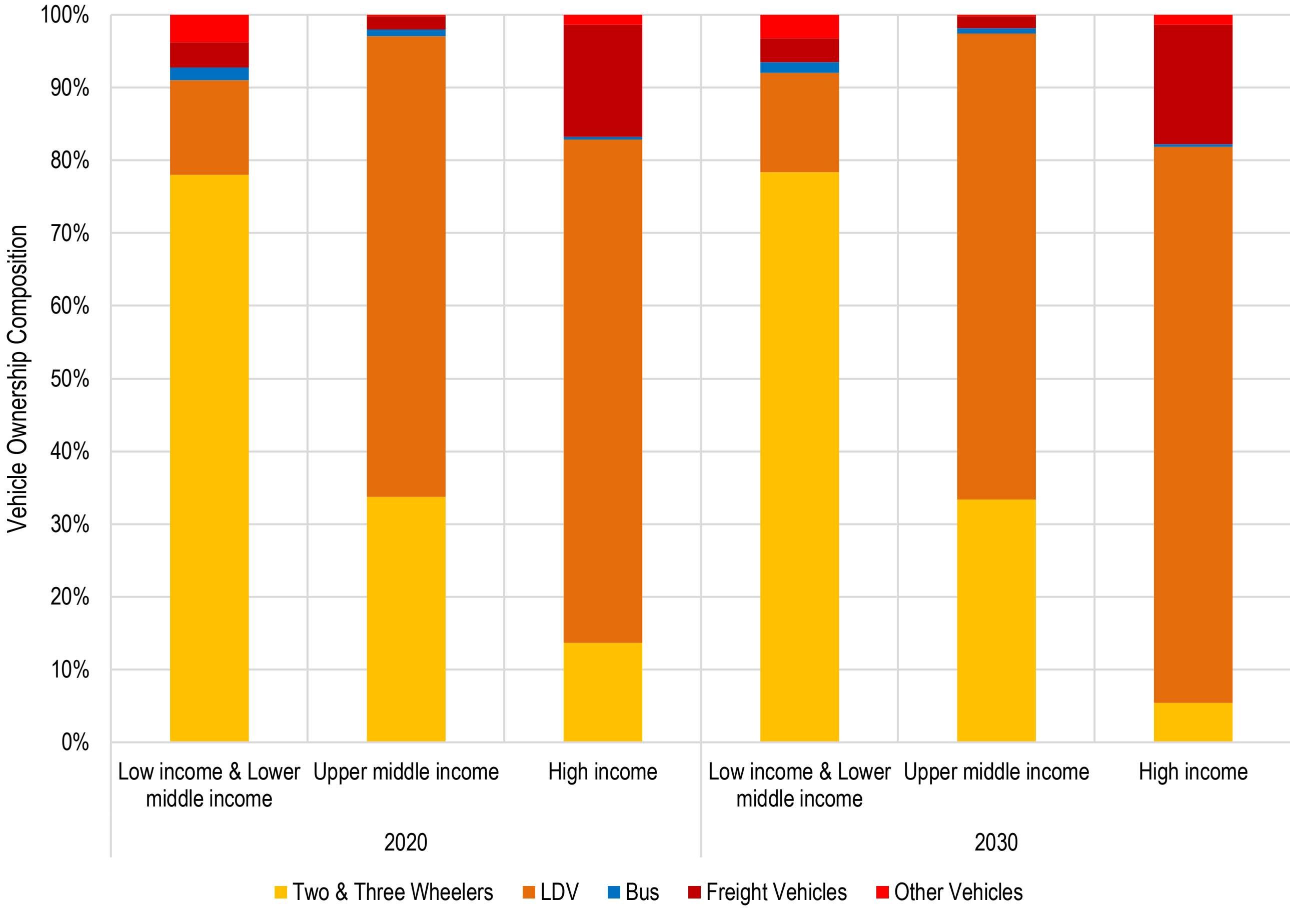


Fig. 9: Vehicle ownership share

LDV = Light Duty Vehicle

Source: Asian Transport Outlook (2022) National Database TAS-VEP-015, TAS-VEP-016, TAS-VEP-017, TAS-VEP-018, TAS-VEP-019, TAS-VEP-020

Two-and-three wheelers continue to dominate vehicle fleet

27. The most significant growth in motorization continues to be in the two and three-wheelers segment (Fig. 9). Currently, two and three-wheelers constitute about half of the total vehicle fleet and will continue to remain so in the next decade. Experts have considered that two-and-three-wheelers ownership levels might become saturated or even reduced as income levels rise in Asia (WOL, 2011). However, we don't see conclusive evidence of that yet. We predict that Asians' love for two- and three-wheelers would continue raising income levels and existing policies for the next decade.

28. A possible peaking of private vehicle ownership also depends on the growing availability of public transport to attract demand. Currently, only 1% of total vehicles are used for public transit. In contrast, in 2000, it was about 2%. Due to a continued lack of public transit subsidies and an influx of shared mobility services, we project that bus ownership could grow slowly, continuing a stagnating trend. Over the past two decades, for close to 80% of the Asian economies, ownership rates of public transport vehicles have grown slower than private vehicle ownership. This trend is likely to continue in future without additional policies and incentives for buses.

29. Our motorisation projections align with other regional forecasts (DNV, 2020), (ICCT, n.d.), (CAA, 2016), (EEA, n.d.) as depicted in Fig. 10.

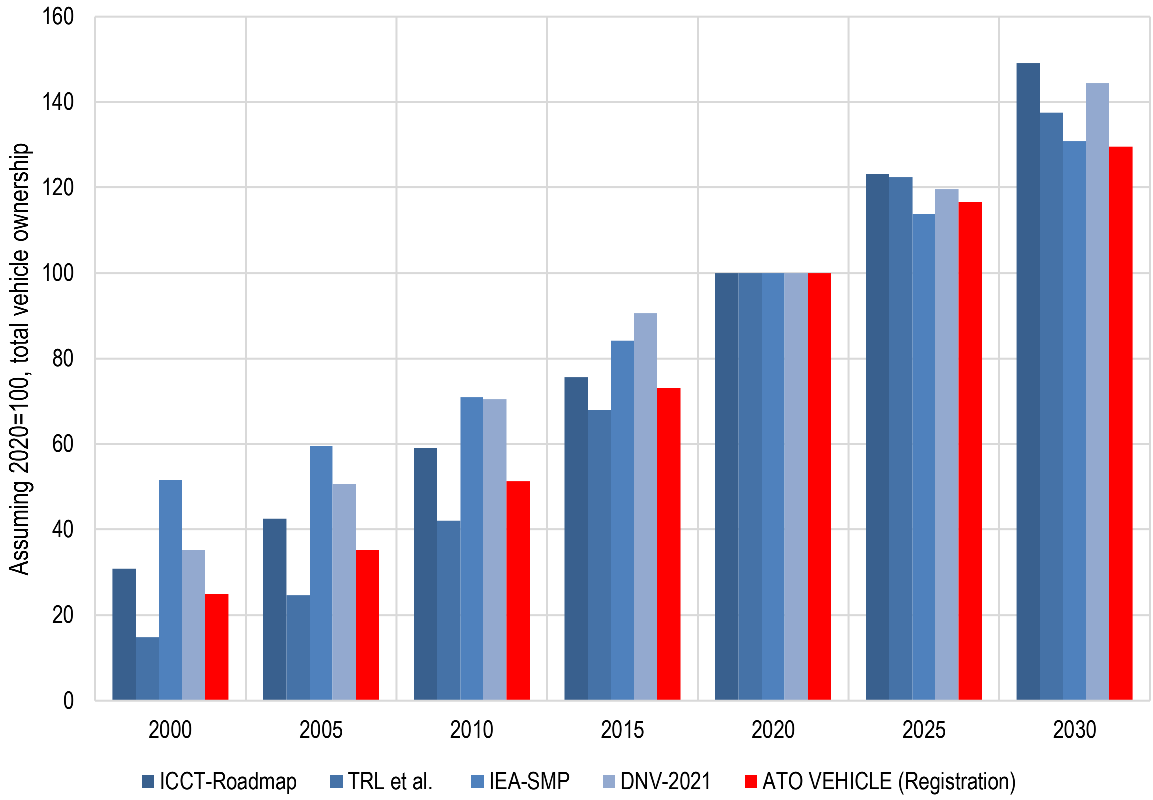


Fig. 10: Vehicle ownership history and projections

ATO = Asian Transport Outlook; DNV = Det Norske Veritas; ICCT = International Council on Clean Transportation; IEA = International Energy Agency; SMP = Sustainable Mobility Project; TRL = Transport Research Laboratory

Source: (DNV, 2020), (ICCT, n.d.), (CAA, 2016), (EEA, n.d.), Asian Transport Outlook (2022) National Database TAS-VEP-021

Box 3:

Methodology for developing vehicle projections

Income levels are often used to forecast motorisation at a national scale. The general premise is that the relationship between the growth of vehicle registrations and per-capita income is highly non-linear. First, vehicle ownership grows relatively slowly at the lowest levels of per capita income, then about twice as fast as income at middle-income levels (from $3,000 to $10,000 per capita), and finally, then growth stabilizes as incomes reach higher levels before reaching saturation at the highest levels of income[1]. However, Asian ownership patterns differ somehow due to the high density of two and three-wheelers. Given that it is much cheaper to buy a two-wheeler than a passenger car (1,000 USD vs 10,000 USD), income growth affects two-wheeler ownership stronger and faster than car ownership. Thus, we utilise disaggregated historical vehicle ownership data from 2000 to 2020 from Asian economies to forecast the growth of the disaggregated vehicle ownership population ratio (vehicle per capita) as a function of per-capita GDP. These motorisation projections are later used as a proxy variable to check and calibrate travel activity, infrastructure and road safety projections.

The following figure shows the historical vehicle ownership rates in Asian economies (Fig. 11).

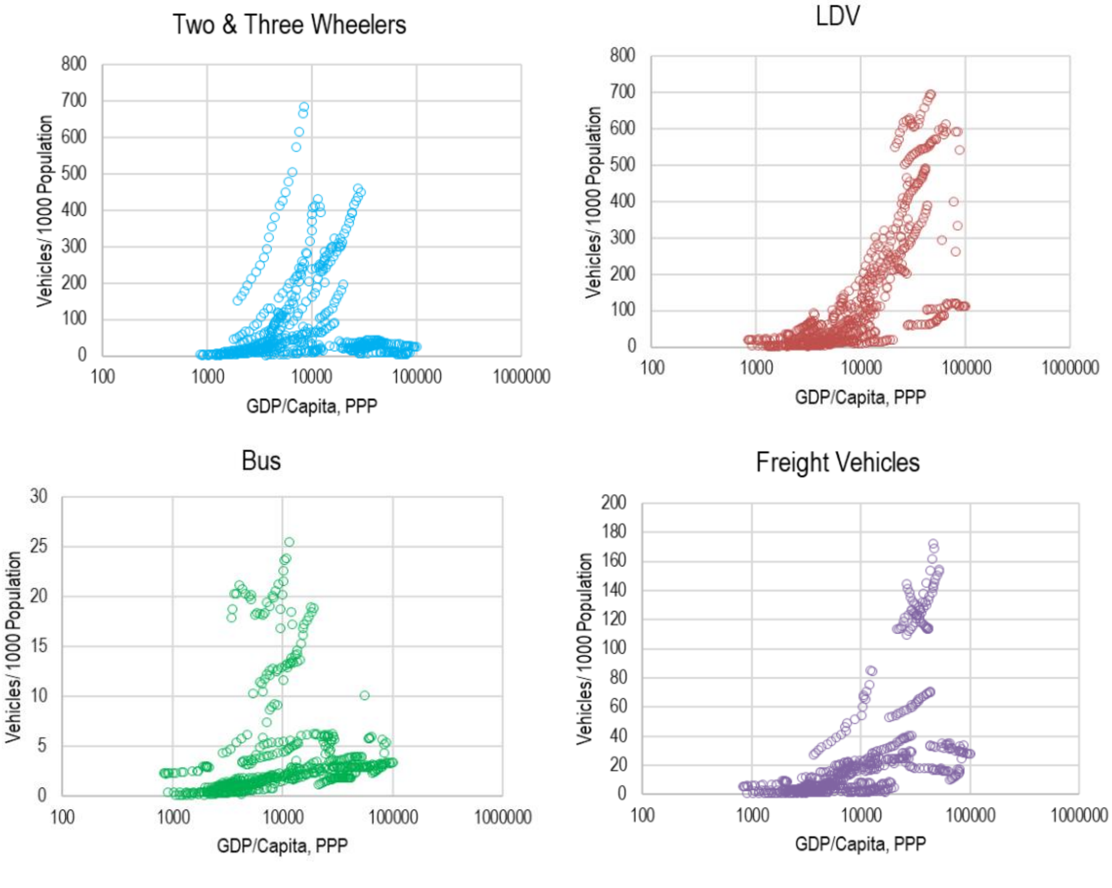


Fig. 11: Historical vehicle ownership rates in Asian economies

GDP = Gross Domestic Product; LDV = Light Duty Vehicle; PPP = Purchasing Power Parity

Source: Asian Transport Outlook (2022) National Database TAS-VEP-058, TAS-VEP-059, TAS-VEP-060, TAS-VEP-061

VI. What is the future of travel in Asia?

Travel demand is growing but at a slower rate with freight transport dominating growth

30. In 2018[4], including all modes of travel, domestic passenger transport demand in Asia was estimated to be about 16 trillion passenger kilometres or about 3,600 kilometres of passenger travel per capita. We estimated that East Asia alone contributed about 45% of passenger activity among sub-regions. Combined, South Asia and South East Asia contributed about 45%. In terms of income typology, low and lower middle income, upper middle income and high-income per-capita passenger activity were 2,500, 4,500 and 8,300 km/capita/year, respectively.

31. By 2030, we estimate that domestic passenger transport could grow from 16 trillion to 22 trillion passenger kilometres per annum, i.e., about 4,500 kilometres per person. While the average distance travelled will only marginally increase in high-income economies, there is a significant growth in low and middle-income economies (Fig. 12). Overall, the passenger transport demand growth would outpace population growth but lag the income growth.

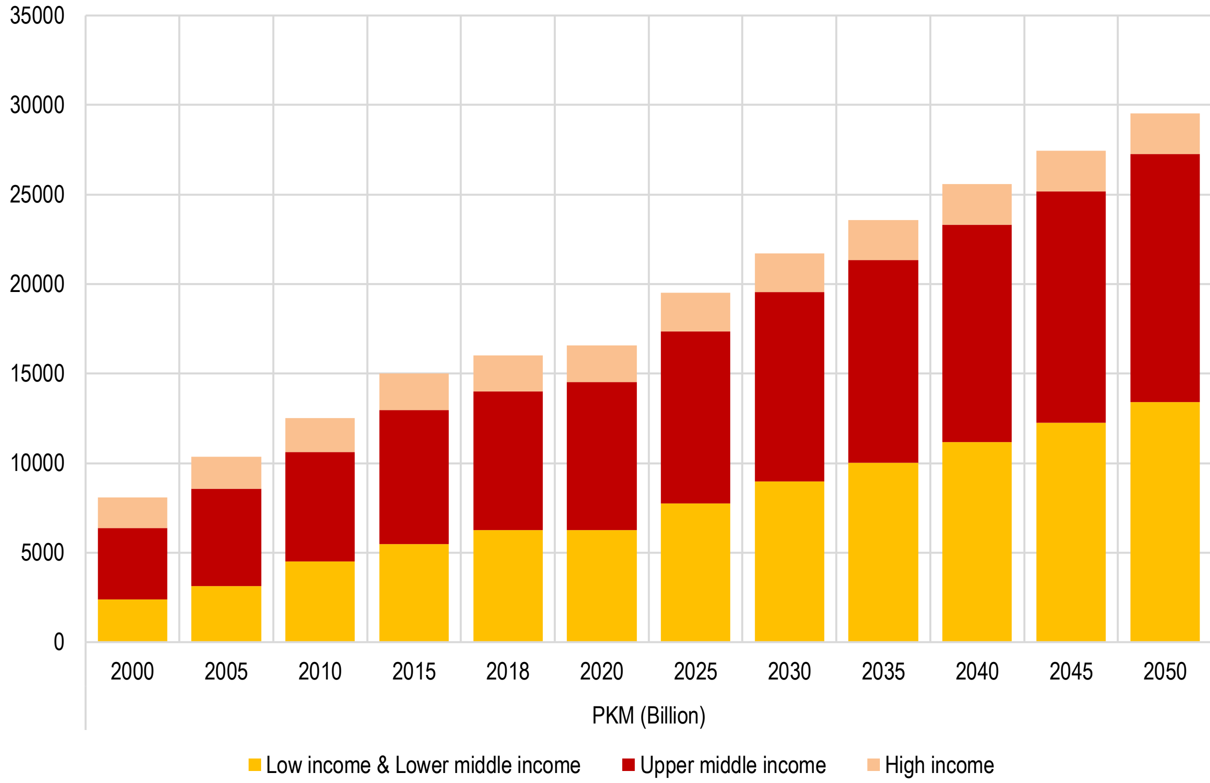


Fig. 12: Passenger kilometre travel growth

PKM = Passenger kilometres

Source: Asian Transport Outlook (2022) National Database TAS-PAT-001, TAS-PAT-002, TAS-PAT-004, TAS-PAT-017

[4] We consider the year 2018 as the base year for the discussions instead of 2020 due to covid pandemic's influence on transport demand

32. Domestic freight transport is expected to grow more than domestic passenger transport, from about 22 trillion freight kilometres in 2018 to around 36 trillion passenger kilometres in 2030. In terms of per capita freight travel, this represents an annual increase from about 5,000 tonne-kilometres to about 7,600 tonne-kilometres per person. Among sub-regions, East Asia alone contributes about two-thirds of domestic regional freight activity. In terms of income typology, current low and lower middle income, upper middle income and high-income annual per-capita freight activity are 1,500, 9,500 and 6,800 km/capita, respectively. By 2030, this will increase to 2,000, 16,000 and 7,700 km/capita respectively. As in the case of domestic passenger transport, the highest increase is in the middle-income countries. Based on historical trends, we project that PRC will continue to disproportionately influence regional freight mobility (Fig. 13).

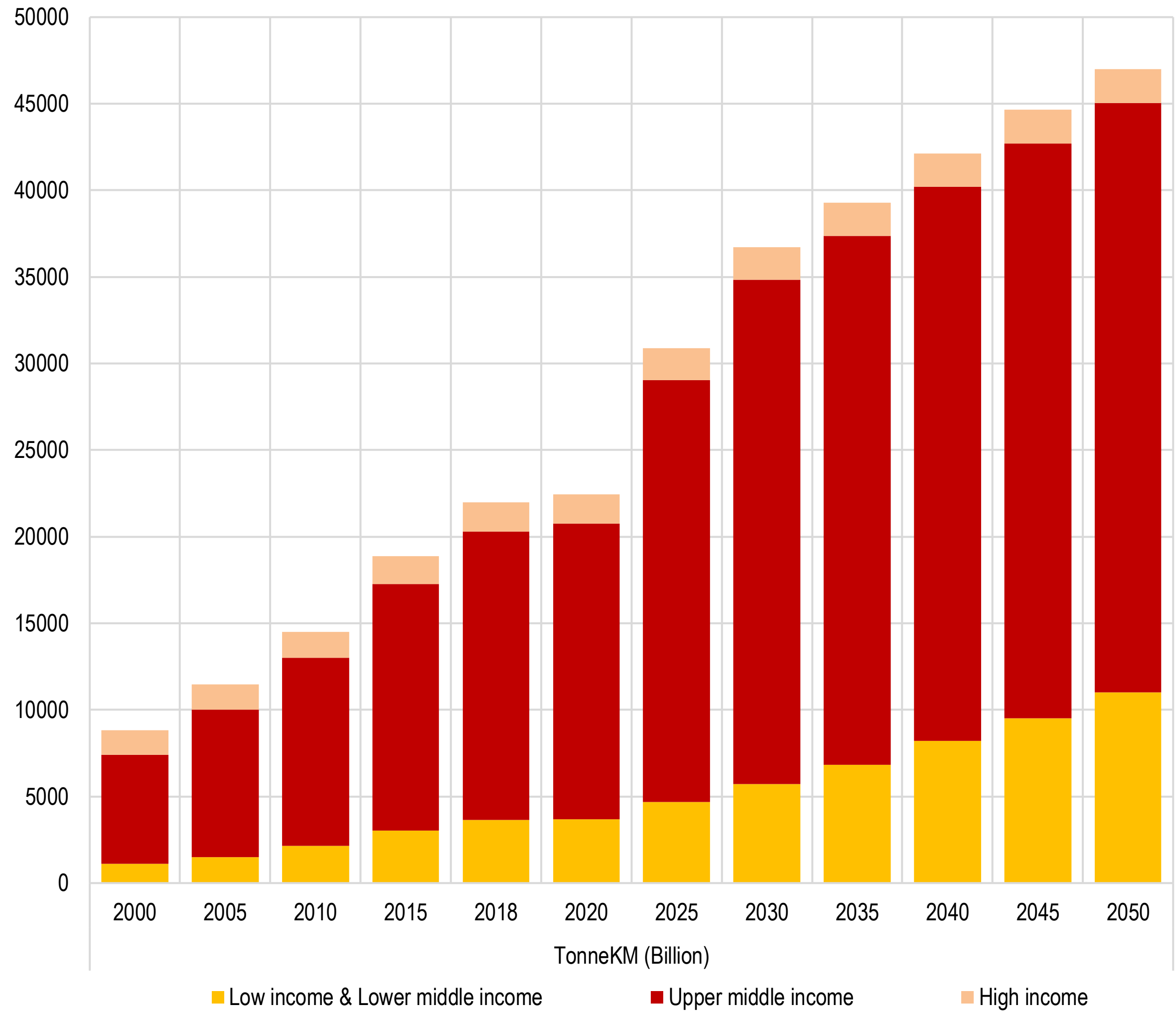


Fig. 13: Freight kilometre travel growth

Tonnekm = Tonne kilometres

Source: Asian Transport Outlook (2022) National Database TAS-FRA-004, TAS-FRA-005, TAS-FRA-006, TAS-FRA-007

33. A major contributor to the growth in freight demand is the improved connectivity of Asia to the global supply chains. Our analysis indicates that high-income economies generally have better transport connectivity compared to lower-income economies. Further, connectivity is positively correlated with trade (i.e., facilitator). As economies become richer, Asian countries will improve transport connectivity to participate in more trade subsequently enhancing freight demand.

34. Overall, compared to the past two decades, we estimate that passenger and freight mobility will grow slower, mainly due to the dampening of socio-economic drivers (population and GDP). However, due to Asia's continued importance in global supply chains and trade patterns, freight activity will continue to grow faster than passenger activity (Fig. 14).

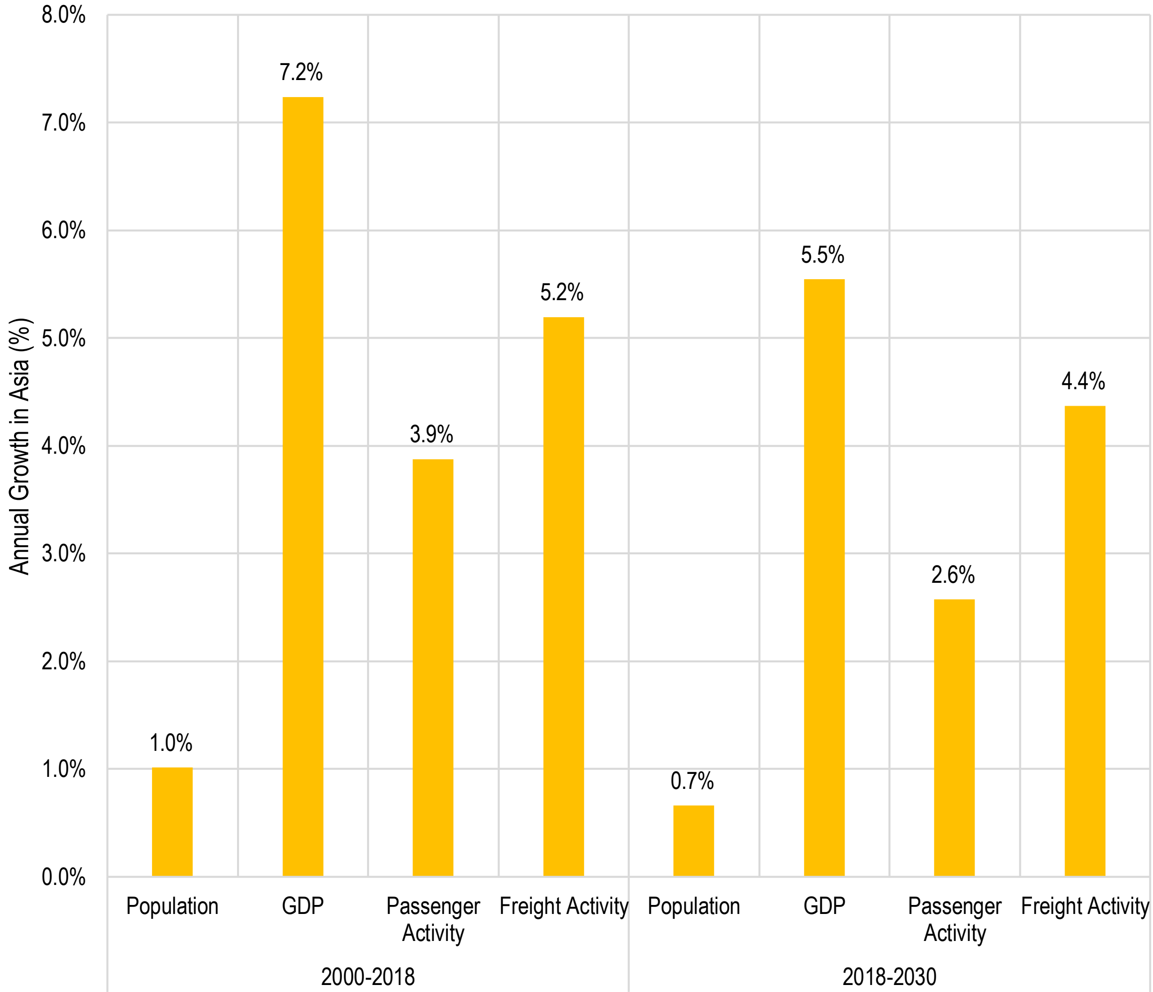


Fig. 14: Annual growth in socio-economic drivers and travel demand in Asia

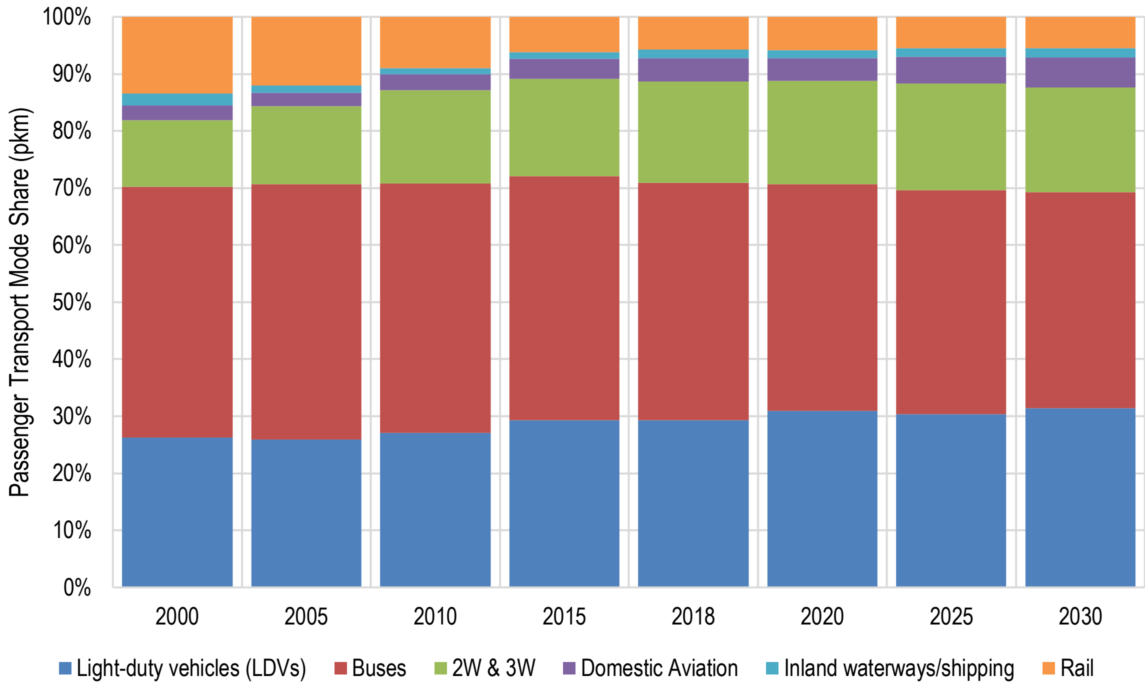
GDP = Gross Domestic Product

Source: Asian Transport Outlook (2022) National Database SEC-DEV-001, SEC-SEG-001, TAS-PAT-001, TAS-PAT-002, TAS-PAT-004, TAS-PAT-017, TAS-FRA-004, TAS-FRA-005, TAS-FRA-006, TAS-FRA-007

35. We find that the mobility rates recover quickly to pre-pandemic levels quickly, latest by 2025. This trend is in line with the analysis of the google community mobility reports and tom-tom congestion data which shows movement trends by region and across different categories of places or cities.

Public transport and rail continue to lose out to road based private vehicles

36. We project a worrisome trend in travel patterns when it comes to environmental and social sustainability of transport. There is a significant mode shift away from public transport to private transport in passenger travel and a shift from railways to road sector, both in domestic passenger and freight transport, leading to higher externalities in terms of road safety and environmental impacts. These shifts are in sync with other trends established in the Outlook – private vehicle ownership increasing faster than buses, stagnant ownership levels of buses, high increase in road infrastructure and slow growth in heavy railways and high-speed railways over the next decade (Fig. 15).



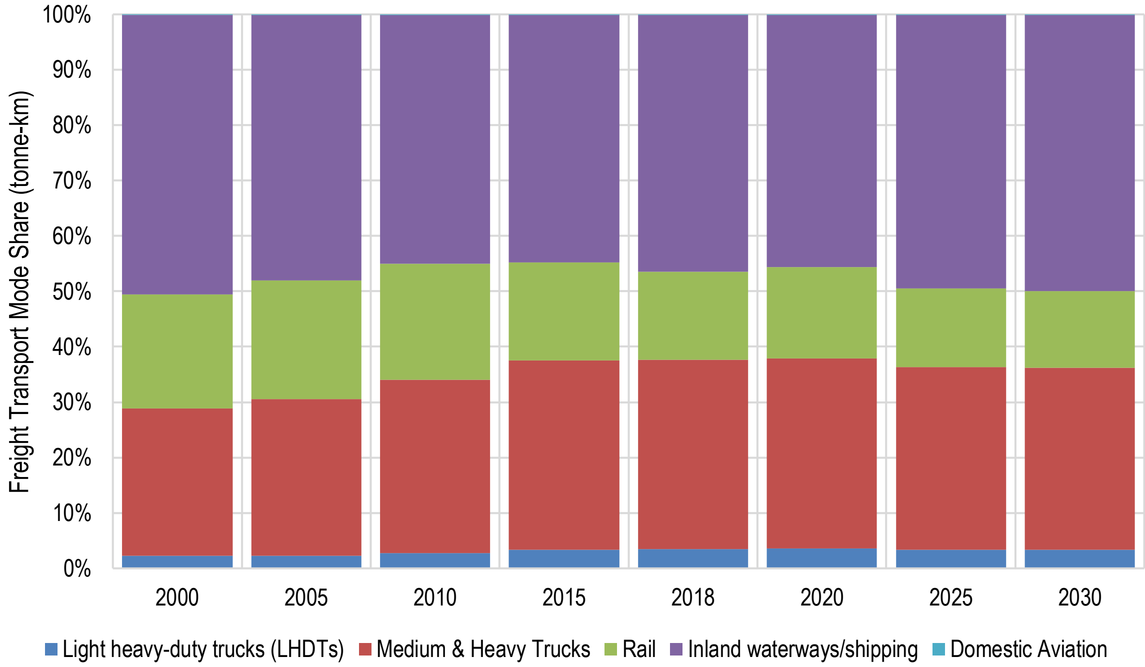


Fig. 15: Freight Mode share estimates

2W = Two wheelers; 3W = Three wheelers; PKM = Passenger kilometres; Tonne-km = Tonne kilometres

Source: Asian Transport Outlook (2022) National Database TAS-PAT-001, TAS-PAT-002, TAS-PAT-004, TAS-PAT-017, TAS-FRA-004, TAS-FRA-005, TAS-FRA-006, TAS-FRA-007

Freight Modal shift policies make an impact on inland waterways and domestic shipping

37. Inland waterways and domestic shipping are an important mode of freight transport in most Asian countries. Our analysis indicates that due to mode shift and infrastructure improvement policies implemented by governments, inland waterways and domestic shipping freight mode share could potentially increase from 45% in 2020 to about 50% in 2030.

Transport Infrastructure development will enable growth in transport activity and thereby facilitate social and economic development

38. Often, transport demand is estimated to evolve regardless of the existence of the infrastructure. Thus, we validate the transport demand growth assessment with motorisation and infrastructure quantifications. Between 2018 and 2030, despite the relative slow increase in transport demand, road infrastructure grows at a slightly higher pace when compared to the past. Asia is still the process of catching up with more developed regions of the world and is putting emphasis on improving national connectivity, as well as urban and rural access. It is apparent, based on our assessment that infrastructure development will be an important enabler for the development of transport demand in Asia thereby facilitate social and economic development.

Table 2: Annual growth in transport demand and infrastructure

	2000-2018				2018-2030			
	PKM	Tonne-km	Vehicle Ownership	Infrastructure	PKM	Tonne-km	Vehicle Ownership	Infrastructure
Light-duty vehicles (LDVs)	5%		7%		3%		3%	
Buses	4%		4%		2%		1%	
2-Wheelers	7%		8%	3.0%	3%		3%	3.5%
3-Wheelers	4%		8%		4%		3%	
Domestic Aviation	6%	8%			5%	3%		
Inland waterways/shipping	2%	5%			3%	5%		
Railway	-1%	4%		1.6%	2%	3%		1.6%
Light heavy-duty trucks (LHDTs)		8%				4%		
Medium heavy-duty trucks (MHDTs)		7%	2%			5%	1%	
Heavy heavy-duty trucks (HHDTs)		7%				4%		

PKM = Passenger kilometres; Tonne-km = Tonne kilometres

Source: Asian Transport Outlook (2022) National Database TAS-PAT-001, TAS-PAT-002, TAS-PAT-004, TAS-PAT-017, TAS-FRA-004, TAS-FRA-005, TAS-FRA-006, TAS-FRA-007, TAS-VEP-021, INF-TTI-005, INF-TTI-014, INF-TTI-015, INF-TTI-016

39. Our estimates only confirm what is already known – continued growth in travel activity, with the highest growth in domestic freight travel and a shift in travel behaviour in Asia towards road-based passenger transport. Compared to other regional projections, we project a somewhat lower intensity of travel growth, especially for domestic passenger transport (Fig. 16). This is mainly due to the use of more modest growth in economic forecasts. Other possible factors could include – differences in regional boundaries, country-specific or regional-specific assumptions and varied modelling approaches

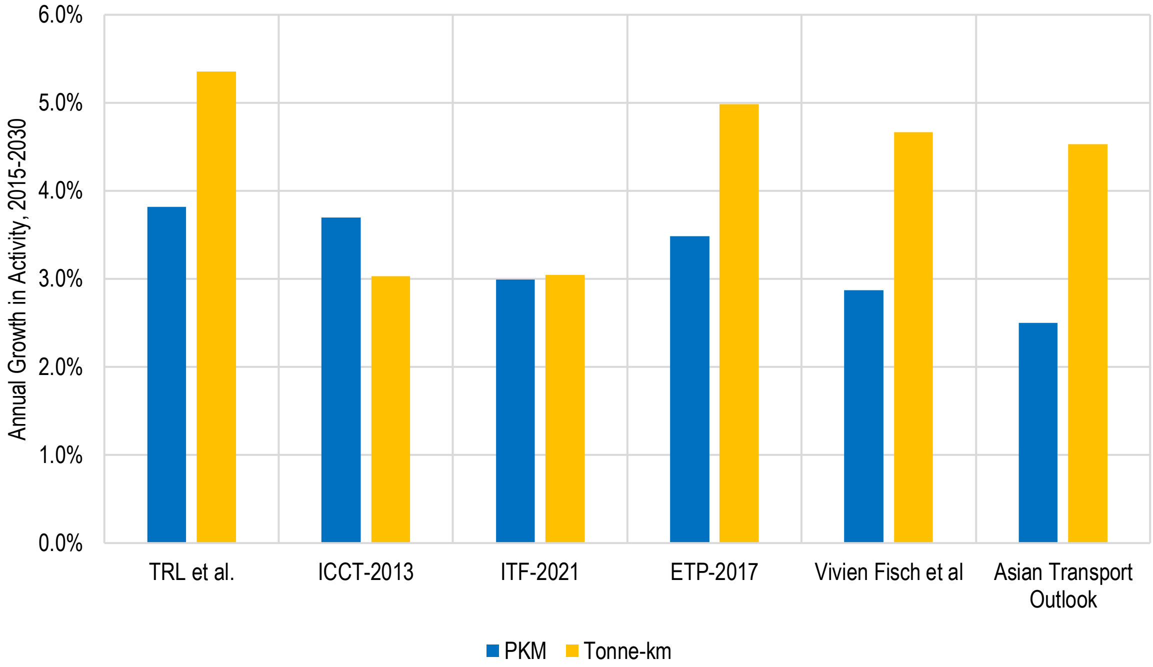


Fig. 16: Annual growth in transport activity (passenger and freight)

ETP = Energy Technology Perspectives; ICCT = International Council on Clean Transportation; ITF = International Transport Forum; PKM = Passenger kilometres; Tonne-km = Tonne kilometres; TRL = Transport Research Laboratory

Source: Asian Transport Outlook (2022) National Database TAS-PAT-001, TAS-PAT-002, TAS-PAT-004, TAS-PAT-017, TAS-FRA-004, TAS-FRA-005, TAS-FRA-006, TAS-FRA-007

Box 4:

Methodology for developing transport activity projections

The transport activity projections presented in this outlook make use of a combination of different aggregated transport national or regional modelling outputs which are combined and calibrated with the historical relationships between economic development, approximated by GDP, key socio-demographic variables (population size), and transport activity. The premise of outlook projections is that historically, there has been a close statistical correlation between the growth in transport, both passenger and freight activity with growth of Gross Domestic Product (GDP) and Population (Fig. 17). We carried out these projections at the country level but aggregated the results into regional or income groups for the presentation of results.

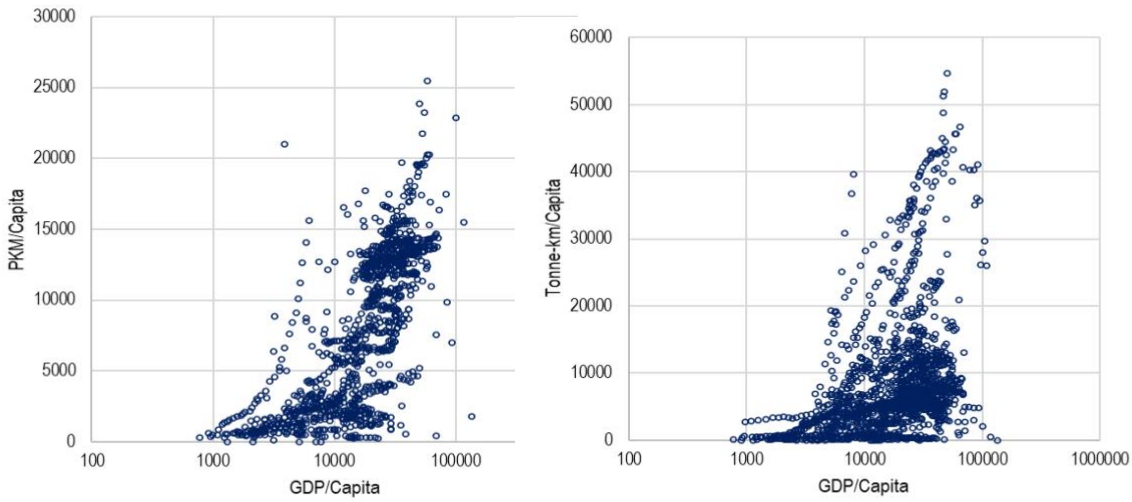


Fig. 17: Per capita transport demand with GDP/Capita

GDP = Gross Domestic Product; PKM = Passenger kilometre; Tonne-km = Tonne kilometre

Source: Asian Transport Outlook (2022) National Database SEC-DEV-001, TAS-PAT-001, TAS-PAT-002, TAS-PAT-004, TAS-PAT-017, TAS-FRA-004, TAS-FRA-005, TAS-FRA-006, TAS-FRA-007, SEC-SEG-002

VII. Are Asian cities becoming more accessible?

40. Poor access to economic and social opportunities in cities is a significant barrier to the socio-economic development of cities. Target 11.2 of the Sustainable Development Goals (SDGs) acknowledges this developmental role of transport and states the following ambition: "by 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons".

1.37 billion urban residents lack efficient access to urban public transit

41. SDG Target 11.2 has as its defined indicator: "Proportion of population that has convenient access to public transport by sex, age, and persons with disabilities". To track the progress towards SDG Target 11.2, it is key to measure the access to reliable, quality public transportation. This is done using a proxy of the percentage of the population within [0.5] kilometres of public transit running at least every twenty minutes. Using this methodological approach UN-Habitat (UN-Habitat, 2020), report that public transit access is still inferior in developing cities of Asia and Africa. Out of 10 people, only about 3 to 4 have the possibility of convenient access to urban public transit. In the case of Asia, this means that in 2019 1.37 billion urban residents lacked efficient access to urban public transit in 2019 (Fig. 18).

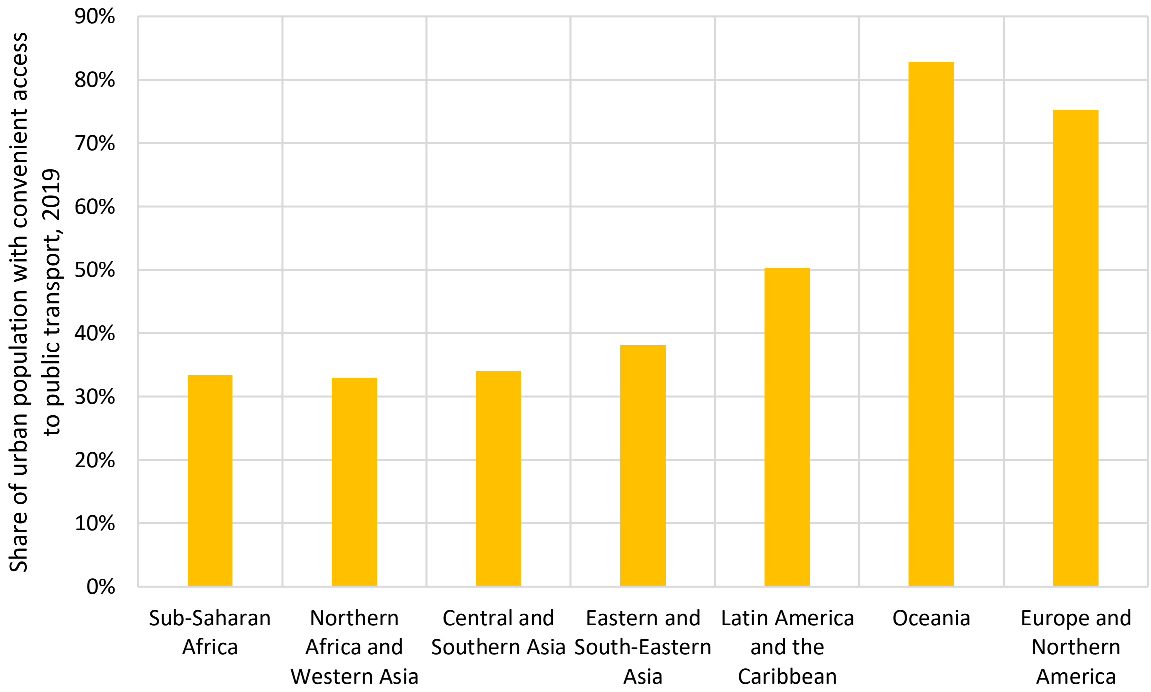


Fig. 18: Share of urban population with convenient access to public transport, 2019

Source: (UN-Habitat, 2020)

42. For the 2030 outlook, we do not measure urban access using the SDG variable due to the lack of access to sophisticated models and disaggregated data. Instead, we utilise proxy variables, i.e., historical construction data (ITDP, 2022) on rapid urban transit, i.e., BRTS, Metro and LRT systems and growth in bus ownership, to project progress on urban access.

Metro dominates improvement of access to urban transit

43. Between 2000 to 2020, Asian economies increased rapid urban transit by about 10,200 kilometres. Between 2020 to 2030, Asia could add an urban transit network of about 11,500 kilometres. We predict the following distribution of additional urban transit infrastructure: upper-middle-income economies (56%) followed by low and lower-middle-income economies (43%) and high-income economies (1%).

44. The amount of rapid urban transit infrastructure varies significantly among Asian countries. For example, in 2020, the low and lower-middle-income, upper-middle-income and high-income economies had urban access of about 2, 8 and 16 km per million urban population, respectively. By 2030, this ratio is expected to be about 4, 14 and 18 km per million urban population for low and lower-middle-income, upper-middle-income, and high-income economies. The increase in urban transit kilometres per urban population is from 6 (in 2020) to 9.6 (in 2030) kilometres per million population (Fig. 19).

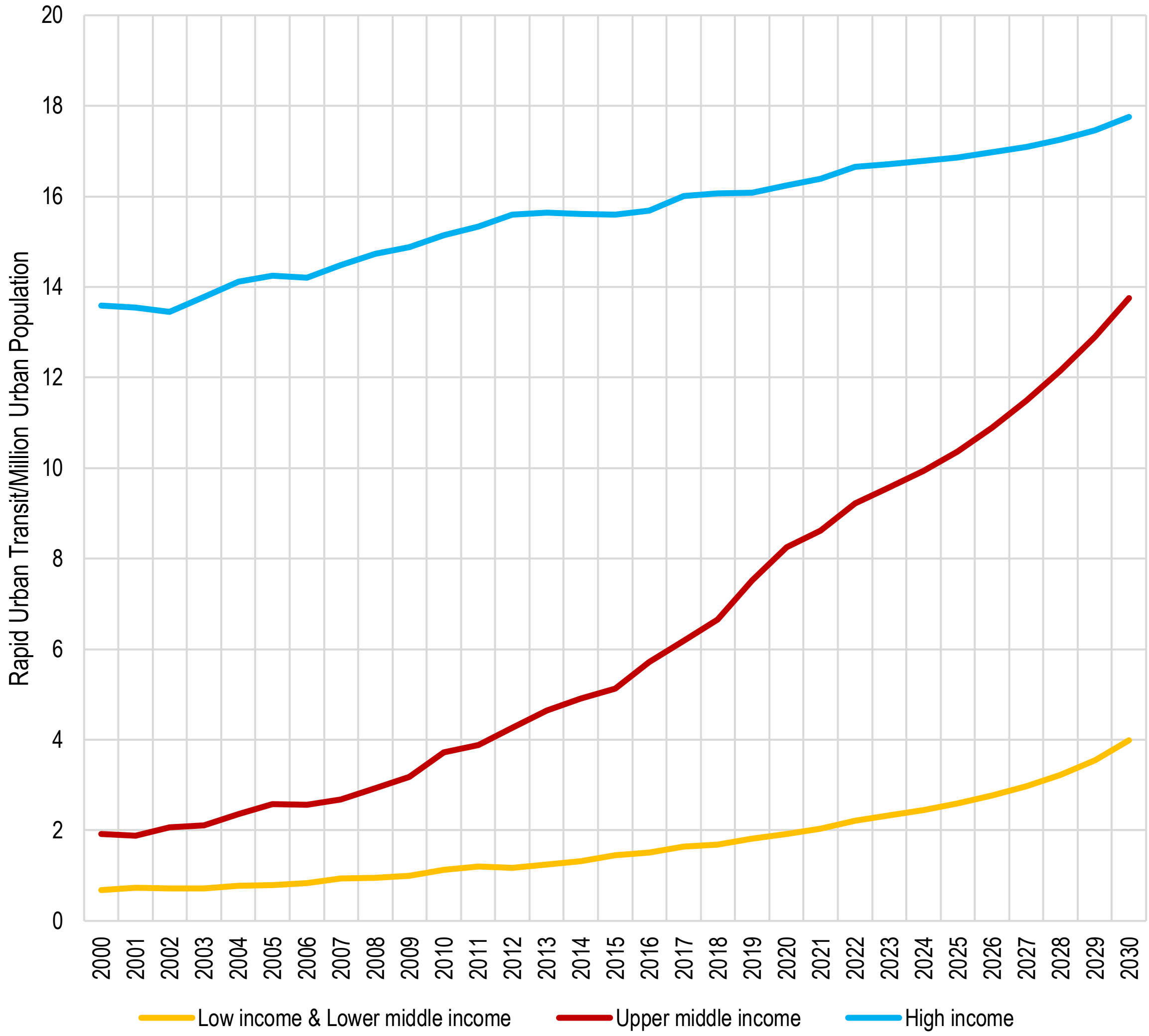


Fig. 19: Rapid urban transit per million urban population

Source: Asian Transport Outlook (2022) National Database ACC-UAC-002

45. Currently, rapid urban transit infrastructure in Asia is mostly in the form of metro systems with 82% share. BRTS and light rail transit constitute only 12% and 6% share. Between 2020 to 2030, most of the infrastructure expansion would be in the form of metro lines with a 73% share. The share of BRTS and LRT in the infrastructure expansion would only be 18% and 8%.

Missing the Buses

46. In terms of access to public transit vehicles, we consider the indicator bus (which includes mini buses and other informal public transport vehicles). The ownership of buses increased significantly over the 2010 to 2015 period, especially in lower-middle-income countries of India and Indonesia, due to urban renewal programs and public subsidies. However, partly due to the rapid increase in shared mobility services and the continued growth of private vehicle ownership, demand for travel by bus and the per capita ownership of buses has reduced marginally from 2015 to 2020. As the drivers for lower demand by bus travel continue to be relevant, we expect that the per capita bus ownership will continue to decline. Currently, bus access is highest in low and middle-income economies (10 buses/1,000 urban population) when compared with the upper middle income (5 bus/1,000 pop) or high-income economies (3 bus/1,000pop) (Fig. 20).

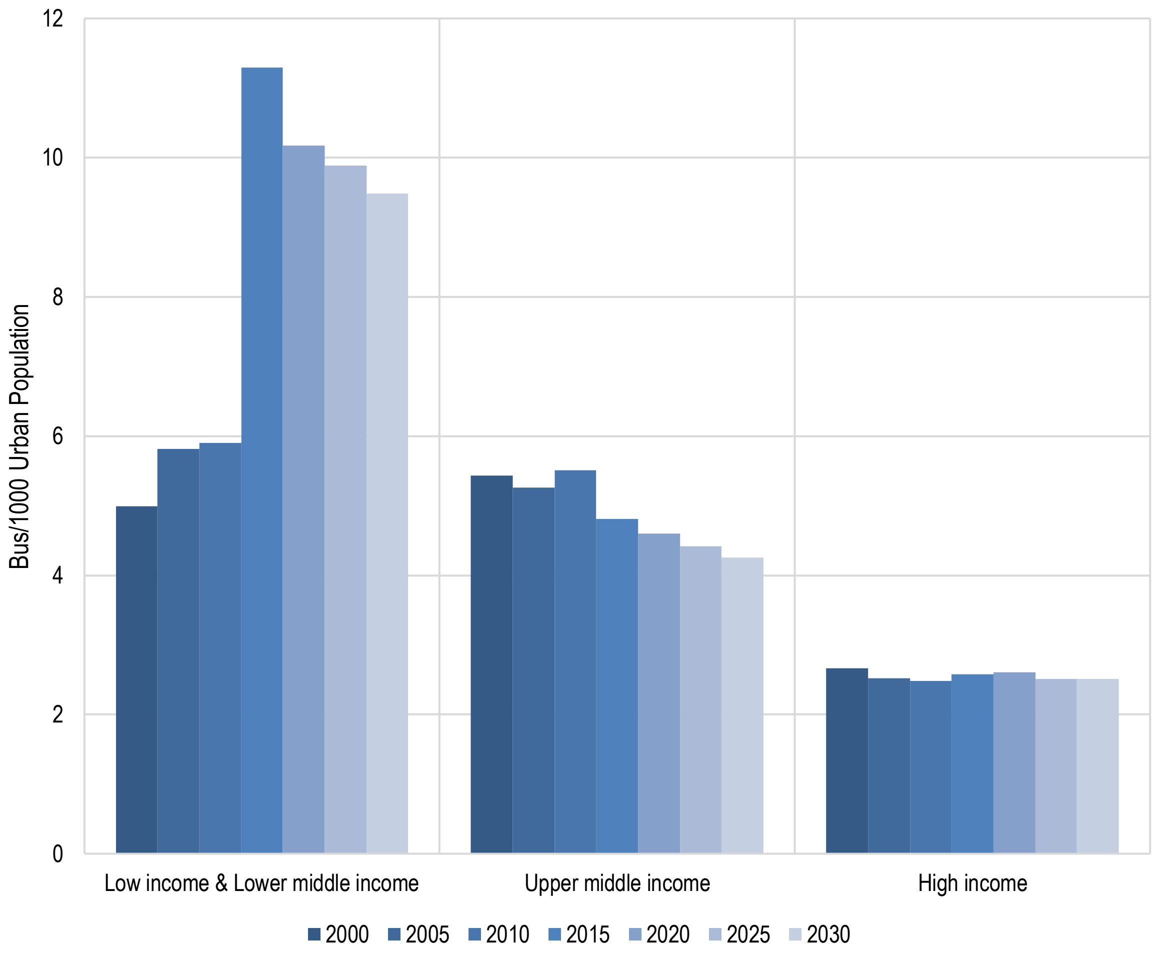


Fig. 20: Buses per 1000 urban population

Source: Asian Transport Outlook (2022) National Database TAS-VEP-060

Box 5:

Methodology for developing urban access projections

For the 2030 outlook, we do not measure urban access using the same variable due to the lack of access to sophisticated models and disaggregated data. Instead, we utilise historical construction data[1] on rapid urban transit, i.e., BRTS, Metro and LRT systems, to measure progress on urban access. The metro and LRT construction projections are described in the previous section. The BRTS projections are based on the average of:

- the historical rate of infrastructure expansion;
- maximum and minimum rates of infrastructure expansion for different typologies of countries to document the enhanced priority of BRTS or saturation levels and
- global regression of BRTS network length with GDP and urban population to establish a relationship with income and urban people and transpose that relationship in Asian economies.

For developing the indicator - Bus/1000 Urban Population, we utilised disaggregated historical bus ownership data (which includes informal public transport vehicles) from 2000 to 2020 from Asian economies to forecast the growth of the public transport vehicle ownership population ratio (vehicle per capita) as a function of per-capita GDP. Using the bus projections, we derive the total buses per thousand urban population as a proxy variable to understand urban access. It is essential to acknowledge that buses not only serve in urban areas but also in rural and intercity operations.

VIII. Will rural transport access in Asia improve?

47. The developmental role of rural transport is reflected in SDG Target 9.1: "develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all". The SDG Target 9.1 has its defined indicator: "Proportion of the rural population who live within 2 km of an all-season road," i.e., Rural Access Index (RAI). The RAI is defined as the share of a country's rural population that lives within 2 km (a walking distance) of an all-season road[5].

Marginal improvements in rural access

48. Poor access to economic and social opportunities offered by rural areas is a significant barrier to socio-economic development. In 2019, close to 75% of the rural population in Asia and Pacific economies lived close to 2 kilometres from an all-season road. However, rural access varies significantly, i.e., from 23% in Papua New Guinea to above 90% in the Republic of Korea, Japan, Sri Lanka, Armenia and Taipei,China.

49. Considering historical trends and if countries sustain existing policies and investments, we predict very minor improvements in rural accessibility by 2030, i.e., the rural access index could increase from 75% to 76% by 2030. The largest, but still modest, improvement is observed in Central & Western Asia (from 57% to 60%). By 2030, we estimate that an additional 55 million rural residents could be additionally provided with rural access as defined by the indicator for SDG target 9.1. However, by 2030, close to 515 million rural inhabitants are projected to be still without rural access, i.e., staying more than 2km away from "all-season" road. Thus, based on historical trends, Asia and the Pacific region will not achieve universal access to all-season roads by 2030. This confirms the need for targeted rural road investments to improve rural accessibility (Fig. 21).

[5] The rural access estimate offers limited insight on rural mobility as being connected to the roads does not mean that transport services are available and affordable.

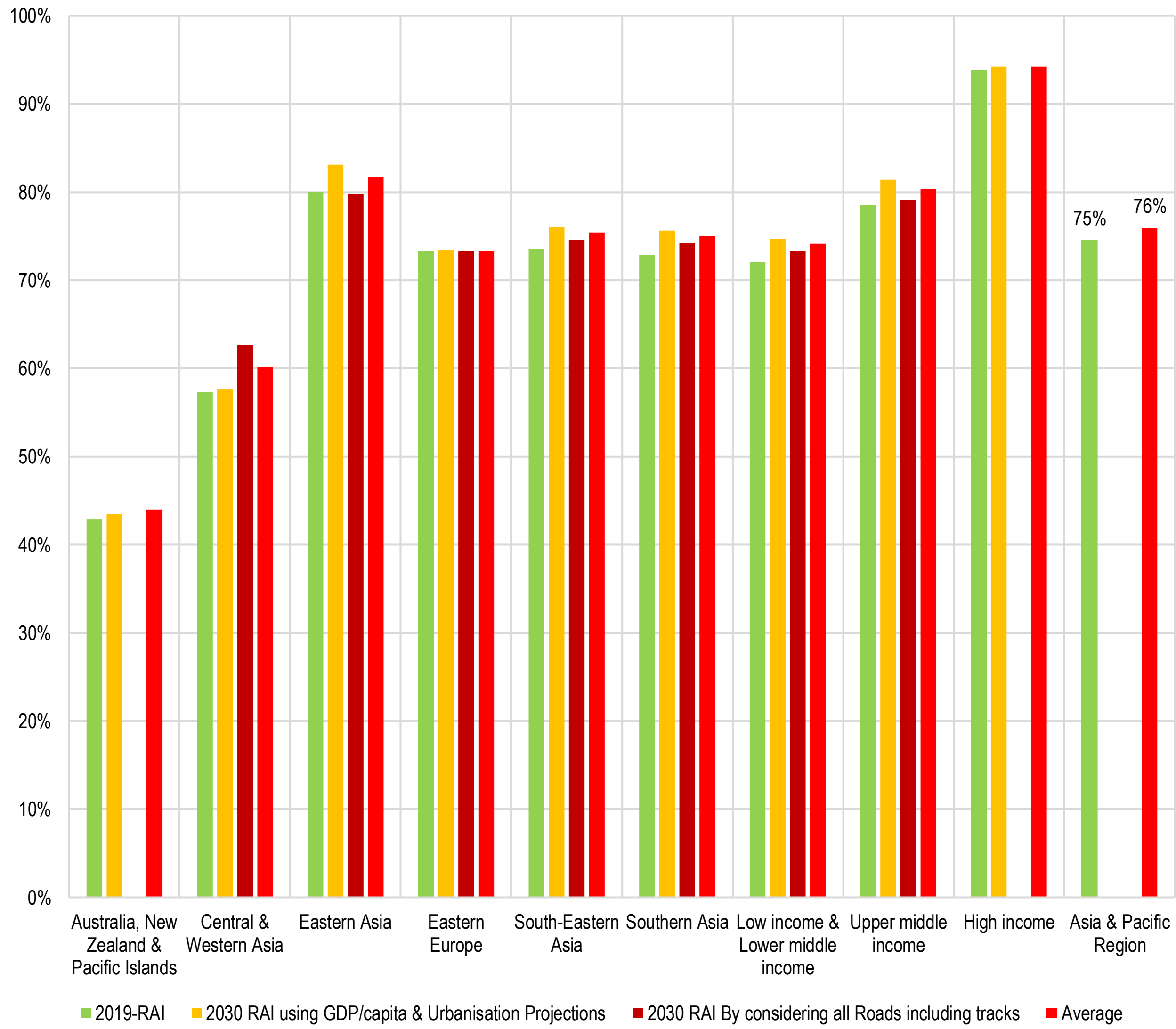


Fig. 21: Rural access index

RAI = Rural Access Index

Source: Asian Transport Outlook (2022) National Database ACC-RAC-001

50. We could not validate the rural access projections with external studies as these depend on several factors, including geography, road network connectivity, population distribution, and road unit costs. Our reference scenario, which assumes a continuation of existing policies and investments, suggests only a modest rural access improvement. Previously, World Bank has quantified a much more ambitious scenario under which developing countries would spend 1% of GDP only on rural roads. Under this ambitious scenario, rural accessibility could increase from 39% to 52% by 2030 across all developing countries (WB, 2019). However, currently, Asian economies spend only an average of 1-2% of GDP on infrastructure construction and maintenance in the transport sector. Considering that rural road investment could be significantly lower, the modest improvement in rural accessibility may become a reality.

Box 6:

Methodology for developing rural access projections

The rural accessibility indicator combines three sets of geospatial data: where people live, the spatial distribution of the road network, and road passability. At a macro level, it is challenging to make accurate predictions on all three parameters - where people live, the spatial distribution of the road network, and road passability. The historical trend on rural accessibility consists of estimates developed using different methodologies and data parameters i.e., household surveys vs geospatial data. Thus, we opted not to rely on historical trends on rural accessibility as shown in Fig. 22.

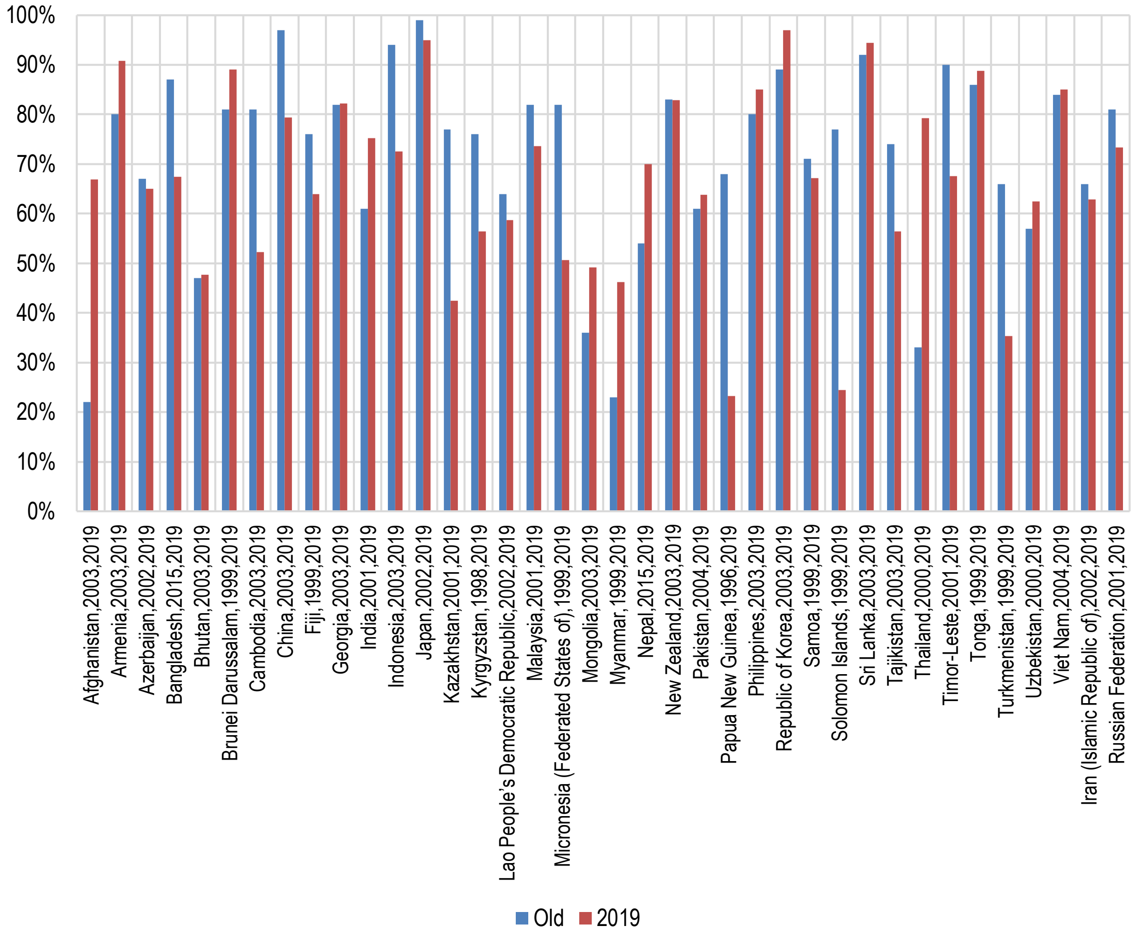


Fig. 22: Rural accessibility

Source: Asian Transport Outlook (2022) National Database ACC-RAC-001

Thus, to develop a baseline scenario for rural access in Asia, we rely on two types of sketch assessments and combine them to determine an average -

i. We rely on the 2019 World bank baseline rural access data derived through spatial techniques and its correlation with GDP/capita and urbanisation ratio. The hypothesis is, that as countries become wealthier, they improve their infrastructure, enhancing rural accessibility. Further, as countries get more urbanised, rural access relatively improves as the migration of the population from rural to urban areas reduces the share of people living in rural areas. We estimated the elasticities by considering a multiple regression of rural access with GDP per capita, the current urbanisation rate derived by UN World Urbanization Prospects by considering 178 economies. We consider global data to get better sample size and more refined relationships. The 2030 rural access index is then estimated using the elasticities with the 2030 projections for GDP per capita and urbanisation rates (Fig. 23).

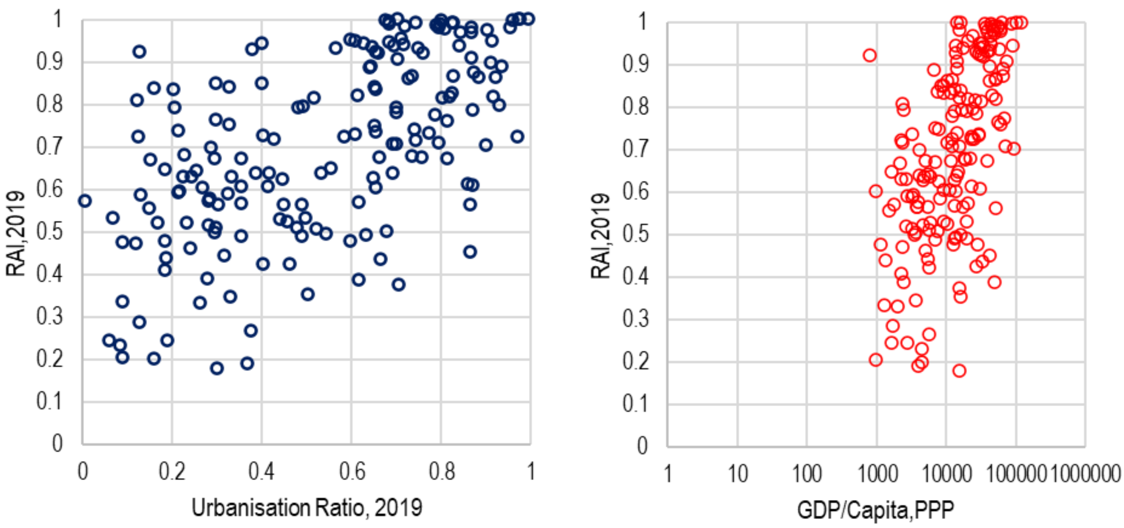


Fig. 23: Rural access index with urbanisation and income

GDP = Gross Domestic Product; PPP = Purchasing Power Parity; RAI = Rural Access Index

Source: : Asian Transport Outlook (2022) National Database ACC-RAC-001, SEC-SEG-002

ii. The second approach is built by replicating a previous developed World Bank[1] scenario where all existing 'tertiary' roads and 'tracks' are converted into "all-season" roads (where applicable), i.e., countries don't build new rural roads but upgrade the quality of existing infrastructure. We assume that over the next ten years, Asian economies improve existing 'tertiary' roads and 'tracks' and make them all-weather. The improvement rates derived from that study are imposed on the historic RAI estimates to estimate the 2030 rural access.

Thus, we derive the 2030 rural access index by averaging the two estimates.

IX. What is the future of Road safety in Asia?

Road safety projected to improve

51. From 2011 to 2020, an estimated 13 million people globally lost their lives in road crashes, and many more were seriously injured (ITF-B, 2021). Over 60% of these casualties occurred in Asia. However, road crash fatalities in Asia peaked in 2016 with an estimated 800,000 victims, with a downward trend since then.

52. Based on historical trends and policies currently implemented, we estimate that by 2030 road crash fatalities in the Asian and Pacific region could decrease from about 762,000 in 2020 to about 600,000 in 2030. This reduction of 20% is significantly lower than the required 50% reduction called for by the SDG's. The annual rate of change in road crash fatality is projected to be the highest in upper-middle-income countries with (-3.7%) followed by low and lower-middle-income economies (-2.7%) and high-income economies (-1.5%) (Fig. 24).

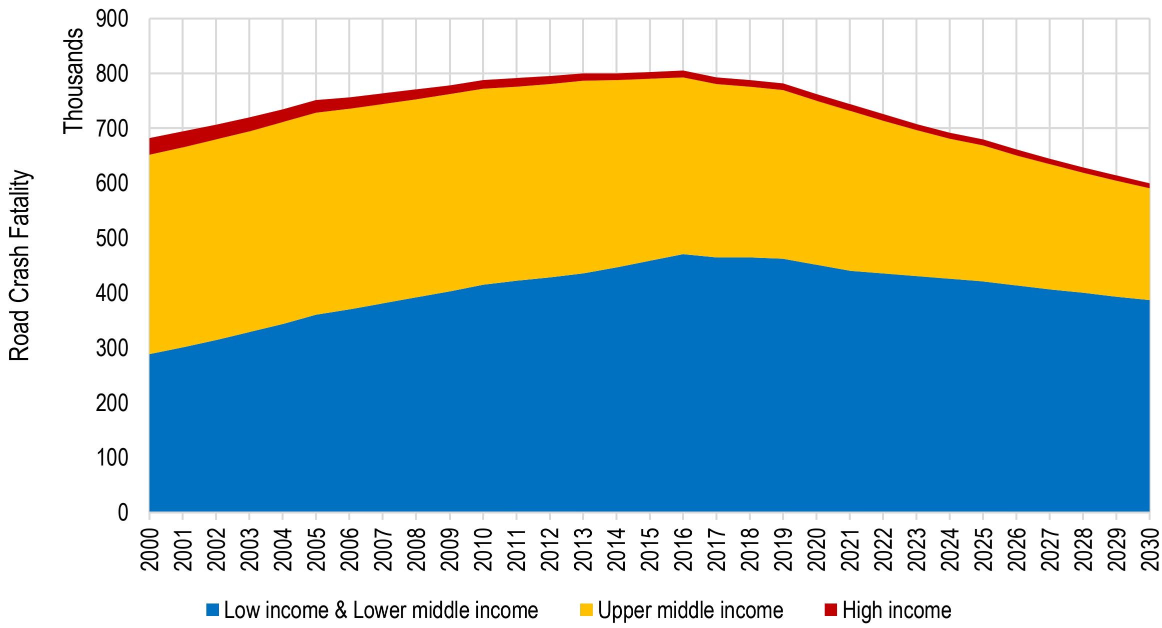


Fig. 24: Road crash fatalities

Source: Asian Transport Outlook (2022) National Database RSA-RSI-001

Economic cost of road safety remains high

53. While road crash fatality and serious injuries are expected to go down by 20% their socio-economic cost and is set to increase from 638 billion USD[6] in 2020 to 850 billion USD in 2030, this is due to an increase in the value of statistical life. In terms of road crash fatality and serious injuries socio-economic costs as a share of GDP, we estimate a reduction from 5% to 4% by 2030. (Fig. 25).

[6]To calculate the socio-economic costs – we considered defaults from International Road Assessment Programme (iRAP)- Value of fatality = 70* GDP/Capita, value of serious injury = 17.5* GDP/capita & ratio of No of serious Injury to fatality = 10

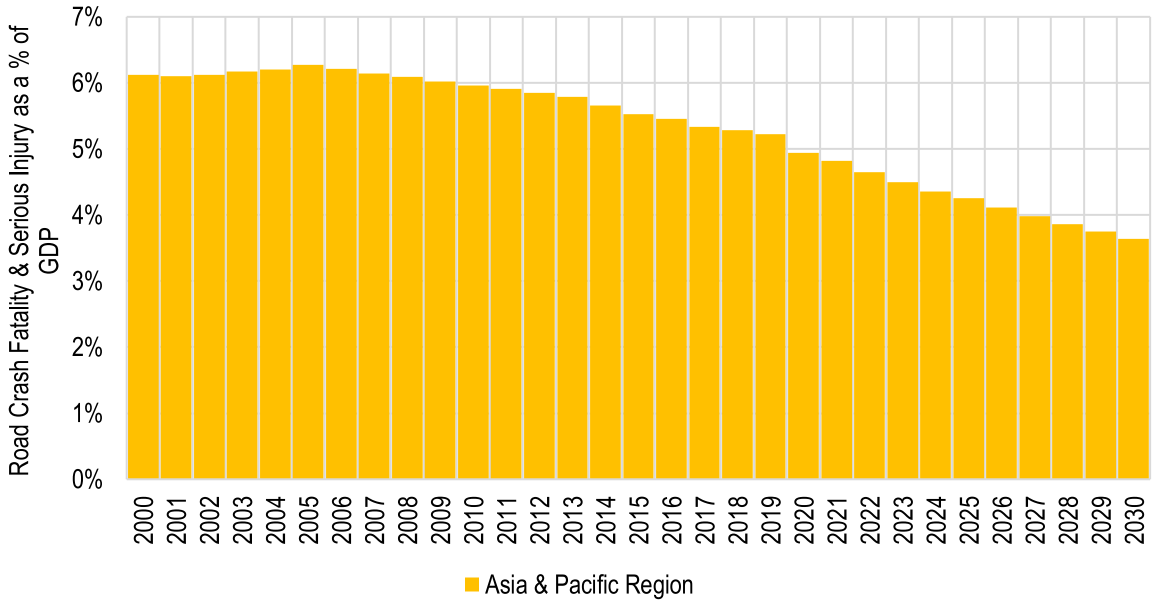


Fig. 25: Road crash fatality and serious injury as a share of GDP

GDP = Gross Domestic Product

Source: Asian Transport Outlook (2022) National Database RSA-RSI-001, RSA-RSI-012, SEC-SEG-002

Box 7:

Methodology for developing Road Safety projections

Road crash fatality projections were derived using multiple tools. Due to a lack of reliable and long enough time series on road fatalities and serious injuries from national sources, we rely on historical estimates from WHO. We used the following approaches and derived an average forecast:

- UNECE - Safe FITS Model. This is a global comprehensive statistical model based on historical road safety data and relationships between several road safety parameters, and provides information on the impacts of different road safety scenarios. It uses a two-step modelling approach, including first the calculation of composite variables, and then their introduction in a generalised linear model correlating them with road safety. It includes the following variables, outputs (and defaults): economy and management, transport demand and exposure, road safety measures, road safety performance indicators as well as fatalities and injuries.
- We build simple Asia-specific regression relationships between road crash fatalities and road length, vehicle kilometers travel and GDP. Based on the forecasts for GDP, vehicle kilometers and road length, future road crash fatalities and serious injuries are quantified.

To calculate the socio-economic costs of road crash fatalities and serious injuries we considered defaults from International Road Assessment Programme (iRAP): Value of fatality = 70* GDP/Capita, value of serious injury = 17.5* GDP/capita whereby the ratio of number of serious injuries to fatalities is set at 10.

X. Transport Carbon Emissions in Asia: is the Glass half full or empty?

54. Transport CO2 emissions have grown faster in Asia in the past two decades than anywhere else in the world. However, the transport landscape in Asia is rapidly evolving. The growing demand for passenger and freight transport is increasingly being met by road-based modes – two-and-three wheelers, cars, and trucks. Vehicle energy technologies are however also evolving. While the road transport sector in Asia is still one of the least diversified energy end-use sectors, fuel efficiency of vehicles is improving, and the share of electric vehicles is increasing fast. Overall, this challenges the general hypothesis that all things being equal, growing mobility will lead to proportional changes in CO2 emissions.

Transport CO2 emissions will continue to grow and not peak by 2030

55. We estimate that between 2018 to 2030, transport CO2 emissions could increase annually by 1.5%, i.e., from 2.9 in 2018 to 3.5 Gt in 2030. East Asia contributes to half of the transport CO2 emissions in Asia. The second biggest contributor is South East Asia with about 22% emissions (Fig. 26). In terms of income segregation, 50% of Asia's transport CO2 emissions are generated by the upper-middle-income economies, one-third by low and lower middle income and the rest by high-income economies. The emission share by regions is expected to remain stable until 2030

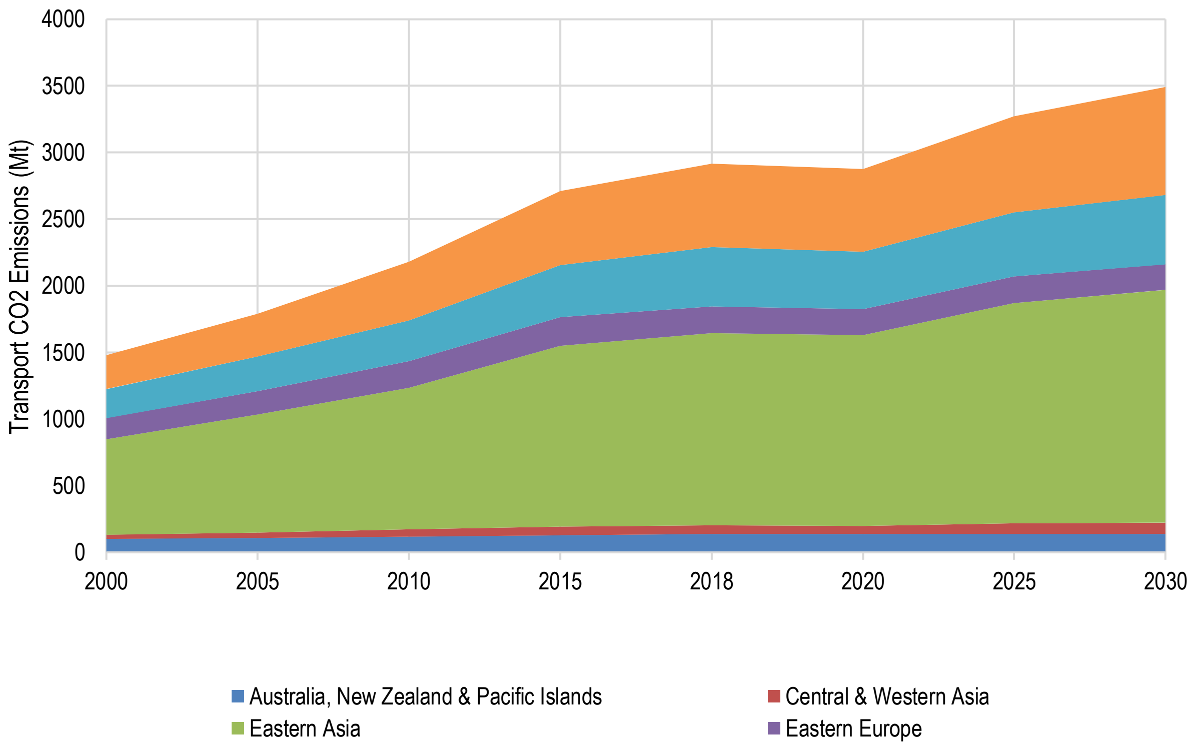


Fig. 26: Transport CO2 emissions

CO2 – Carbon Dioxide; Mt = Metric Tonne

Source: Asian Transport Outlook (2022) National Database CLC-VRE-045

Road freight is the most critical source of transport-related CO2 emissions

56. Most of the transport CO2 emissions are generated by roads and would continue to remain so in future (about 86%). Details of the modal split vary by country, depending on policies, product mix and activity. However, at a regional level, we estimate that in 2018 nearly 60% of transport CO2 emissions were contributed by passenger cars and medium-heavy duty trucks. Two and three-wheelers which constitute 50% of the vehicles and 18% of passenger kilometres travel, contributed 5% of emissions. Research has established that passenger transport has a head start in the decarbonisation journey compared to freight (Gota, Huizenga, Peet, Medimorec, & Bakker, 2018). Our quantification confirms this premise. We find passenger transport mode share in overall transport emissions reducing due to slower growth in passenger activity and shift in technologies when compared to freight (Fig. 27). As noted, earlier growth in demand for domestic freight movement will continue to outpace the demand for domestic passenger mobility in Asia. This results in an increasing share of freight emissions within the transport sector. For example, in 2000, domestic related freight CO2 emissions constituted about 48% of transport CO2 emissions. By 2030, we estimate that the freight share could increase to 57% of transport CO2 emissions.

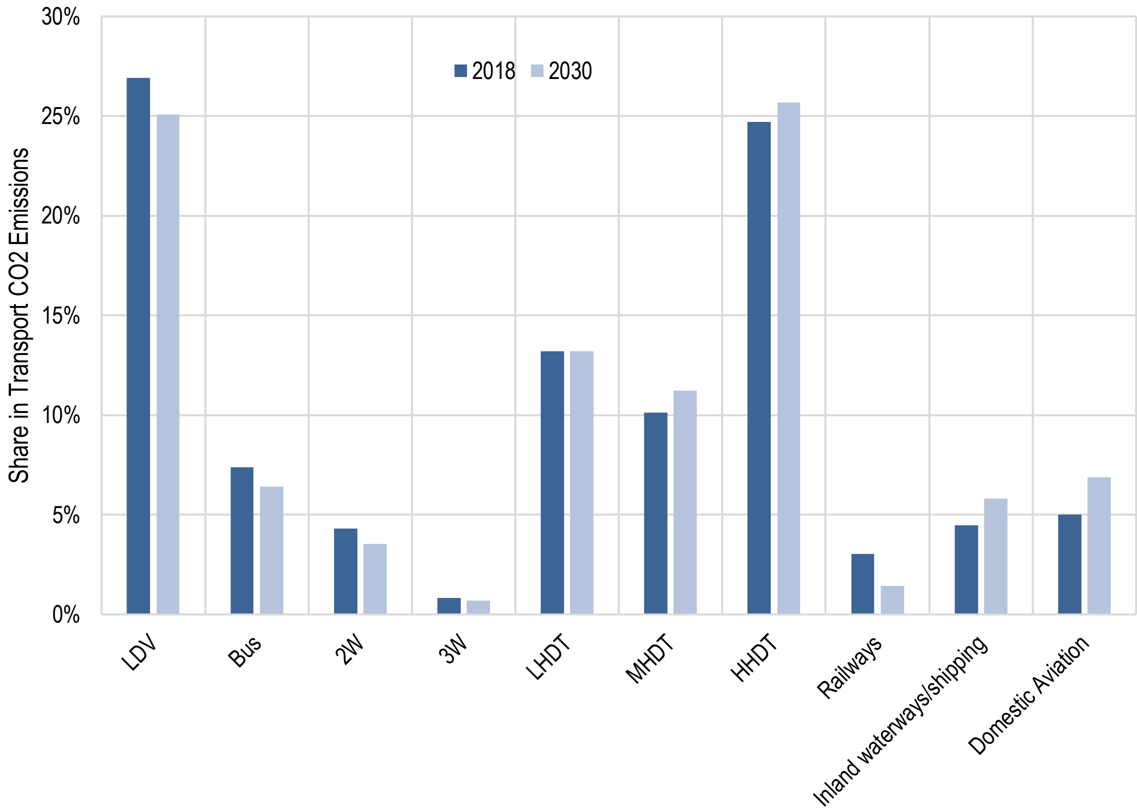


Fig. 27: Modal share in transport CO2 emissions

2W = Two-wheeler; 3W = Three-wheeler; CO2 = Carbon Dioxide; LDV = Light Duty Vehicle; LHDT = Light, Heavy-Duty Truck; MHDT = Medium, Heavy-Duty Truck; HHDT = Heavy, Heavy-Duty Truck

Source: Asian Transport Outlook (2022) National Database CLC-VRE-054, CLC-VRE-055, CLC-VRE-056, CLC-VRE-057

Steady progress in relative decoupling of transport CO2 emissions from economic growth

57. While the domestic passenger and freight activity is projected to increase by 2.6% and 4.4%, passenger and freight transport-related CO2 emissions are only expected to increase 1.1% and 1.8%, respectively. Thus, the net result of the combined evolution of transport demand growth, modal composition, technological change, and climate-related policy action is that CO2 emissions will rise less quickly than mobility and GDP. Historically, transport carbon emissions are already relatively decoupling with GDP in Asia, i.e., growing slower than GDP. We predict that the relative decoupling trends will continue. However, our estimates also conclude that transport CO2 emissions are not expected to peak before 2030, putting at risk the voluntary commitments under the Paris Agreement and the Aichi 2030 Declaration on Environmentally Sustainable Transport[7] (Fig. 27).

58. Among Asian economies, collectively, the high-income economies provide a glimmer of hope. We find that high-income economies have started absolute decoupling of emissions. As a result, we estimate that 2030 transport CO2 emissions of this group of economies could be 6% below COVID levels.

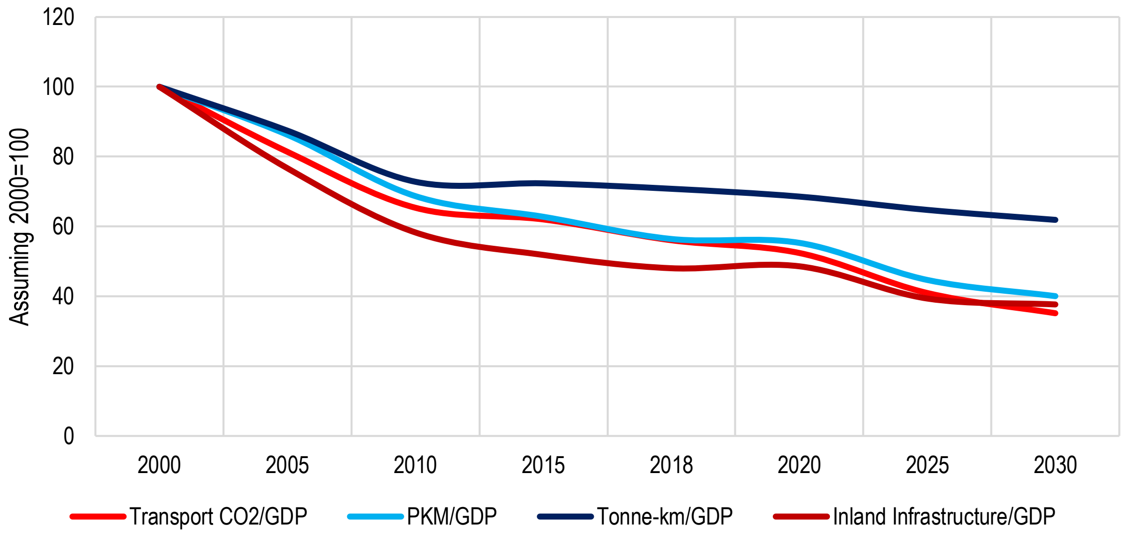


Fig. 28: Transport CO2, activity and infrastructure estimates

CO2 = Carbon Dioxide; GDP = Gross Domestic Product; PKM = Passenger kilometres; Tonne-km = Tonne kilometres

Source: Asian Transport Outlook (2022) National Database CLC-VRE-045, SEC-SEG-001, TAS-PAT-001, TAS-PAT-002, TAS-PAT-004, TAS-PAT-017, TAS-FRA-004, TAS-FRA-005, TAS-FRA-006, TAS-FRA-007, INF-TTI-005, INF-TTI-014, INF-TTI-015, INF-TTI-016

59. An important, albeit relatively modest, contribution toward the decarbonisation of the transport sector in the Asia Pacific region is the rapid electrification of the railway sector. We estimate that Asian railway transport CO2 emissions have already peaked and project an absolute decoupling of railway transport CO2 emissions with rail activity and GDP (Fig. 29).

[7] In 2021, 21 Asian countries had set an aspirational voluntary target under the Aichi 2030 Declaration on Environmentally Sustainable Transport – Making Transport in Asia Sustainable. The target set on transport and climate change was: "By 2030, aim to peak transport CO2 emissions and initiate reductions in transport related CO2 emissions with the intention to move towards decarbonization of the transport sector by 2050, or shortly thereafter (Based on SDG 7.2, 9.1, 13.2, Paris Agreement)"

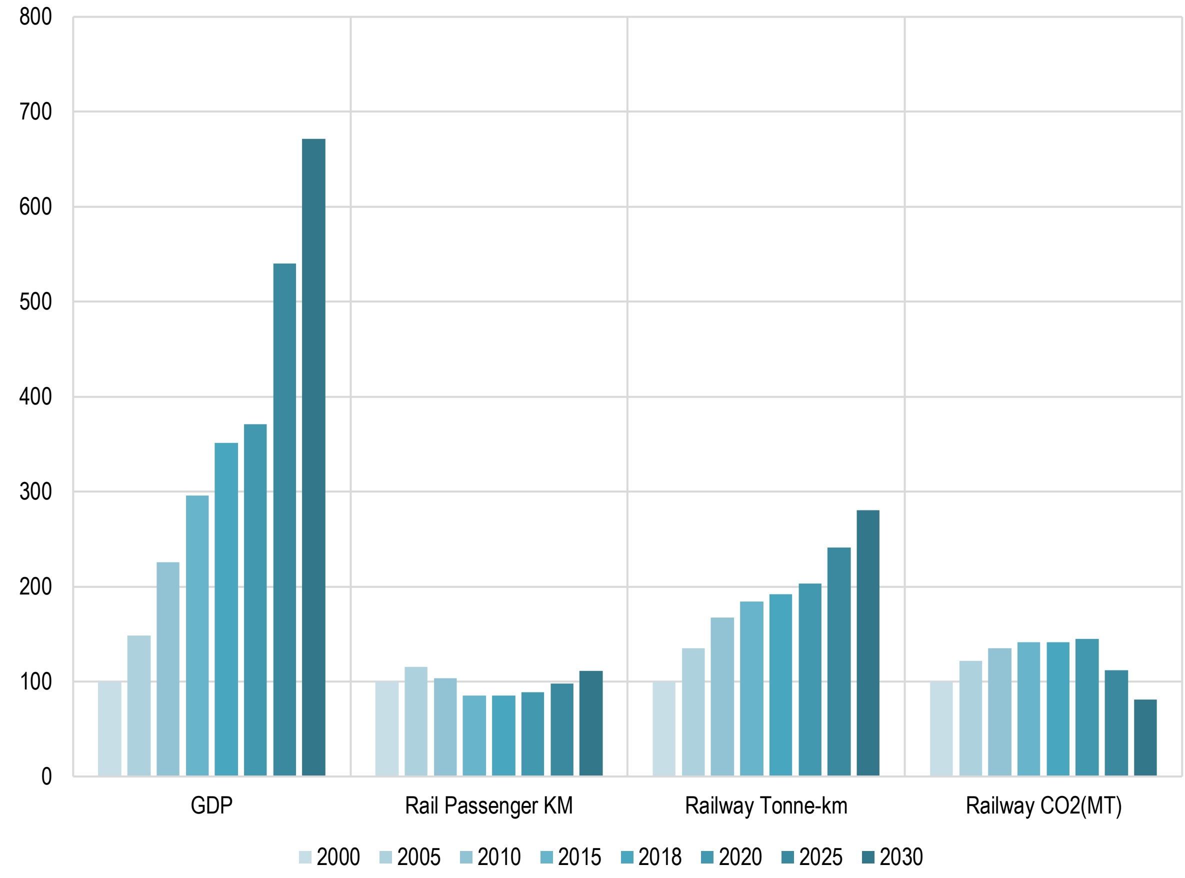


Fig. 29: Rail transport estimates

CO2 = Carbon Dioxide; GDP = Gross Domestic Product; MT = metric tonne; PKM = Passenger kilometres; Tonne-km = Tonne kilometres

Source: Asian Transport Outlook (2022) National Database SEC-SEG-001, TAS-PAT-001, TAS-FRA-005, CLC-VRE-055

Is Asia making progress in Transport Decarbonisation?

60. Benchmarking of quantifications of Asia's Transport CO2 emissions by different reputed institutions over the last two decades suggests a steadily decreasing BAU projection of 2030 transport-related CO2 emissions for the Asian Pacific region. Our ATO projection confirms the slower growth in baseline transport CO2 emissions. This slower growth results from a growing penetration of low carbon technologies, more efficient infrastructure and increasing policy ambition. All of these occur already at still relatively lowest income levels compared to other more developed global regions, resulting in significant changes in emissions trajectory. Although moving in the right direction, our analysis also indicates that the reference scenario outlook for transport CO2 emissions is still incompatible with the Paris Agreement on Climate Change targets.

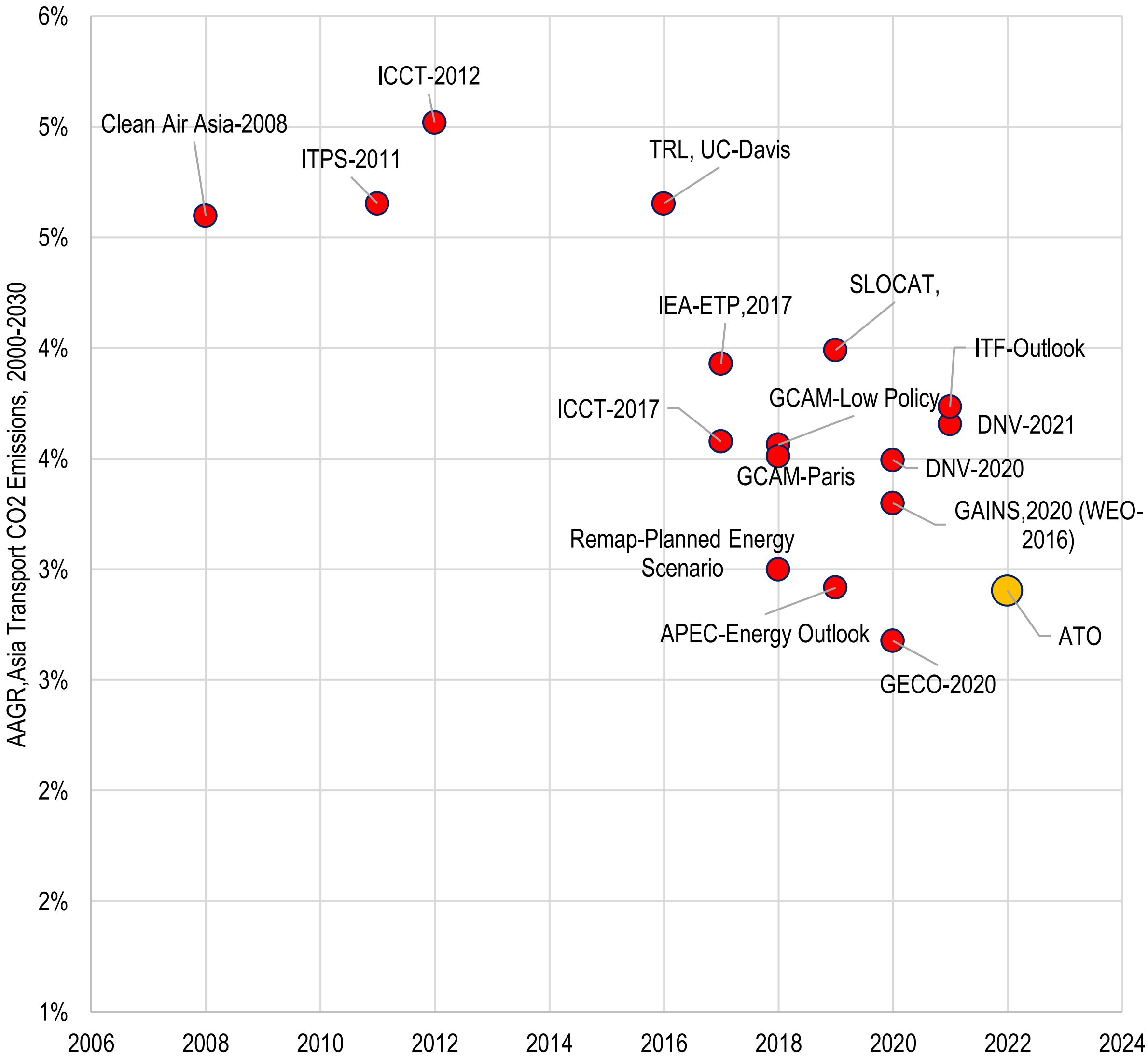


Fig. 30: Asia transport CO2 emissions annual growth, 2000-2030

AAGR = annual average growth rate; APEC = Asia-Pacific Economic Cooperation; ATO = Asian Transport Outlook; CO2 = Carbon dioxide; DNV = Det Norske Veritas; ETP = Energy Technology Perspectives; GAINS = Greenhouse Gas and Air Pollution Interactions and Synergies; GCAM = Global Change Assessment Model; GECO = Global Energy and Climate Outlook; ICCT = International Council on Clean Transportation; IEA = International Energy Agency; ITF = International Transport Forum; ITPS = Institute for Transport Policy Studies; SLOCAT = Partnership on Sustainable, Low Carbon Transport; TRL = Transport Research Laboratory; WEO = World Economic Outlook

Source: Authors

Box 8:

Methodology for developing transport carbon emission projections

We estimate the CO2 emissions from transport using the ASIF framework[1]. For translating transport activity in different modes into CO2 emissions, we utilise regional emission factors mainly derived from: ICCT Roadmap, ITF Outlook 2021 and TRL-ADB Databank. The emission factors are regional and dynamic in character i.e., they reflect improvement in fuel efficiency, technologies, fuel types and vehicle emission standards replicating current policies in play.

We derived the CO2 projections at the country level but aggregated the results into regional or income groups to present the results through a two-step approach. First, we translate the transport activities into CO2 emissions based on regional emission factors from 2000 to 2030. To account for considerable discrepancies in historical data and varied assumptions, we calibrate the differences in historical quantified emissions with the reported CO2 emissions using the top-down methodology for different sub-modes like roads, railways, aviation and shipping. We reconcile the differences to the extent possible by modifying the input variables, i.e., demand, mode share and emission factors. Then in the second step, we quantify the CO2 emissions using the calibrated inputs.

However, we recognise the challenge for countries where there are few accurate data points available for calibration. It is impossible to reconcile the differences (top-down vs bottom-up) due to the paucity of quality data. At an aggregated regional and sub-regional level, the projections are accurate based on benchmarking with other regional estimates.

XI. Is the Transport sector a growing source of Air pollution?

Continued improvements in transport-related air pollution

61. While the key drivers of transport-related air pollution: vehicle numbers and transport activity, are projected to go up, we project that key transport-related air pollutants PM10, Black Carbon (BC), NOx and SOx will continue to decrease in the period up to 2030. This is due to the continued effects of a tightening of vehicle emission standards which is enabled by an improvement in fuel quality, especially the reduction of sulphur levels in gasoline and diesel (Fig. 31).

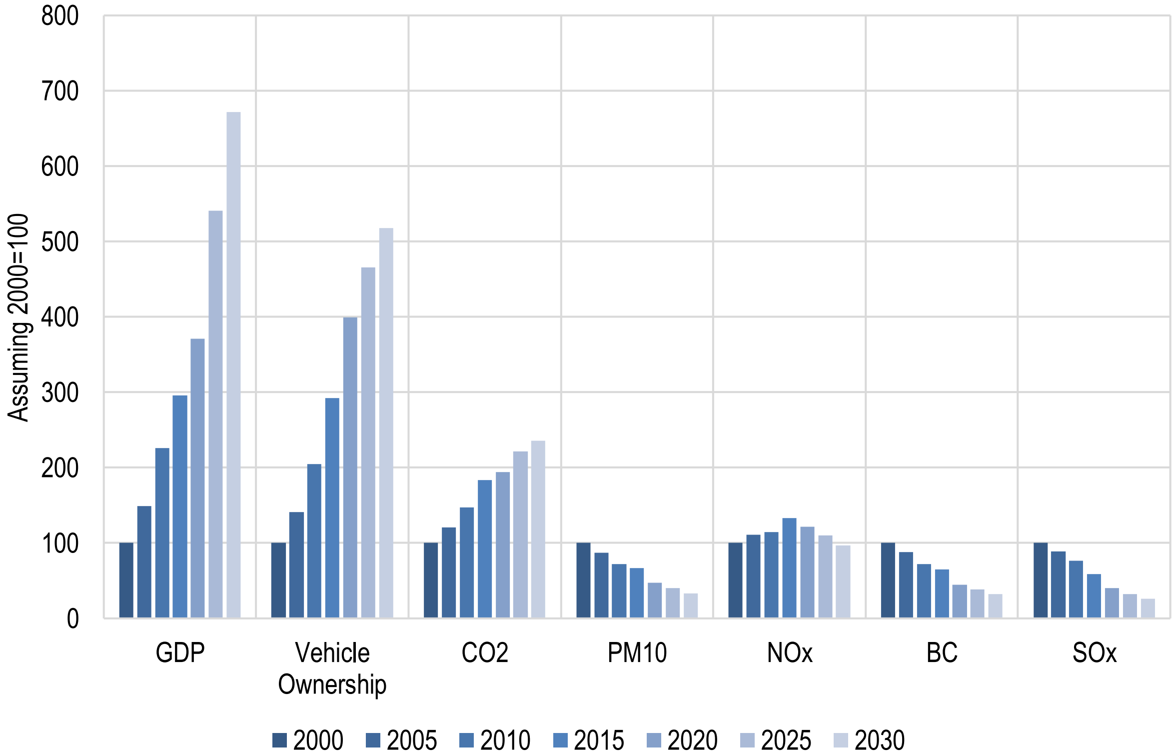


Fig. 31: Transport air pollutant emission estimates

BC = Black carbon; CO2 = Carbon dioxide; GDP = Gross Domestic Product; NOx = Nitrogen oxides; PM = Particulate Matter; SOx = Sulphur oxides

Source: Asian Transport Outlook (2022) National Database SEC-SEG-001, TAS-VEP-021, CLC-VRE-045, APH-VAP-021, APH-VAP-022, APH-VAP-023, APH-VAP-025

62. While these reductions in transport-related air pollution are region-wide there is variation across income levels and subregions. However, there is a clear link between income levels and the rate of decrease in transport-related air pollution. High-income and upper-middle-income economies are projected to make the most progress in lowering transport-related air pollution and lower-middle-income economies the least. This is also reflected in the regional breakdown of projected transport-related air pollution. The greatest improvements will be in the Pacific region and Eastern Asia while the lowest improvement is seen in South East Asia and South Asia. To consolidate and further expand this progress in the fight against this type of air pollution economies need to enhance the vehicle emission standards and shift from polluting modes to non-polluting modes and technologies to reduce air pollution from the transport sector (Fig. 32).

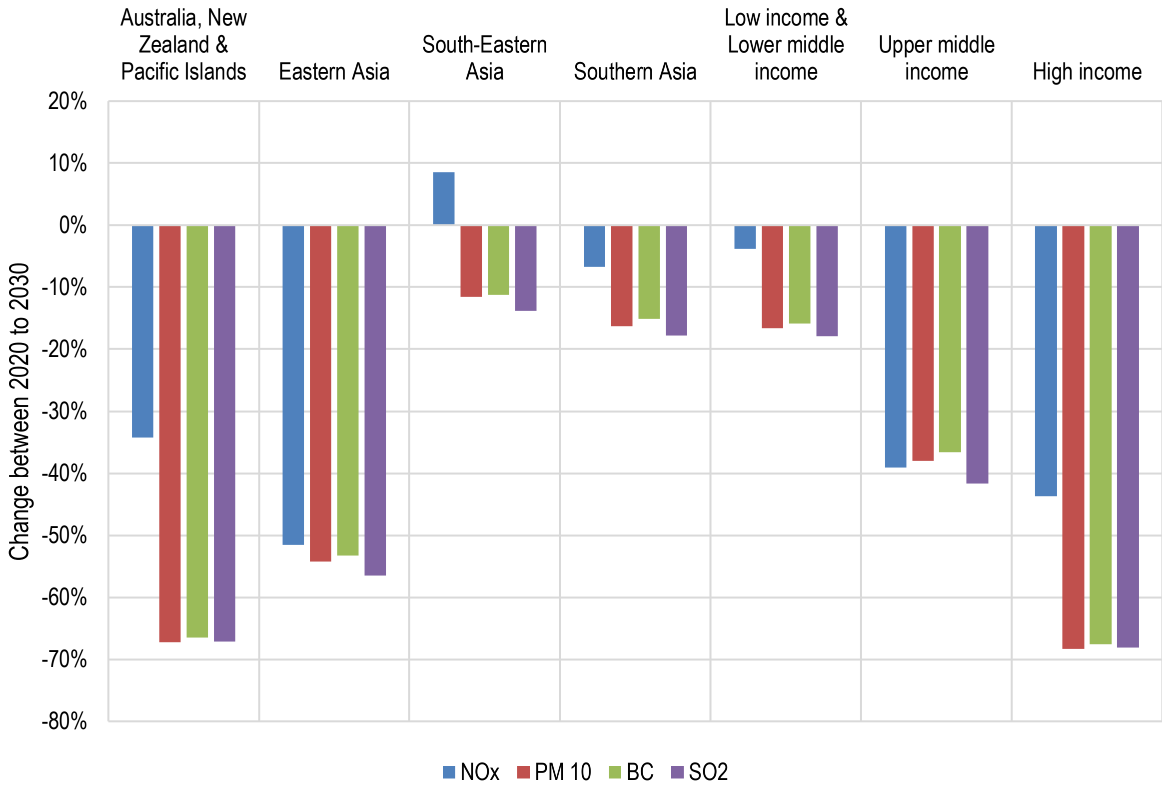


Fig. 32: Transport emissions growth

BC = Black carbon; NOx = Nitrogen oxides; PM = Particulate Matter; SOx = Sulphur oxides

Source: Asian Transport Outlook (2022) National Database APH-VAP-021, APH-VAP-022, APH-VAP-023, APH-VAP-025

Box 9:

Methodology for developing transport related air pollutants projections

Transport sector air pollutant emissions typically lag the regulatory standards and it takes time before the impact of tighter vehicle emission standards is felt. Thus, consideration of regulatory standards provides a key input in the outlook projections. The overall outlook methodology mirrors the CO2 emissions quantifications. However, the main difference lies in the use of the emission factor and calibration source. The emission factor for PM10, NO_X, BC and SO_2 are sourced from the ICCT Roadmap 2013 version. These emission factors developed in 2013 do, however, no longer accurately replicate the current regulatory standards in play. Thus, we utilise IIASA's GAINS model to calibrate the outputs. This scenario captures possibly the best mix of regulatory improvements and is applicable for 101 subregions within Asia for the road sector.

XII. How much will Asia invest in Transport Assets?

Transport infrastructure investments continue to grow but as a smaller part of GDP

63. Transport infrastructure investments are economically costly and the choice for specific transport investments can be politically contentious. Based on historical trends, we estimate on the basis of current policies that the transport infrastructure investments required to develop, maintain and repair inland transport infrastructure in Asia and the Pacific region, from 2020 to 2030 could be about 14.5 trillion USD (in PPP, equivalent to 1.6% of GDP. This is about 3 trillion higher than the investments in the 2010 to 2020 decade. (Fig. 33).

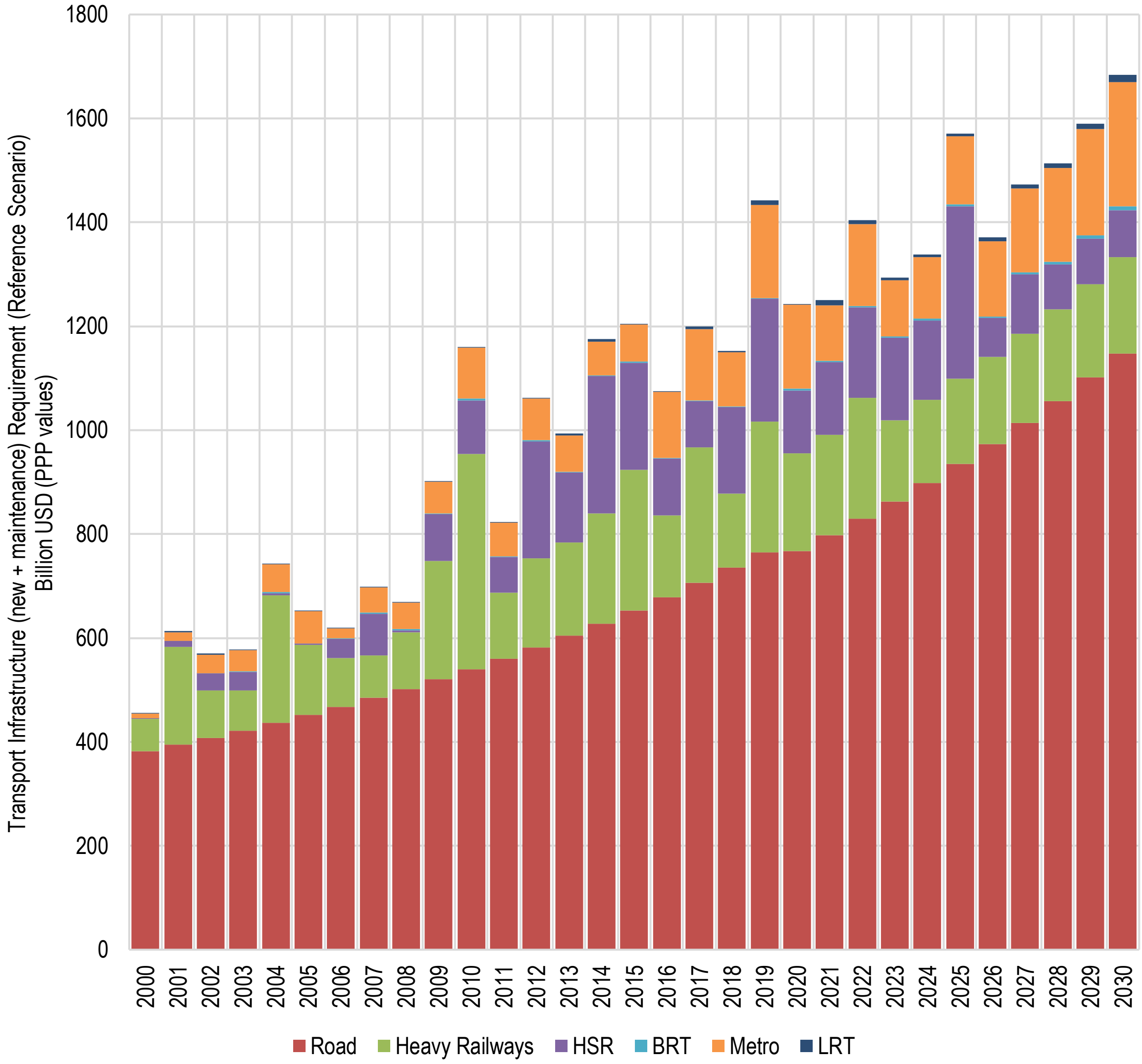


Fig. 33: Transport infrastructure (new + maintenance) requirement, Billion USD (PPP values)

BRT = Bus Rapid Transit; HSR = High Speed Rail; LRT = Light Rail Transit; PPP = Purchasing Power Parity; USD = US Dollars

Source: Asian Transport Outlook (2022) Cost Database

64. Our 2030 projection (1.3 trillion USD or 1.6% of GDP) is in line with earlier estimates by ADB, AIIB, and UNESCAP which indicated that historically, annual infrastructure investments have been estimated to be in the range of 1-3% GDP (UNESCAP, 2019), (ADB-B, 2017) (440 to 865 billion USD). While overall investments in the development of the transport sector will increase, the percentage of GDP needed for transport infrastructure is expected to fall between 2020 and 2030, due to GDP expanding faster than spending on infrastructure. Asian economies' transport infrastructure as a share of GDP has reduced from 2.8% (2000-2010), 2.3% (2010-2020) and is projected to go down to 1.6% (2020-2030).

Road transport continues to dominate transport infrastructure investments

65. Considering individual transport subsectors, high-speed railways had the highest intensity of growth in the last decade. However, due to the slower increase of this type of infrastructure, which we observe, the demand for HSR investments reduces over 2020 to 2030, i.e., a reduction from an annual need of 160 billion to about 140 billion USD. Roads will still remain the biggest area of investment, i.e., about 66% of total investment (UNESCAP, 2019). This is mainly to accommodate the projected increase in vehicle ownership and continued efforts to improve national connectivity. The improvement of urban and rural access also contributes to the continued emphasis on road building. We estimate that countries will continue spending majorly on road infrastructure expansion and less on maintenance (14%). We also project that for the first time, urban rail transit would receive the same investment as heavy rail infrastructure. In the next decade, when compared with the previous, we estimate that the heavy rail infrastructure investments could reduce slightly mainly due to the lower estimate of the additional new heavy rail infrastructure construction i.e., close to 2 trillion USD from 2011-2020 to 1.8 trillion from 2021 to 2030.

66. In high-income economies, we project a marginal reduction in transport infrastructure investments. This reduction is mainly due to the peaking of travel demand and the availability of mature transport infrastructure networks. However, due to the more limited access to transport infrastructure and expected higher growth in demand for passenger and freight transport, we project stronger growth in low and middle-income economies (Fig. 34).

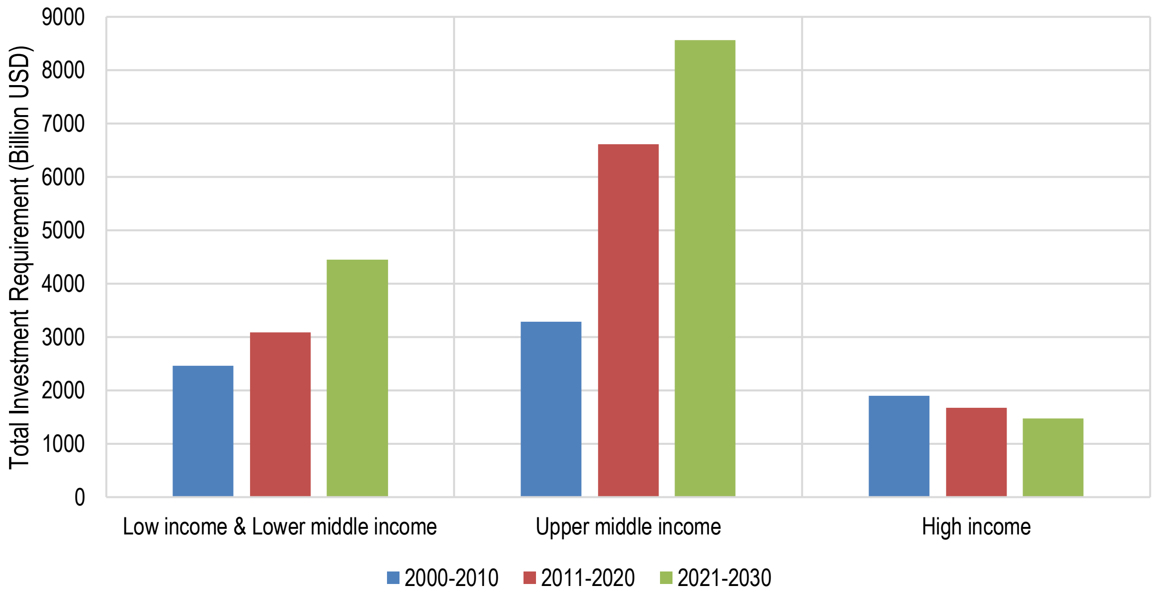


Fig. 34: Total transport infrastructure investment requirement (Billion USD)

USD = US Dollars

Source: Asian Transport Outlook (2022) Cost Database

67. In the last two decades, the most significant transport infrastructure investments were made in the upper-middle-income economies. We project the trend to continue in future. The share of the upper-middle-income economies in total transport infrastructure investments is expected to increase from 43% in 2000-2010 to 59% in 2020-2030. Close to 85% of the infrastructure investment will be absorbed in East and South Asia over the next decade due to the continued rapid growth in transport demand in India and PRC.

Sustainable development goals and Paris Agreement on Climate Change not achieved in the transport sector

68. By 2030, the transport sector in Asia will continue to evolve and remain a crucial driver of the economy and society. Our analysis concludes that the reference scenario investments in the infrastructure do not result in achieving the sustainable development goals or Paris Agreement related transport targets. Progress will be made in improving infrastructure, access and connectivity. But, transport demand will grow faster than infrastructure; there is no significant modal shift towards railways and buses, leading to an increase in transport CO_2 emissions, and significant gaps in access and connectivity will remain. We do expect continued reductions in air pollutant emissions and road crash fatalities but also these will still not meet the targets set by the sustainable development goals.

69. Currently, most Asian countries, like other developing parts of the world, have comparatively lower amounts of transport infrastructure and services than the developed world. However, increasing road-based and aviation passenger and freight transport will make it more challenging to realise targets like air pollution, road safety, energy efficiency and climate change. Moreover, continuing historical trends would result in a widening infrastructure, demand and technology gap. As a result, by 2030, substantial gaps in access and connectivity and transport in Asia will become a barrier to implementing the Paris Agreement and the sustainable development goals. However, our analysis also shows that policies and investments can have a positive outcome, i.e. marginal reductions in air pollutant emissions, road crash fatalities and transport CO_2 emissions growth rates indicating that transport externalities could potentially decouple with economic growth.

70. Timescales are a crucial factor. Transport infrastructure and vehicles can last several decades. The present outcome, i.e. significant gaps in infrastructure, transport demand and technologies, is a result of historical investments. Transport sector investments being processed now will have future ripple effects. Stakeholders like ADB must increasingly align transport investment decisions with the Paris Agreement and Sustainable Development Goals. However, considering the enormous challenge, rejecting projects that are not Paris or SDG-compliant is not enough. The adoption and implementation of more ambitious transport policies and mobilising additional investments in more efficient modes and infrastructure is therefore crucial for a more sustainable development of the transport sector.

Box 10:

Methodology for developing transport infrastructure investments projections

Our transport infrastructure investment projections are grounded in the infrastructure growth estimates i.e., a bottom-up econometric approach. As previously described, the ATO infrastructure projections are a factor of economic growth, urbanisation, passenger and freight transport demand and historical pace of construction. We estimate the demand for infrastructure sub-sectors and estimate the cost of implementation based on the Asian Transport Outlook cost database. To make the calculations more realistic, we apply infrastructure cost multipliers by income group before carrying out a bottom-up assessment (Table 3). Finally, we aggregate the estimates to obtain the total infrastructure investments for the Asia Pacific region, at sub-regional level, and by transport sub-sectors.

There are, however, limitations of our approach to the development of transport investment projections. Our estimates are based on historical trends and the continuation of existing policies – we do not answer how much countries could be ideally spending on infrastructure in case of enhanced ambition. This is particularly relevant when considering goal-oriented needs or infrastructure investment gaps linked to i.e., the SDGs or the Paris Agreement on Climate Change. Further, we only consider the investment need at a macro level (country level) for domestic infrastructure. We neglect ports, airports and domestic navigation needs.

Table 3: Transport sector infrastructure costs

Mode	Type	ADB-2017	IEA-2013	AIIB-2018	Fisch-Romito et al. (2019)	ATO-2022 (PPP) Million $/km, assumed		
						High Income	Middle Income	Low Income
Road	Construction	0.6 million$/km	1.2 million$/lane-km	1.7 M$/km	1.1 million$/lane-km	2.6	1.0	0.5
	Annual Maintenance (% of Cons)		2.5%		0.75%	1.0%	0.3%	0.1%
Heavy Rail	Construction	3.8 million$/km	4.5 million/track-km	9 M$/km	4.5 million/track-km	20.0	12.0	6.0
	Annual Maintenance (% of Cons)		1%			2.0%	1.0%	1.0%
HSR	Construction		24 million$/track-km	50.5 M$/km	24 million$/track-km	100.0	40.0	35.0
	Annual Maintenance (% of Cons)		0.40%		0.40%	1.0%	1.0%	1.0%
Metro	Construction					250.0	150.0	100.0
	Annual Maintenance (% of Cons)					1.0%	1.0%	1.0%
BRT	Construction		9 million per trunk-km		7 million per trunk-km	30.0	15.0	10.0
	Annual Maintenance (% of Cons)		3%		1%	2.0%	1.5%	1.5%
LRT	Construction					100.0	75.0	50.0
	Maintenance (% of Cons)					1.0%	1.0%	1.0%

ADB = Asian Development Bank; AIIB = Asian Infrastructure Investment Bank; ATO = Asian Transport Outlook; BRT = Bus Rapid Transit; HSR = High Speed Rail; IEA = International Energy Agency; km = kilometre; LRT = Light Rail Transit; M$ = Million US Dollars

Source: ADB-B. (2017)., AIIB. (2018)., IEA. (2013)., Fisch-Romito and C. Guivarch (2019), Asian Transport Outlook (2022) Cost Database

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