ESCAP
Economic and Social Commission for Asia and the Pacific

REVIEW OF DEVELOPMENTS IN TRANSPORT IN ASIA AND THE PACIFIC 2024

TRANSITION TOWARDS SUSTAINABLE TRANSPORT SOLUTIONS

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Review of Developments in Transport in Asia and the Pacific 2024: Transitions Towards Sustainable Transport Solutions

United Nations Publication
Sales no: E.24.II.F.13

PRINT ISBN: 9789210032810
PDF ISBN: 9789211067927
Print ISSN: 2411-8079
Online ISSN: 2411-8087
Bar code: ean-13_9789210032810

This publication should be cited as: United Nations, Economic and Social Commission for Asia and the Pacific (2024). *Review of Developments in Transport in Asia and the Pacific 2024: Transitions Towards Sustainable Transport Solutions*. Sales no: E.24.II.F.13. Bangkok.

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FOREWORD

The role the transport sector plays in achieving the Sustainable Development Goals cannot be ignored, especially for targets related to health, economic growth, infrastructure, cities and human settlements, energy and climate action. Despite the transport challenges in Asia and the Pacific, this is a region where innovative solutions can be found and where transformative action has been identified, developed and implemented.

Asia and the Pacific has experienced unprecedented motorization growth dominated by road transport demand and road infrastructure development, which are contributing to jobs and economic opportunities and increased regional connectivity. Yet, this has also increased energy use, emissions and road safety concerns at the same time.

This report includes policy actions for developing a pathway for sustainable transport development for Asia and the Pacific as the region continues to grow and evolve under increasing climate pressure, changes in social demographics, digitalization and the rising need to integrate social inclusion and gender equality principles into transport planning and policy.

To cope with current and future transport challenges, ambitious transport policies that will shape the future of the sector need to be implemented and regional cooperation must be strengthened to help countries align their regional and national priorities. Cross-sectoral collaboration must also be accelerated to address the scale, scope and complexity of sustainable transport development. Furthermore, as countries are growing differently across the Asia-Pacific region, to implement sustainable transport action, relevant national or subregional characteristics, especially in the context of scaling up successful pilot projects, need to be considered.

I hope the insights of the *Review of Developments in Transport in Asia and the Pacific 2024: Transition Towards Sustainable Transport Solutions* will help transport leaders in the region achieve their sustainable transport goals and provide safe, affordable, accessible, efficient, resilient and sustainable transport systems for all, while contributing towards the advancement of the Sustainable Development Goals at the same time.

Armida Salsiah Alisjahbana

Under-Secretary-General of the United Nations
and Executive Secretary of ESCAP

ACKNOWLEDGEMENTS

The *Review of Developments in Transport in Asia and the Pacific 2024: Transition Towards Sustainable Transport Solutions* was prepared under the guidance of Weimin Ren, Director, Transport Division of the Economic and Social Commission for Asia and the Pacific (ESCAP).

The preparation of the Review was led and coordinated by Wei-Shiuen Ng and Tham Lu of the Transport Research and Policy Section, ESCAP. Lead authors were Ariadne Abel, Ishtiaque Ahmed, Azhar Jaimurzina Ducrest, Gyu Serb Kim, Sooyeob Kim, Changju Lee, Alejandro Garcia Macias, Wei-Shiuen Ng and Bekhzod Rakhmatov. Quantitative research and data analyses were conducted by Guangsheng Huang and qualitative survey analysis was contributed by Tham Lu.

The authors are grateful for the inputs and peer review from Sudhir Gota and Alvin Mejia (Asian Transport Outlook); Jan Hoffman (United Nations Conference on Trade and Development); Intaek Jung (Korea Institute of Civil Engineering and Building Technology); Yuki Takada (United Nations Human Settlements Programme); Poornima Singh (International Association of Public Transport (UITP) Asia-Pacific Centre for Transport Excellence); Mohsen Fallah (Kharazmi University); Chika Sakashita (Global Alliance for NGOs for Road Safety); and Alejandra Cruz Ross (International Labour Organization), and the ESCAP Editorial Board for their review and guidance. Special thanks are extended to ESCAP consultant, Jenny Yamamoto, and interns, Daphné Basthard-Bogain, Guangsheng Huang, Nabila Imam, Jack Lavery, Boonyanin Pakvisal, Yuhan Xiao and Lei Zou for their substantive contributions and review.

The administrative processing necessary for the issuance of the Review was done by Tham Lu. The Review was copyedited by Alan Cooper, the cover and layout design was done by Rywin Nitiprapathananun and printing services were provided by Ideol Digital Print Co. Ltd. with guidance from the ESCAP Communications and Knowledge Management Section.

EXPLANATORY NOTES

The term "ESCAP region and Asia-Pacific" refers to the group of countries and territories/areas comprising: Afghanistan; American Samoa; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Cook Islands; Democratic People's Republic of Korea; Fiji; French Polynesia; Georgia; Guam; Hong Kong, China; India; Indonesia; Iran (Islamic Republic of); Japan; Kazakhstan; Kiribati; Kyrgyzstan; Lao People's Democratic Republic; Macao, China; Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Caledonia; New Zealand; Niue; Northern Mariana Islands; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Tajikistan; Thailand; Timor-Leste; Tonga; Türkiye; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; and Viet Nam.

The term "Asia" refers to the above group of countries and territories/areas excluding the Pacific.

The term "East and North-East Asia" refers collectively to: China; Hong Kong, China; Democratic People's Republic of Korea; Japan; Macao, China; Mongolia; and Republic of Korea.

The term "North and Central Asia" refers collectively to Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Russian Federation, Tajikistan, Turkmenistan and Uzbekistan.

The term "Pacific" refers collectively to American Samoa, Australia, Cook Islands, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Micronesia (Federated States of), Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

The term "South and South-West Asia" refers collectively to Afghanistan, Bangladesh, Bhutan, India, the Islamic Republic of Iran, Maldives, Nepal, Pakistan, Sri Lanka and Türkiye.

The term "South-East Asia" refers collectively to Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste and Viet Nam.

EXECUTIVE SUMMARY

The *Review of Developments in Transport in Asia and the Pacific 2024: Transition Towards Sustainable Transport Solutions* includes an overview of progress made across seven transport thematic areas included in the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022–2026), which are (a) regional land transport connectivity and logistics; (b) maritime and interregional transport connectivity; (c) digitalization of transport; (d) low carbon mobility and logistics; (e) urban transport; (f) road safety, and (g) inclusive transport and mobility. These transport thematic areas are also directly linked to the advancement of five specific Sustainable Development Goals (SDGs), as they can enhance accessibility to essential services and facilities, such as education, health care, employment and public services, and thus reduce inequalities (Goal 5, Goal 11). Sustainable and resilient transport infrastructure development can further support industry, innovation and connectivity, including associated supply chain networks and cross-border freight transport, which will also lead to higher levels of efficiency in the system, especially through the deployment of information and communications technology (ICT) and real-time data sharing across a supply chain in the long term, as well as increases in competitiveness in the region (Goal 9). By reducing greenhouse gas emissions and air pollution through low-carbon technologies, mode shifts, alternative fuels and route optimization, sustainable passenger and freight transport can mitigate the climate change impact (Goal 13), while improving public health (Goal 3) at the same time. Additionally, improved public transport systems serve as a core function of sustainable cities (Goal 11) while minimizing resource use and the environmental impact in the transport sector.

Eight major trends that drive the changes in the transport sector in Asia and the Pacific have been identified. The first trend is rapid motorization growth, in which the mean motorization rate has increased by 64 per cent between 2010 and 2022, with countries in South-East Asia and East and North-East Asia growing in this regard the most rapidly. The second trend points to road transport constituting the highest share of passenger transport demand; road transport demand is nearly three times as much as rail transport, while active mobility has grown by 4 per cent between 2015 and 2020. The third trend shows that increasing freight demand is dominated by the expansion of road and rail transport. Although sea transport constitutes the largest share of total freight demand, road and rail transport have increased by nearly 20 and 15 per cent, respectively, between 2015 and 2020. The fourth trend is the increase of vehicle registration at different rates across the Asia-Pacific region; it is generally increasing in line with population growth in most countries, but there are some outliers where vehicle registration is increasing at a more rapid rate than population growth. The fifth trend is the growing road transport infrastructure, which has increased by more than 50 per cent between 2005 and 2019 and more than any other type of transport infrastructure. The sixth trend is rapidly growing transport carbon dioxide (CO_2) emissions, which have increased by 34 per cent between 2010 and 2021, with the most significant increases occurring in South and South-West Asia (40 per cent), South-East Asia (40 per cent) and East and North-East Asia (39 per cent), while $PM_{2.5}$ and nitrogen oxides (NO_x) emissions have increased by 10 and 5 per cent, respectively, between 2010 and 2018. The seventh trend is that although traffic deaths have decreased, it is not the case for all age groups. The number of road deaths has decreased for all age groups below 64 from 2000 to 2019, but there has been

a gradual increase in road fatalities among the age group of 65 and above. The eighth trend highlights that the gender gap exists in the transport workforce, which is male dominated; less than 20 per cent of the global transport workforce are women and in Asia and the Pacific, in 2022, it was lower, at approximately 16 per cent.

Progress towards sustainable transport development remains uneven and inadequate across countries within the Asia-Pacific region, while transport demand is also increasing differently based on different levels of economic development, population trends, changing trade flows and connectivity, travel behaviour, transport standards and associated regulations. Nevertheless, the provision of transport systems that are safe, affordable, accessible, resilient and sustainable for all continues to be a priority for countries in Asia and the Pacific, as reflected in their current policies.

Common sustainable transport solutions include the need to enhance capacity, match sustainable transport infrastructure needs with appropriate financing mechanisms, strengthen data collection and analysis, build greater regional collaboration and cross-sectoral cooperation, and develop, implement and enforce sustainable transport policies.

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
APRSO	Asia Pacific Road Safety Observatory
ASEAN	Association of Southeast Asian Nations
ATO	Asian Transport Outlook
C-ITS	Cooperative Intelligent Transport Systems
CO_2	Carbon dioxide
EAEU	Eurasian Economic Union
EDGAR	Emissions Database for Global Atmospheric Research
ESCAP	Economic and Social Commission for Asia and the Pacific
GDP	gross domestic product
GSMA	Global System for Mobile Communications Association
ICT	Information and Communications Technology
IEA	International Energy Agency
ILO	International Labour Organization
IPCC	Intergovernmental Panel on Climate Change
ITF	International Transport Forum
ITU	International Telecommunication Union
LCVs	light commercial vehicles
MaaS	mobility-as-a-service
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
OECD	Organisation for Economic Co-operation and Development
pkm	passenger-kilometre
PPPs	public-private-partnerships
SDGs	Sustainable Development Goals
SO_2	Sulphur dioxide
SO_x	Sulphur oxides
SUTI	Sustainable Urban Transport Index
tkm	tonne-kilometre
UN HABITAT	United Nations Human Settlements Programme
UNCTAD	United Nations Conference on Trade and Development

UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFPA	United Nations Population Fund
VOC	volatile organic compound
WHO	World Health Organization

CHAPTER 1

SUSTAINABLE TRANSPORT DEVELOPMENT TRENDS IN ASIA AND THE PACIFIC

1.1. INTRODUCTION

Current estimates have shown that the Asia-Pacific region is not on track to realize the Sustainable Development Goals (SDGs) by 2030 (ESCAP, 2024a). In the 2030 Agenda for Sustainable Development, sustainable transport is mainstreamed across several SDGs and targets, especially those related to food security, health, energy, economic growth, infrastructure, and cities and human settlements. To support the region in meeting its SDGs, progress made towards the achievement of sustainable transport development also needs to be accelerated; transformative actions need to be identified, developed and implemented. Sustainable transport can be defined as an integrated intermodal transport and logistics system that combines the advantages of each mode of transport to achieve the balanced integration of economic, social and environmental benefits.

The importance of transport for climate action is also recognized as the transport sector is playing a particularly important role in the achievement of the Paris Agreement, given that close to a quarter of energy-related global greenhouse gas emissions come from transport and that these emissions are projected to increase substantially in the coming years, especially in Asia and the Pacific. Moreover, sustainable transport development in Asia and the Pacific can contribute to global processes, such as the Summit of the Future, which aims to adopt an ambitious, concise, action-oriented pact for the future, per General Assembly resolution 76/307.

Despite its negative environmental and social impacts, transport continues to be one of the most important economic pillars of any country and has the potential to create significant socioeconomic opportunities. In 2022, the transport sector created more than 124 million jobs in Asia and the Pacific, including transport services, manufacturing within transport and other derived employment (ILO, 2022a). Accessible and efficient transport systems can also result in positive multiplier effects, connecting people to economic markets, employment and investment opportunities beyond the transport sector.

Nevertheless, depending on the policies implemented today, the future of the transport sector in Asia and the Pacific could look very different. For example, the Asian Development Bank (ADB) has developed eight visions of what an ideal future transport system could look like. These include (a) safe, reliable and efficient systems that deliver safety across transport modes, reliability and efficiency outcomes for all users; (b) inclusive and accessible spaces and services that are safe and affordable for all users; (c) delivery of resilient transport infrastructure systems that are planned, designed and operated to steer developing countries and Asia and the Pacific towards low-carbon and resilient development; (d) seamless transport and logistics systems that have fully integrated transport and land-use plans; (e) delivery of environmentally considerate outcomes; (f) robust institutional, financial and technical capacity; (f) technology-enabled transport services driven by clear outcome-led planning to address specific social, environmental and economic issues and aims; and (g) strong regional cooperation and comprehensive development to deliver multimodal strategic transport connectivity and facilitate critical economic corridors (ADB, 2022).

Such visions can guide sustainable transport development pathways in the short and long terms. However they can only be realized when current transport challenges are identified, as described in chapter 2

and addressed with appropriate solutions to close the sustainable transport development gaps, as presented in chapter 3.

In this chapter, major regional trends driving transport demand and its subsequent environmental and social impacts are introduced, and the collected results from an ESCAP survey, which was conducted to better understand ESCAP member States' priorities, challenges and existing policies in achieving sustainable transport are presented.

1.2. LINKAGES BETWEEN TRANSPORT AND THE SUSTAINABLE DEVELOPMENT GOALS

Sustainable mobility and transport are crucial for achieving several of the SDGs. For example, they can enhance accessibility to essential services and facilities, such as education, health care, employment and public services, and therefore, reduce inequalities (Goal 5, Goal 11). Sustainable and resilient transport infrastructure development can further support industry, innovation and connectivity, including associated supply chain networks and cross-border freight transport. This will also lead to higher levels of efficiency in the system, especially with the deployment of ICT and real-time data-sharing across a supply chain in the long term and boost the competitiveness in the region (Goal 9). By reducing greenhouse gas emissions and air pollution through low-carbon technologies, mode shifts, alternative fuels and route optimization, sustainable passenger and freight transport can mitigate climate change impact (Goal 13), while improving public health (Goal 3) at the same time. Additionally, improved public transport systems serve as a core function of sustainable cities (Goal 11), while minimizing resource use and the environmental impact in the transport sector (table 1.1). Accordingly, integrating sustainable transport solutions is essential for holistic and equitable progress towards achieving the SDGs.

Table 1.1. Linkages between transport and the Sustainable Development Goals

Sustainable Development Goals	Target	Linkages with transport
Goal 3 Global health and well-being	Target 3.6: Halve the number of global deaths and injuries from road traffic accidents.	• Better road safety regulations. • Improve transport infrastructure design. • Implement safety innovations.
	Target 3.9: Reduce mortality rate attributed to ambient air pollution.	Transport is the dominant contributor to air pollutant emissions (NO_X and SO_X), leading to health problems.

Table 1.1. Linkages between transport and the Sustainable Development Goals (cont.)

Sustainable Development Goals	Target	Linkages with transport
Goal 5 Gender equality	Target 5.2: Eliminate all forms of violence against all women and girls in the public and private spheres	Gender-responsive planning and design in public transport enhances safety, accessibility and social inclusion.
	Target 5.5: Ensure women's full and effective participation and equal opportunities for leadership at all levels of decision-making in political, economic and public life	• Actively engage women in decision-making processes across all aspects of transport planning and development and promote gender equality within the transport sector as users and workers. • Ensure transport policies are inclusive, conduct gender impact analysis.
Goal 9 Industry, Innovation and Infrastructure	Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure to support economic development and human well-being Indicator 9.1.1 Proportion of the rural population who live within 2 km of an all-season road. Indicator 9.1.2 Passenger and freight volumes, by mode of transport Target 9.a: Facilitate sustainable and resilient infrastructure development in developing countries through enhanced financial, technological and technical support	• Transport catalyses regional economic development through better connectivity and wider economic impacts. • Transport infrastructure plays a crucial role in supporting human well-being by providing accessibility to essential services that enhance the quality of life and promote social inclusion. • Efficient knowledge transfer and innovative financing mechanisms to contribute to the development of sustainable and resilient transport infrastructure in urban and rural areas, and in developing countries.

Table 1.1. Linkages between transport and the Sustainable Development Goals (cont.)

Sustainable Development Goals	Target	Linkages with transport
Goal 11 Sustainable cities and communities	Target 11.1: Ensure access for all to adequate, safe and affordable housing and basic services.	Efficient transport systems, including public transport, can provide all residents with equal access to affordable housing, essential services and urban amenities.
	Target 11.2: Safe, affordable, accessible and sustainable transport systems, with special attention to the needs of vulnerable groups.	Develop reliable and inclusive public transport systems to reduce social inequality.
	Target 11.3: Enhance inclusive and sustainable urbanization, integrated and sustainable human settlement planning and management	• Integrate transport planning with urban development strategy to promote sustainable land use and enhance the efficiency of resource use. • Build compact and connected cities through transport-oriented development.
	Target 11.6: Reduce the adverse environmental impact of cities.	• Promote sustainable transport to reduce waste materials associated with vehicle use and maintenance and fuel consumption. • Encourage green transport to improve urban air quality.
Goal 13 Climate action	Target 13.1: Resilience and adaptive capacity-building for climate change.	Incorporate climate-resilient designs in transport infrastructure to reduce the vulnerability of transport networks to climate-related disasters and extreme weather conditions.

Table 1.1. Linkages between transport and the Sustainable Development Goals (cont.)

Sustainable Development Goals	Target	Linkages with transport
Goal 13 Climate action	Target 13.2: Climate change adaptation and greenhouse gas reduction.	• Promote the use of low- or zero-carbon emission and electric vehicles and vessels, public transport and non-motorized transport options to help reduce greenhouse gas emissions from the transport sector. • Include low-carbon transport initiatives in national climate policies and strategies.

Source: ESCAP (2021a).

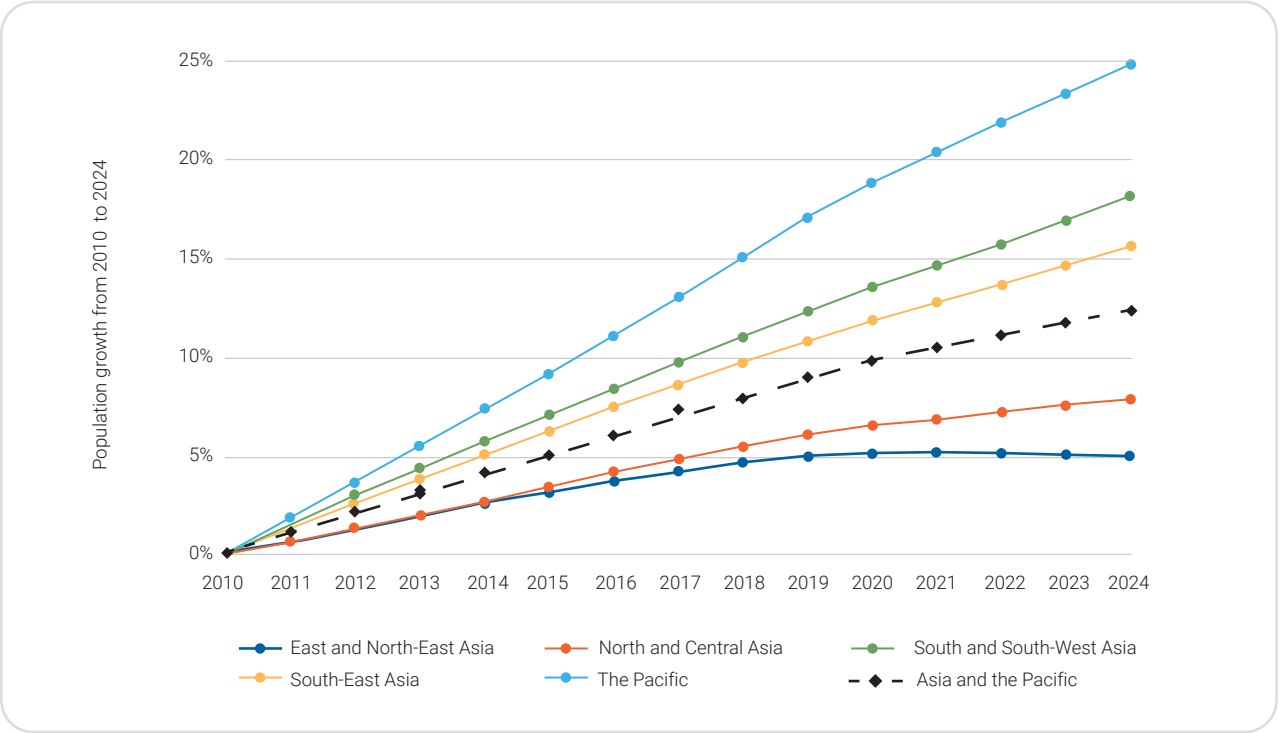
1.3. MAJOR REGIONAL TRENDS DRIVING TRANSPORT

Transport demand in the Asia-Pacific region has been driven by various factors over the past few decades, in particular population and economic growth and rapid motorization. In most countries in Asia and the Pacific, transport demand has surged in line with the growing population and economic development. Based on an analysis conducted using various data sources, eight major trends have been identified that will shape the future of transport in the region. They are (a) rapid growth in motorization; (b) road transport constituting the highest share of passenger transport demand; (c) increasing freight demand dominated by road and rail transport growth; (d) vehicle registration increasing at different rates across the region; (e) road infrastructure growing the most compared to other types of transport infrastructure; (f) greater transport emissions, including CO_2, $PM_{2.5}$ and NO_x; (g) decreasing road traffic deaths, but not for all social groups; and (h) gender gap persisting in the transport workforce. These trends are further described in this section.

1.3.1. Population dynamics

The Asia-Pacific region has undergone significant demographic changes over the past decade, which has influenced transport demand and will continue to shape transport growth. This demographic transition has led to rapid population ageing, an increase in urbanization, smaller family sizes and larger numbers of internal and international migrants (ESCAP, 2023a). Home to nearly 60 per cent of the global population, Asia and the Pacific contains some of the most populous countries, such as China and India, and some of the smallest countries, particularly among the Pacific small island developing States (UNFPA Asia and the Pacific, 2023). As shown in figure 1.1, demographics in this region are booming, with the population growing by approximately 12.3 per cent from 4.15 billion in 2010 to 4.66 billion in 2024, even though the annual population growth rate has decreased steadily over the same period.

Figure 1.1. Population growth by ESCAP subregion from 2010 to 2024



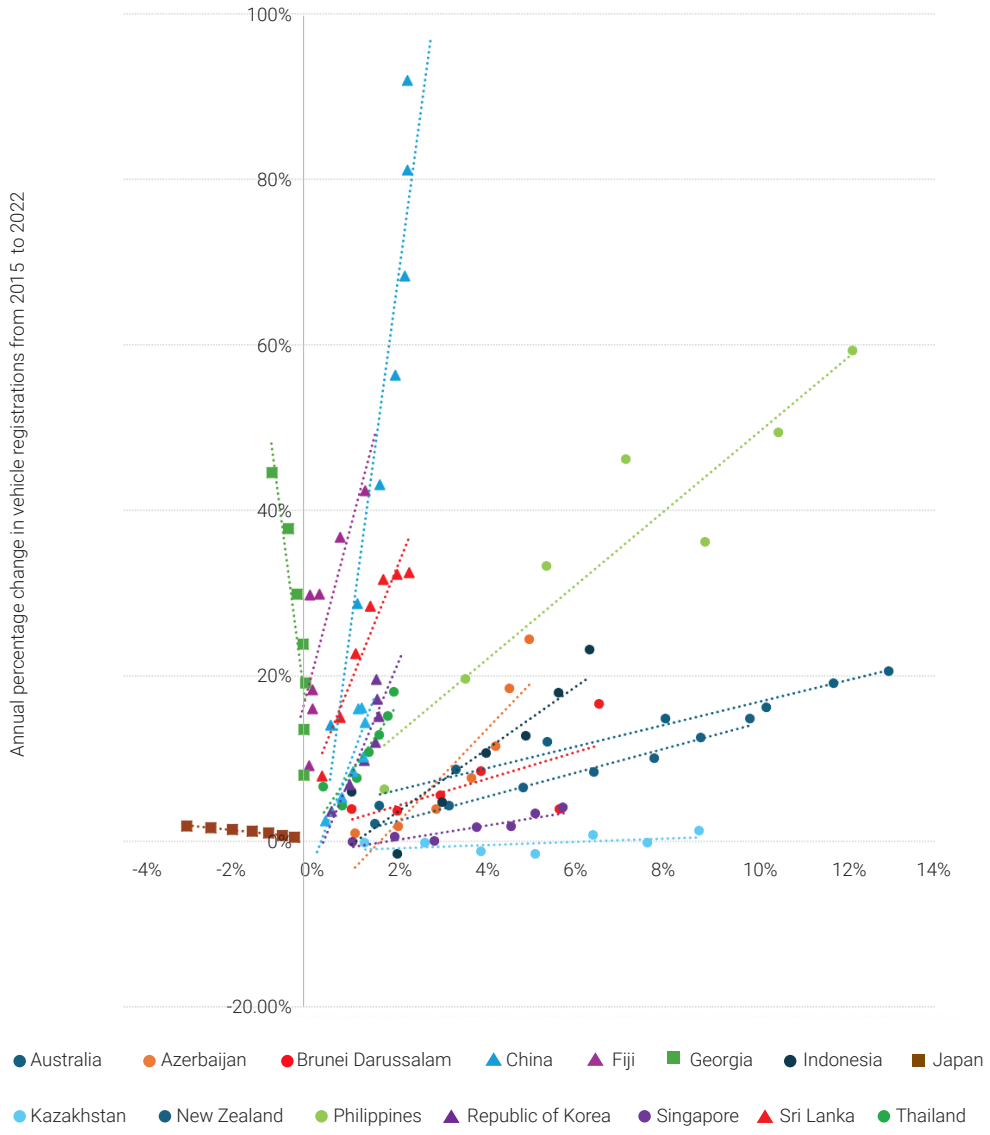
Source: United Nations Department of Economic and Social Affairs (2024).

Despite these general trends, there is much variation within and across countries in the region. Over the past decade, the highest population growth rate in the region occurred in South and South-West Asia, but it dropped dramatically after the COVID-19 pandemic. In contrast, the population growth rate in East and North-East Asia has remained significantly below the region's average growth rate.

This uneven trend is primarily due to disparities in fertility rates, resulting in a "youth bulge" in some countries and rapid ageing in others. This demographic shift presents opportunities for accelerated development of transport infrastructure and emerging transport technologies in countries with younger populations, while others must focus on providing accessible and inclusive transport for older persons. The number of people aged 60 years and older will more than double by 2050, with one in four people being 60 years or older, compared to one in ten today. In East and North-East Asia, the proportion of older persons will be even higher, with one in three people over 60 years old. Moreover, most individuals in this age group will be women without pensions or any form of social protection (UNFPA Asia and the Pacific, 2023), which will widen the gender gap and result in inclusive transport needs.

Population growth is widely considered a key driver of demand for passenger and freight transport, and vehicle ownership. As populations grow, especially in urban areas, transport demand, travel distance and vehicle registration, will increase as well. Figure 1.2 presents the relation between percentage changes in vehicles registration and population between 2015 and 2022 in 15 countries in Asia and the Pacific; each data point represents their relation for one year.

Figure 1.2. Relation between percentage changes in vehicle registrations and population from 2015 to 2022



Source: United Nations Department of Economic and Social Affairs (2022).

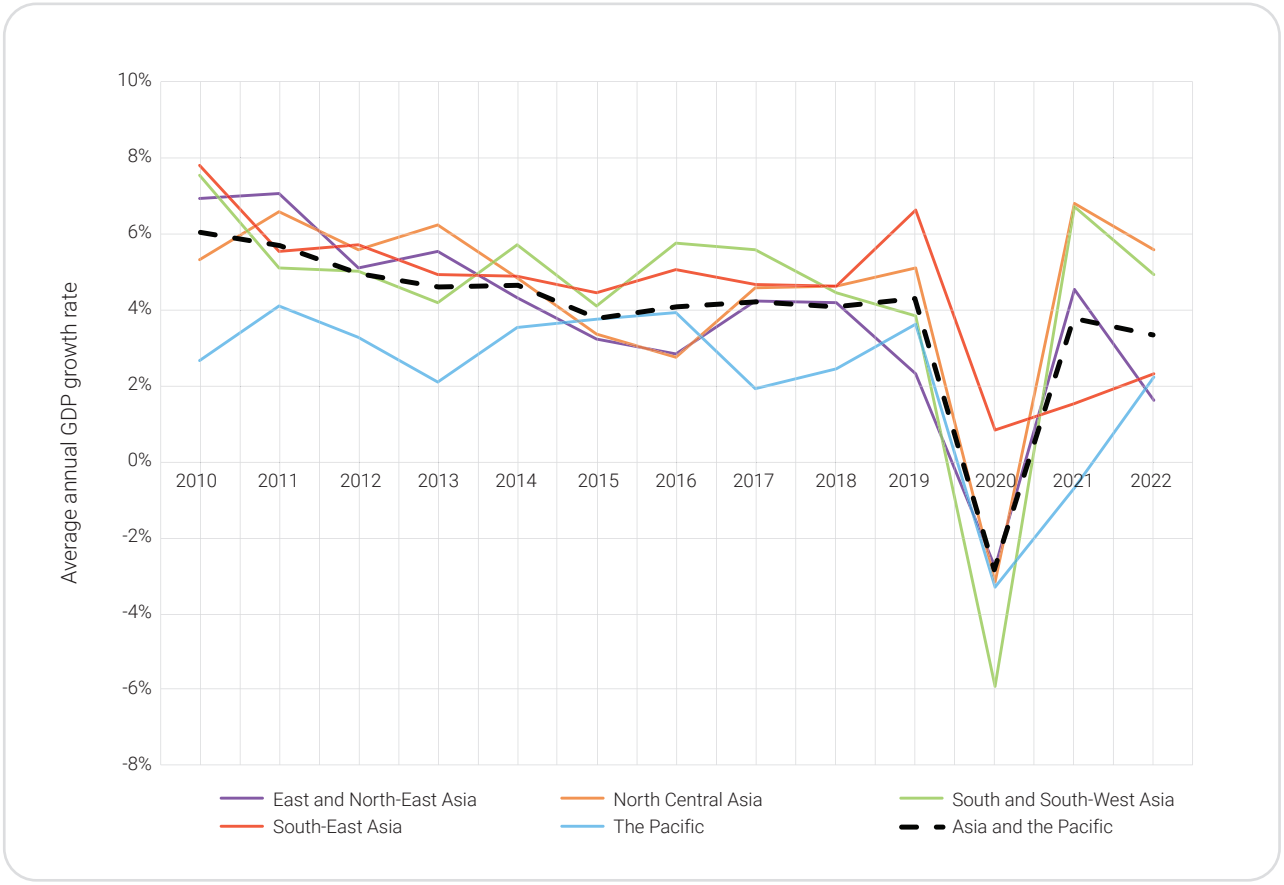
While it is evident that vehicle registrations generally increase in line with population growth in most countries, the magnitude of change has varied across the region, as represented by the steepness of the lines shown in figure 1.2. This divergence can be attributed to several factors, including, economic performance, the degree of urbanization and infrastructure development, the availability of public transport and vehicle management policies. Countries showing steeper slopes indicate that vehicle registration is increasing faster than population growth, where a small increase in population corresponds to a larger increase in the number of vehicles registered. In figure 1.2, the steepest slope is displayed for China, while Japan and Georgia are the only two countries with a negative slope, indicating that despite a decrease in population, the number of vehicles increased during the same period. Regarding Japan, the disproportionate growth between vehicle registrations and population could be attributed

to the country's economic development and its role as a key automotive transit market hub in the region, as there is significant trade volume for both imported and exported used cars despite the country's changing demographics and ageing population (Galt and Taggart, 2023; Tsinstabadze, 2023).

1.3.2. Economic trends

Asia and the Pacific has experienced rapid economic growth over the past few decades, driven by industrialization, technological advancements and increased trade. This region has made remarkable economic strides, and the regional economic trends closely mirror those of each of the five ESCAP subregions, as shown in figure 1.3.

Figure 1.3. Average gross domestic product growth rate by ESCAP subregion from 2010 to 2022



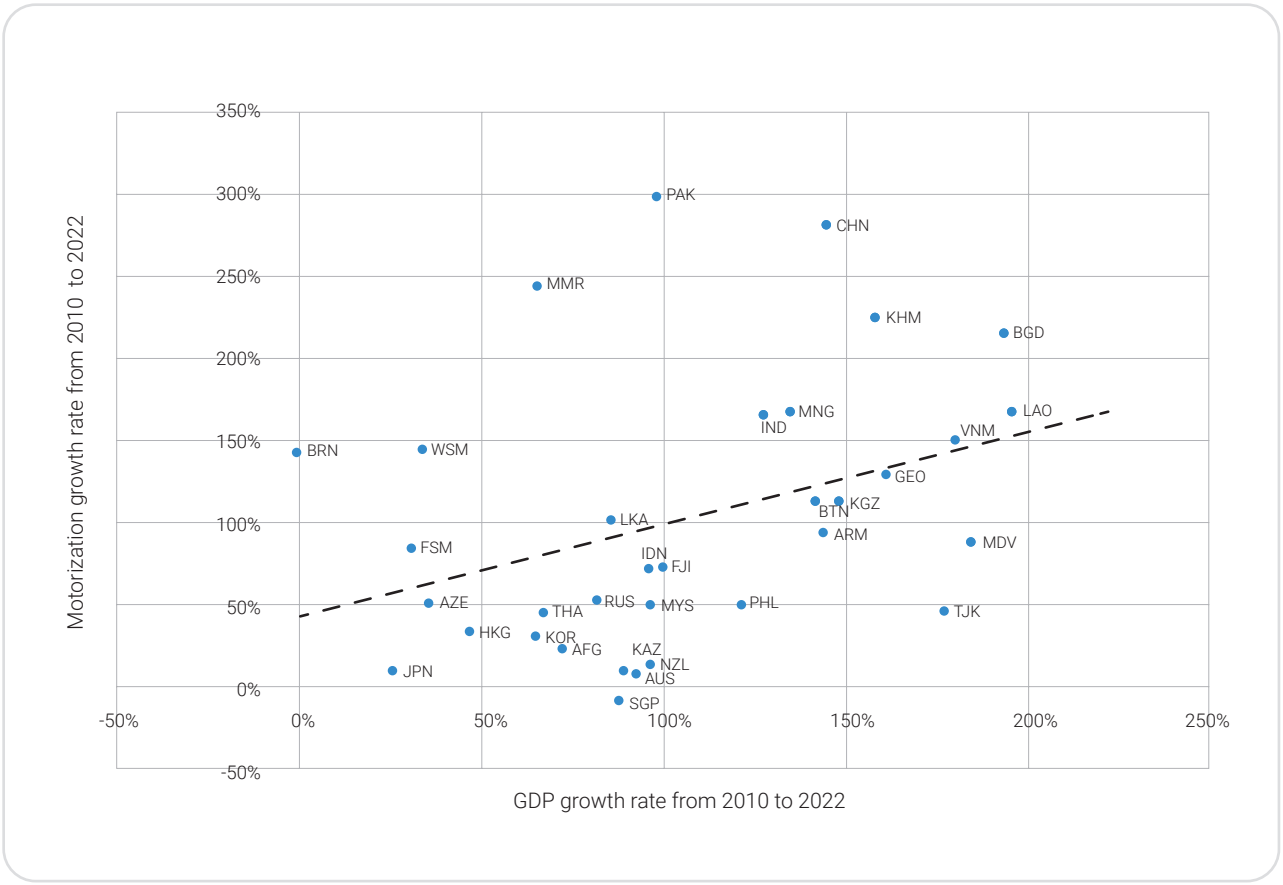
Source: World Bank (2023a).

The average gross domestic product (GDP) growth rate for the region was 4.3 per cent between 2010 and 2019. However, the pandemic in 2020 changed this upward trend, with most countries experiencing their first negative growth rates in years, averaging -2.9 per cent for the region. By 2021, the figures rebounded to a positive average GDP growth rate of 3.8 per cent, indicating an economic upswing and recovery (World Bank, 2023a). Notably, even though this steady upward trend continued into 2022, the economic momentum has begun to wane.

Compared to the rest of the region, economic recovery in the Pacific is lagging. One important reason for this trend is the high cost of transport due to geographic restrictions and energy risks. World Bank (2023b) reported that a combination of extreme dispersion, small size and remoteness from larger markets, limits the sources of economic growth to activities in which scale economies and transport costs are less important. Consequently, Pacific economies are much more vulnerable to adverse external effects and disruptions. Furthermore, development in this subregion may be hindered by inadequate infrastructure and regional connectivity.

In countries with higher levels of GDP, typically, there is greater transport demand in terms of distance travelled, vehicle ownership and number of trips made. The positive correlation between GDP growth and motorization in Asia and the Pacific is illustrated in figure 1.4. Countries far below the trendline represent those where GDP growth has had less of an impact on motorization growth.

Figure 1.4. Correlation of gross domestic product growth and motorization growth from 2010 to 2022



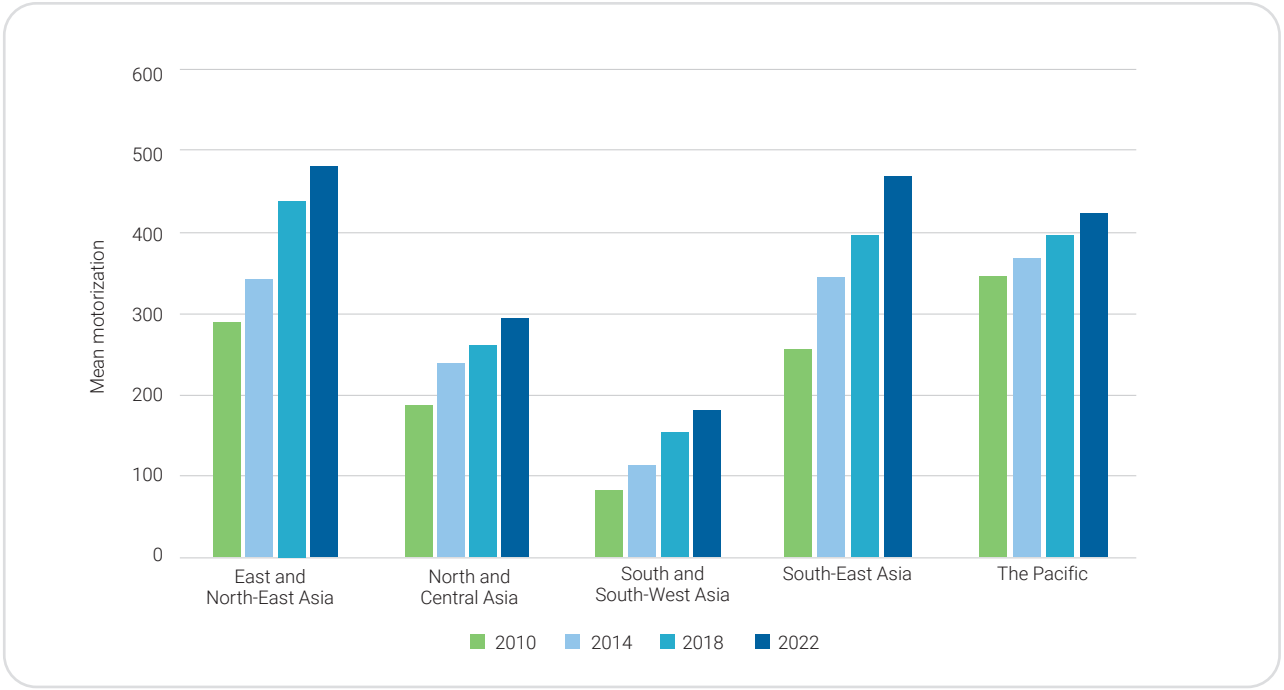
Sources: World Bank (2023a); ATO (2022a).

Note: AFG-Afghanistan; ARM-Armenia; AUS-Australia; AZE-Azerbaijan; BGD-Bangladesh; BTN-Bhutan; BRN-Brunei Darussalam; KHM-Cambodia; CHN-China; FJI-Fiji; GEO-Georgia; IND-India; IDN-Indonesia; JPN-Japan; KAZ-Kazakhstan; KGZ-Kyrgyz Republic; LAO-Lao People's Democratic Republic; MYS-Malaysia; MDV-Maldives; FSM-Micronesia (Federated States of); MNG-Mongolia; MMR-Myanmar; NZL-New Zealand; PAK-Pakistan; PHL-Philippines; KOR-Republic of Korea; WSM-Samoa; SGP-Singapore; LKA-Sri Lanka; TJK-Tajikistan; THA-Thailand; VNM-Viet Nam; HKG-Hong Kong, China; RUS-Russian Federation

1.3.3. Transport demand

The factors described in Section 1.3.2. are often the most direct drivers of transport demand. Figure 1.5 provides a snapshot of the vehicle demand in the region in the form of the mean motorization, which is defined as the total number of registered vehicles per 1,000 population, including motorized two-wheelers, motorized three-wheelers, light-duty vehicles, buses and freight vehicles.

Figure 1.5. Mean motorization by ESCAP subregion



Source: Country Official Statistics (ATO, 2022a).

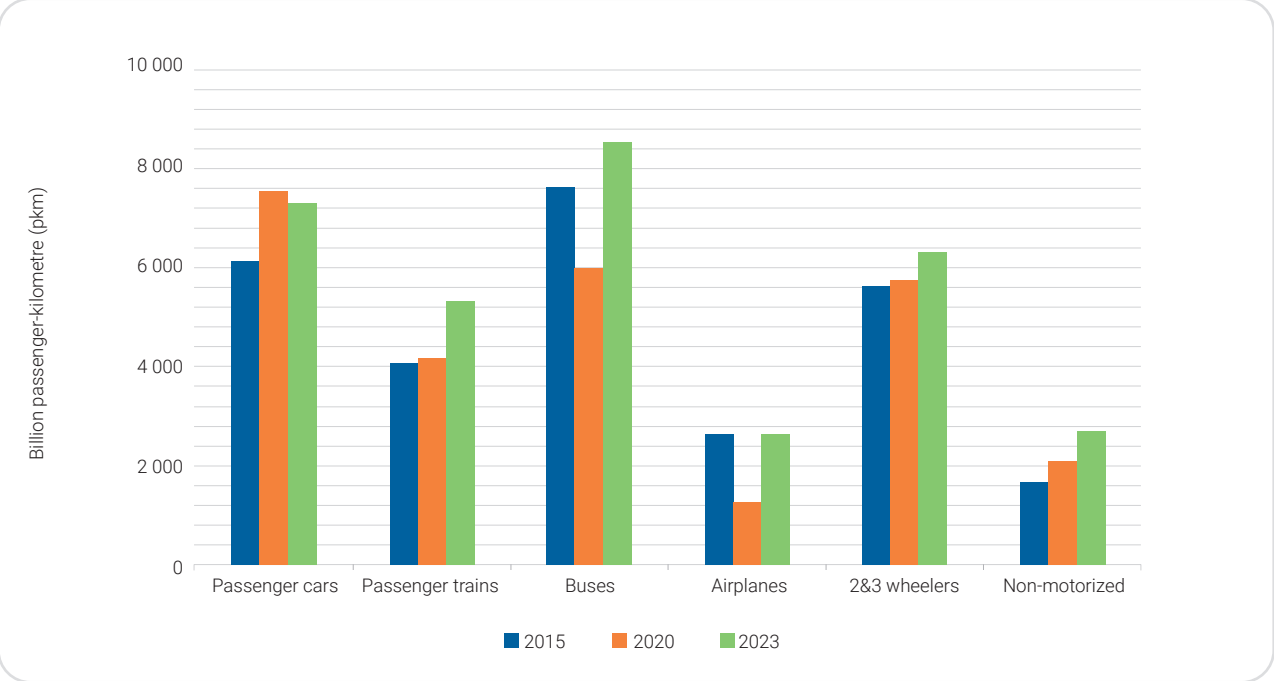
The mean motorization rate has grown from 230 in 2010 to 378 in 2022, an increase of 64 per cent. Vehicle demand has also varied regionally and has risen sharply in South-East Asia and East and North-East Asia, while holding steady at a lower rate in the South and South-West Asia subregion during the same period. The motorization rate remains high in the Pacific, where public transport is less developed due to the low population and urban densities. Although these figures are still lower than those of the European Union (567 vehicles per 1,000 population) (European Automobile Manufacturers' Association, 2023) and the United States of America (821 vehicles per 1,000 population) (Carlier, 2023), the current growth trajectory shows that some countries are approaching the European average. However, the growing motorization rate in Asia and the Pacific reflects the increasing use of two- and three-wheelers, unlike in Europe.

Transport demand is commonly represented by passenger-kilometre (pkm), which is a unit of measurement for the transport of one passenger by a defined mode of transport (such as road, rail, air, sea and inland waterways) over one kilometre and tonne-kilometre (tkm), which is a unit of measure of freight transport indicating the transport of one tonne of goods by a given transport mode (such as road, rail, air, sea, inland waterways and pipelines) over a distance of one kilometre. Both pkm and tkm have

changed significantly in the region, even though many countries imposed strict lockdowns in response to the COVID-19 pandemic, restricting transport and mobility in 2020, which led to a temporary plunge in all modes of passenger transport and to major mode choice shifts in freight transport (ESCAP, 2021a; ITF, 2021).

Figure 1.6 indicates total pkm in Asia and the Pacific by mode, where passenger bus transport is the leading mode, followed by passenger cars and two- and three-wheelers, while non-motorized transport demand is slowly increasing in the region. Road transport accounts for the majority of pkm compared to rail and aviation.

Figure 1.6. Total passenger-kilometres in Asia and the Pacific by mode

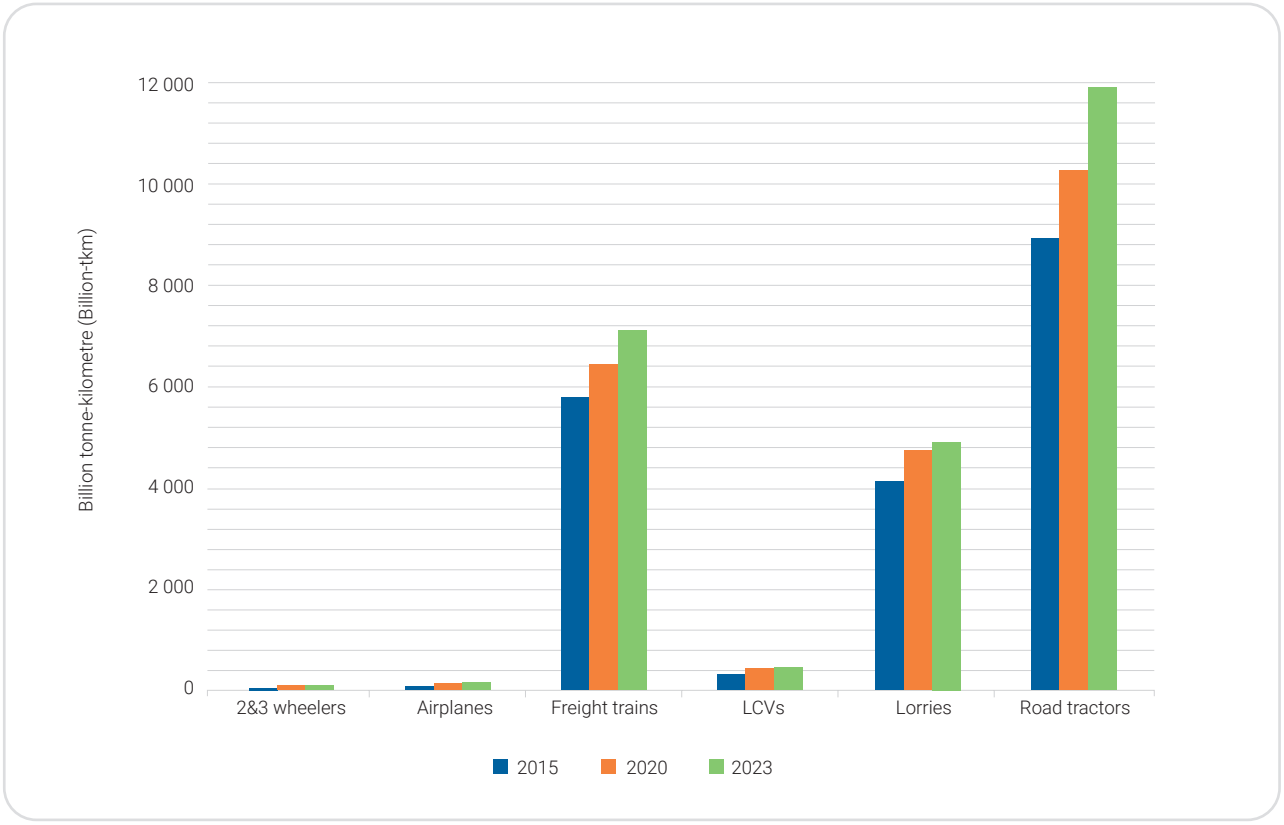


Source: ITF (2023a).

Air travel was the mode most severely affected in 2020 due to COVID-19 travel restrictions, decreasing by nearly 50 per cent in the region from 2015, but has since recovered to pre-COVID-19 level. In this context, it is essential to integrate robust strategies for future disruptions into national policies, long-term planning, evaluation processes, competition frameworks and transport metrics (ITF, 2024a). By identifying the challenges that transport infrastructure face and working collaboratively, reliable, resistant and adaptable transport systems can quickly recover from future crises.

Compared to passenger transport demand, freight demand was relatively less affected during the COVID-19 pandemic, and it has been rising steadily over the past few years across all modes (figure 1.7).

Figure 1.7. Total billion tonne-kilometres in Asia and the Pacific by mode



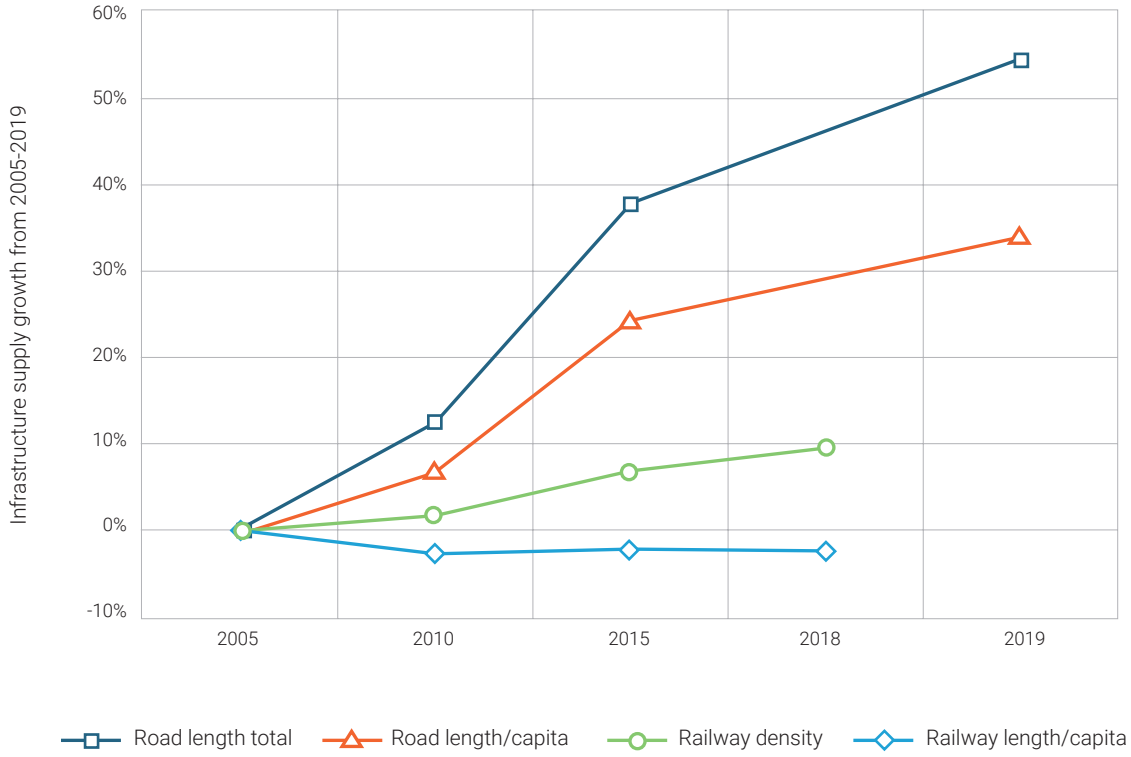
Source: ITF (2023a).

Road freight transport demand in the form of road tractors and lorries are dominating tkm in Asia and the Pacific, where urban freight demand is also gradually growing in the forms of two-and three-wheelers and light commercial vehicles (LCVs) (figure 1.7). Although sea transport has the largest freight transport volume, followed by road and rail freight transport, road and rail freight transport demand had increased by 21 and 15 per cent from 2015 to 2020, respectively, owing to the expansion of infrastructure networks and economic development (ITF, 2021). It is evident that emissions from road transport are higher than those from rail transport. Hence, mode shift strategies should be considered essential as part of freight transport decarbonization efforts.

1.3.4. Infrastructure development

Over the past decade, there was significant development in transport infrastructure in Asia and the Pacific driven by economic growth, an increase in passenger and freight transport, trade flows, urbanization and the need to enhance regional connectivity. Road length, railway density and the number of airports and ports have increased to varying extents. However, the level of road and rail infrastructure growth has differed over the past 15 years, with road supply far outpacing that of rail in the region. As shown in figure 1.8, railway density has even decreased in some countries, highlighting a disparity in investment and development focus. According to the International Union of Railways (2017), the road construction growth is in line with the high population increase in the region and can be attributed to significantly more funds being allocated to road infrastructure compared to rail infrastructure in the region.

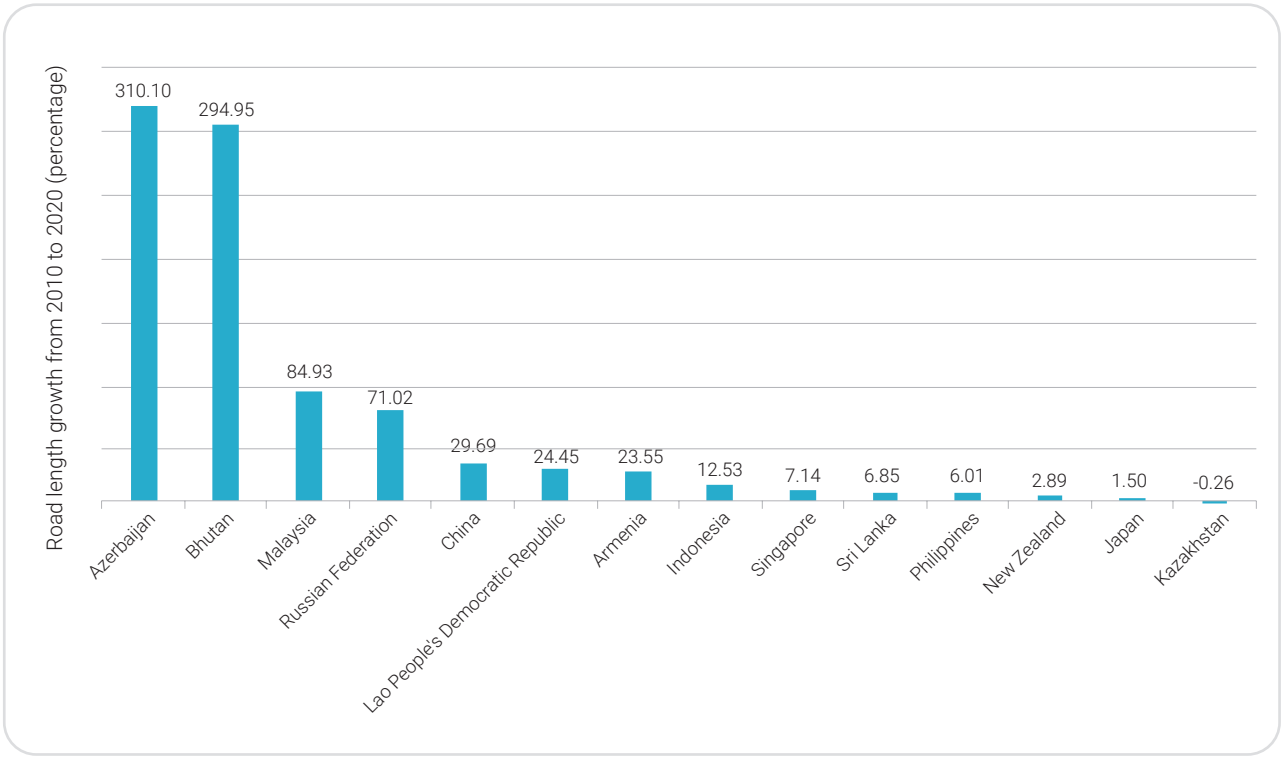
Figure 1.8. Infrastructure supply from 2005 to 2019 in ESCAP member States



Note: Author's calculations based on relevant data from ATO (2022a).

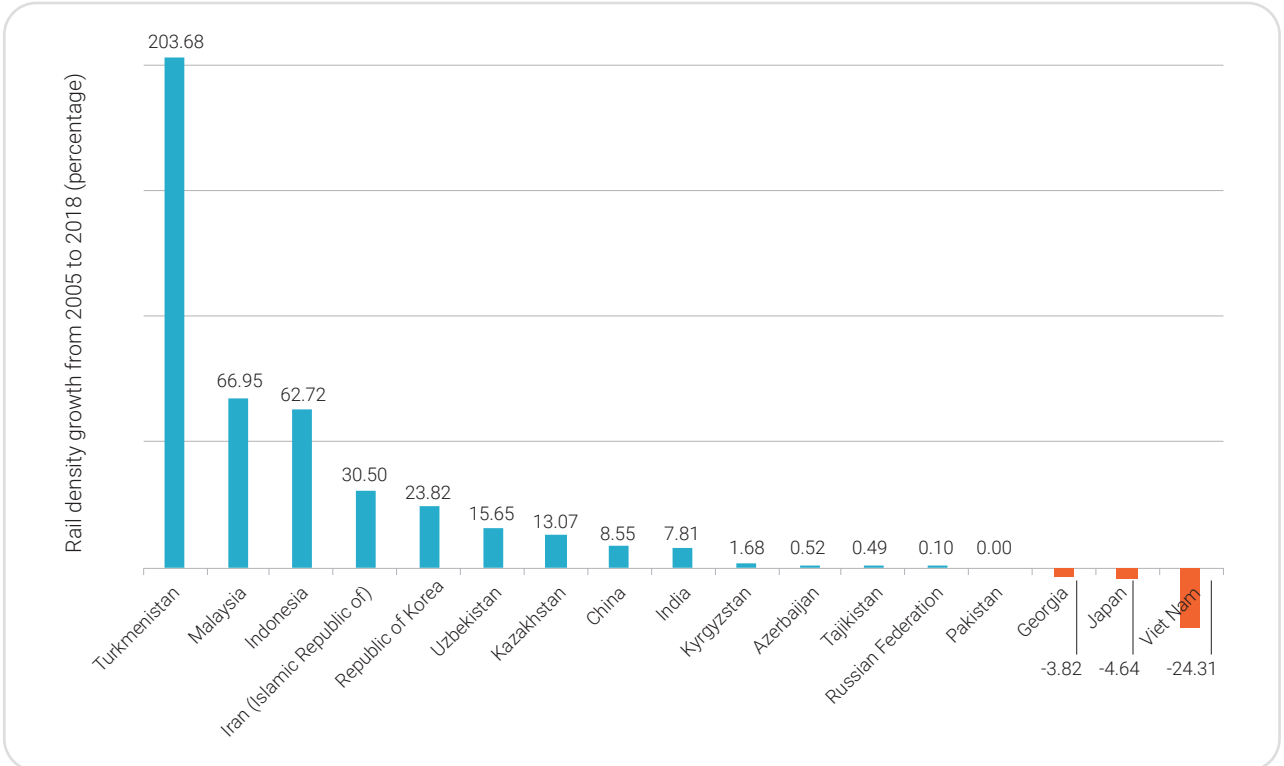
As the region encompasses economies at various stages of development, progress made in transport infrastructure has varied significantly across it (figures 1.9 and 1.10). Challenges remain, such as uneven development, maintenance issues, environmental concerns, and in some cases, political and financial stability, which can affect ongoing and planned projects. Overall, transport infrastructure in the Asia-Pacific region is on a path of rapid transformation, which is playing a crucial role in its economic progress and regional integration.

Figure 1.9. Road length growth in selected countries in Asia and the Pacific from 2010 to 2020



Source: Country official statistics (ATO, 2022a).

Figure 1.10. Rail density growth in selected countries in Asia and the Pacific from 2005 to 2018



Source: International Union of Railways (2017).

As international trade continues to determine freight transport patterns, demand and infrastructure supply, regional freight transport activities will also be influenced by changes in trade flows in Asia and the Pacific. In 2023, regional merchandise trade expanded modestly; nominal exports and imports growth (excluding the Russian Federation) was projected to reach 1.9 per cent and 2.5 per cent, respectively (ESCAP, 2022a). South-East Asia was the only subregion logging strong positive real exports and import growth, while the South and South-West Asia and the Pacific subregions were expected to record more modest positive export and import growth. South-East Asia was also expected to register the strongest export performance (ESCAP, 2022a). Additionally, higher e-commerce sales and activities will lead to a rise in freight transport demand, as they are projected to reach 25 per cent of global retail sales in 2025 (ITF, 2023a).

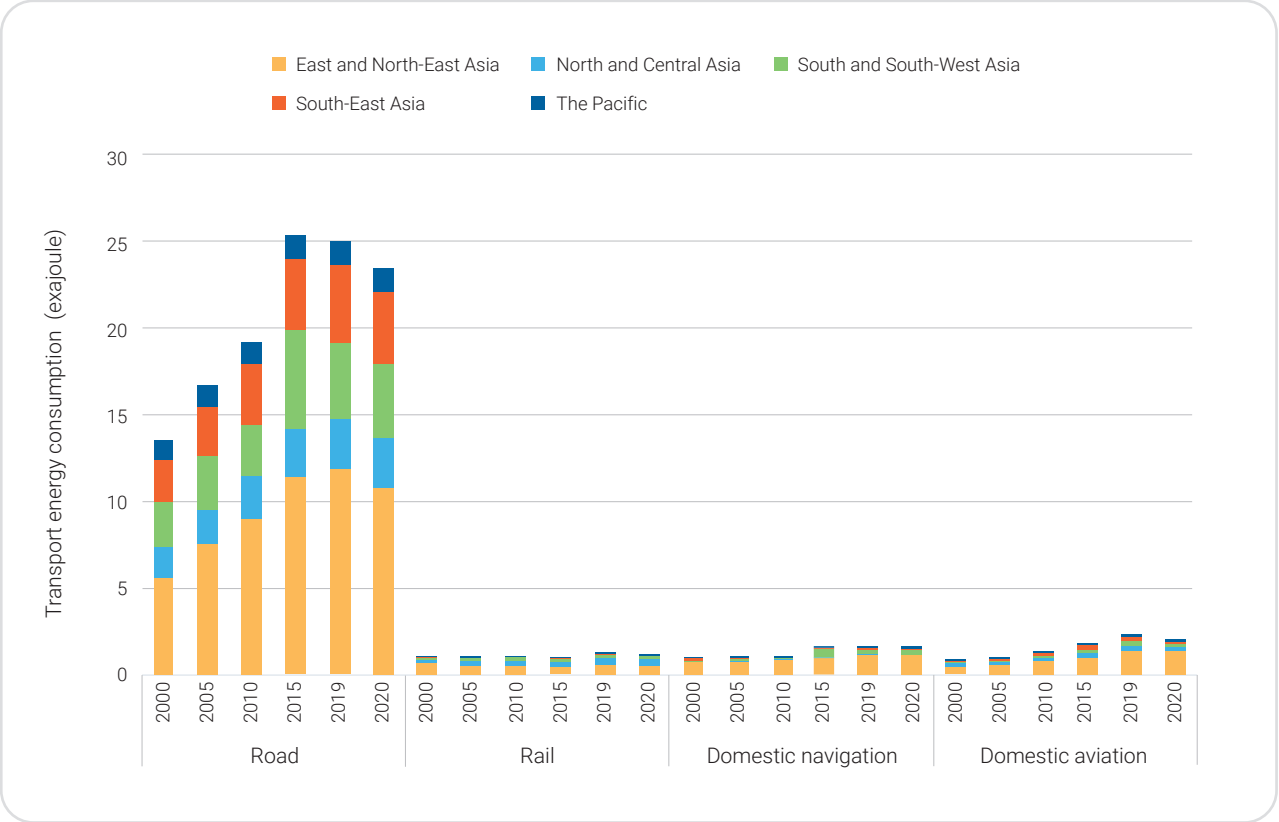
1.4. THE ENVIRONMENTAL AND SOCIAL IMPACT OF INCREASING TRANSPORT DEMAND

Although rapid increases in transport demand and supply in Asia and the Pacific have contributed to economic and social benefits, they have also led to significant environmental and social costs. Among these social costs are air, land and noise pollution, an adverse public health impact, road fatalities, ecosystem degradation, loss of agricultural land and global climate change. Impacts of air, land and noise pollution are the most visible forms of transport's externalities. Frequent exposure to transport emissions, including ambient particulate matter, sulfur dioxide (SO_2), nitrogen dioxide (NO_2) and volatile organic compound (VOC), could lead to chronic lung diseases, heart disease, strokes, cancer and even premature deaths (Buckeridge and others, 2002). In addition to local air pollution, the transport sector has also become a significant contributor to global greenhouse gas emissions over the past few decades, primarily due to its heavy dependence on fossil fuels.

1.4.1. Energy use

Transport accounted for almost 50 per cent of total oil consumption in Asia and the Pacific in 2021 (IEA, 2021). The heavy reliance on oil has had various effects, with the most direct being the production of CO_2 emissions. Road use is the largest share of transport energy consumption across all ESCAP subregions (figure 1.11). The East and North-East Asia subregion has the highest level of energy consumption in terms of absolute values, followed by South and South-West Asia and South-East Asia.

Figure 1.11. Transport energy consumption by mode in Asia and the Pacific from 2000 to 2020



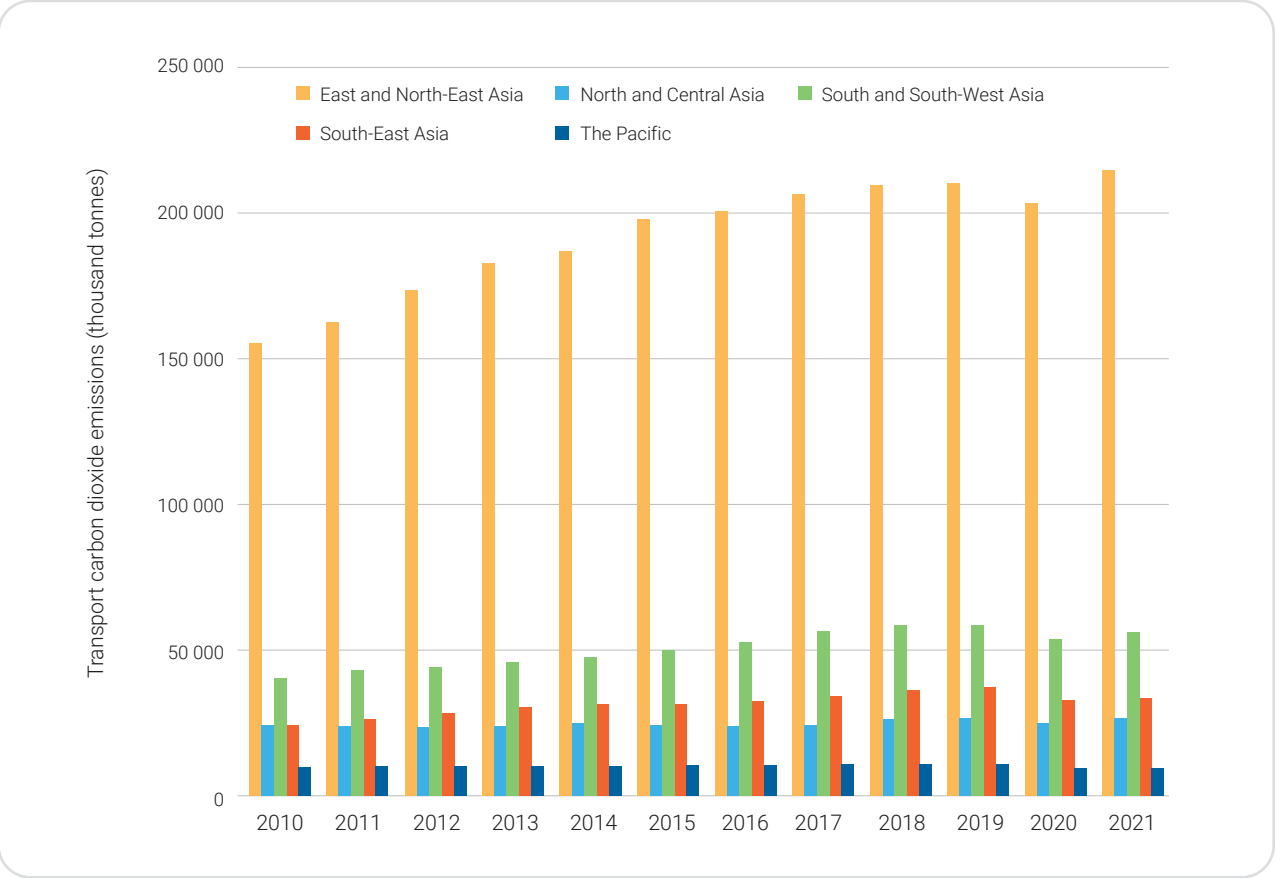
Source: United Nations Statistics Division (2021).

1.4.2. Carbon dioxide and transport

Motorized transport remains dependent on internal combustion engines that generally run on fossil fuels, which is the leading reason for the transport sector to account for more than one-third of CO_2 emissions from end-use sectors. Transport CO_2 emissions have also increased at an annual average rate of 1.7 per cent from 1990 to 2022, faster than any other end-use sector, except for industry (which also grew at approximately 1.7 per cent) (Teter, 2023). Figures 1.12 and 1.13 show the total fossil fuel CO_2 emissions emitted by the transport sector from 2010 to 2021 in Asia and the Pacific. East and North-East Asia accounted for the largest share of emissions during the period, significantly surpassing the second-highest region, South and South-West Asia.

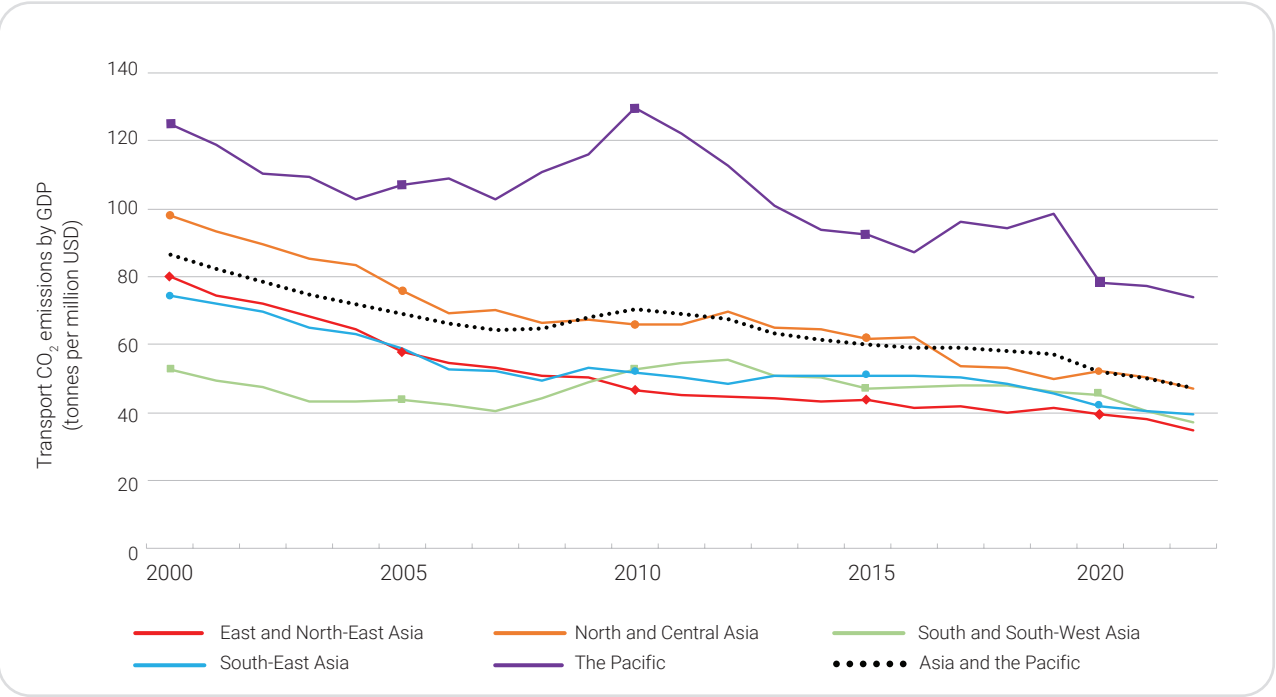
The aggregated trend for the entire Asia-Pacific region indicates a general rise in transport-related CO_2 emissions, peaking around 2019, with a slight dip in 2020 and a recovery in 2021, a pattern mirrored across ESCAP subregions during this period (figure 1.12). The general CO_2 growth rate of Asia and the Pacific was 34 per cent from 2010 to 2021, with East and North-East Asia at 39 per cent, North and Central Asia at 16 per cent, South and South-West Asia at 40 per cent, South-East Asia at 40 per cent and the Pacific region experiencing a decrease of 4 per cent.

Figure 1.12. Transport carbon dioxide emissions by ESCAP subregion from 2010 to 2021



Note: Author's calculation based on EDGAR (2022).

Figure 1.13. Transport carbon dioxide emissions by gross domestic product at the subregional level from 2010 to 2022



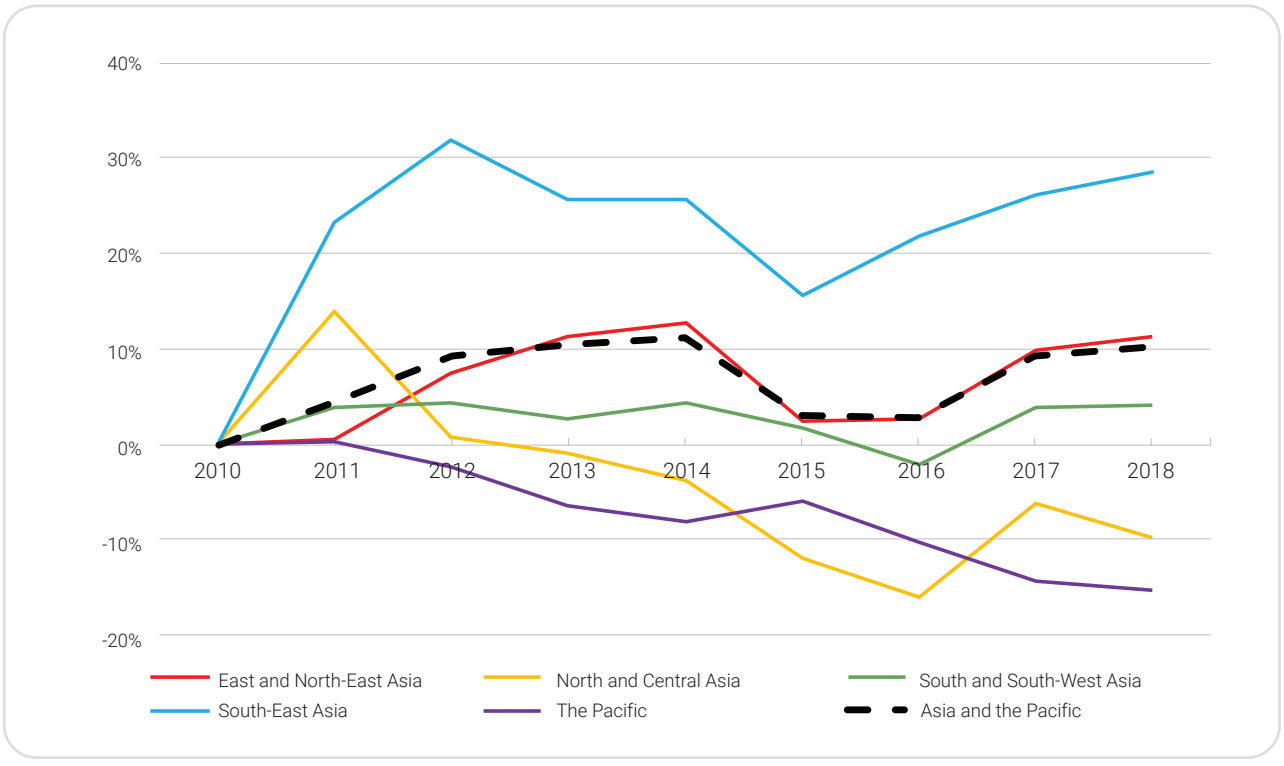
Source: ATO (2022a).

In all ESCAP subregions, the emissions growth rate declined in 2020 due to the impact of the pandemic on transport activities. Most countries applied pandemic-induced lockdown policies in 2020, which led to a marginal decline in CO_2 emissions in the region. Compared to the previous years, the significant increase in transport CO_2 emissions in 2021 could be attributed to the rebound in passenger and cargo transport activity after the pandemic, nearly returning to 2019 levels (Teter, 2023). Generally, the region has continued to trend downward in terms of transport CO_2 emissions by GDP, indicating continuous progress in decoupling economic development from carbon emissions growth (figure 1.13). East and North-East Asia, South-East Asia, South and South-West Asia have recorded rates that are below the regional average level. However, the Pacific is dealing with high CO_2 emissions from their transport sectors relative to their economic outputs. This could be attributed to their reliance on fossil fuels for aviation and shipping, driven by the geographically dispersed nature of many countries in the Pacific (SLOCAT, 2021).

1.4.3. Air pollution and transport

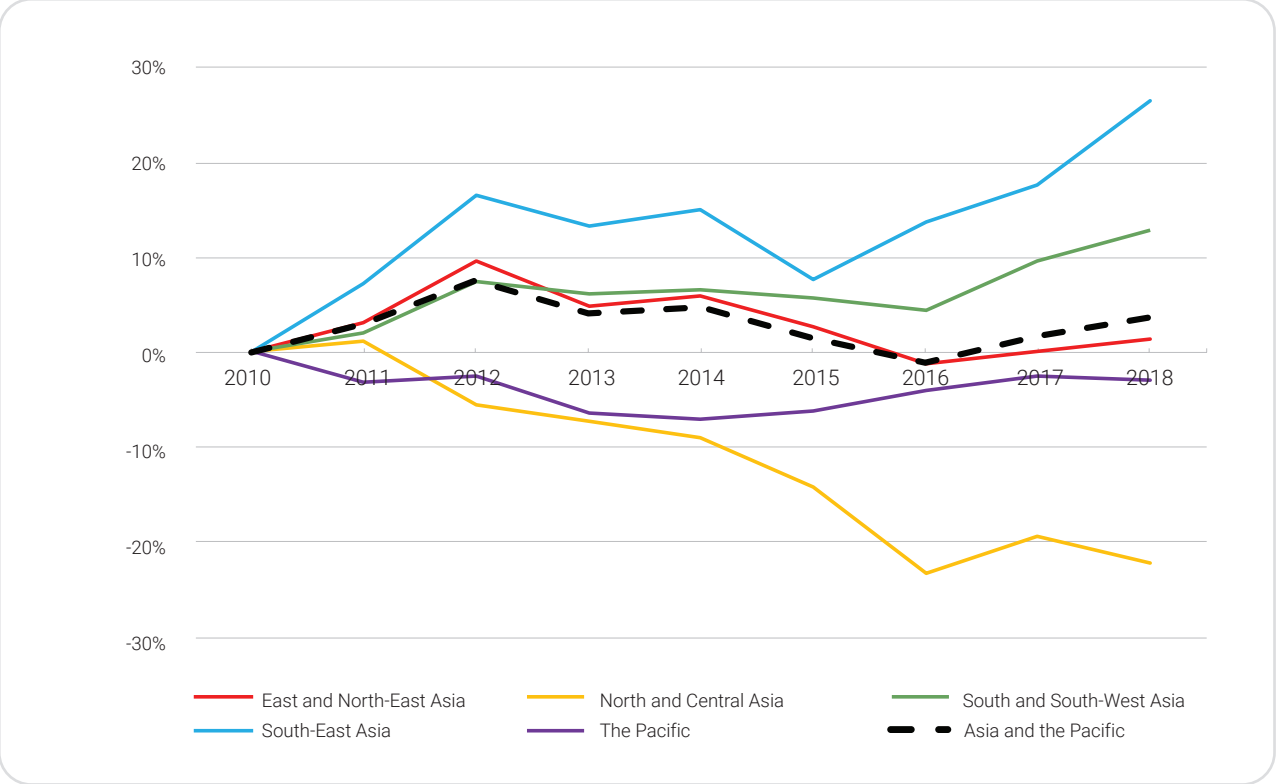
Besides CO_2 emissions, other pollutants are also on the rise. Between 2010 and 2018, emissions of particulate matter, particularly $PM_{2.5}$ and NO_x increased by an estimated 10 per cent and 5 per cent respectively (figures 1.14 and 1.15). These pollutants have direct and severe implications for public health, contributing to respiratory and cardiovascular diseases, heart disease, lung cancer, and even premature death (WHO, 2022). Additionally, they degrade air quality by contributing to smog and ground-level ozone. The ongoing impact of these emissions underscores the urgent need for cleaner transport alternatives and stringent regulations to protect public health and the environment in the region.

Figure 1.14. Total $PM_{2.5}$ emissions from transport by ESCAP subregion



Note: Author's calculation based on EDGAR (2022).

Figure 1.15. Total nitrous oxides emissions from transport by ESCAP subregion



Note: Author's calculation based on EDGAR (2022).

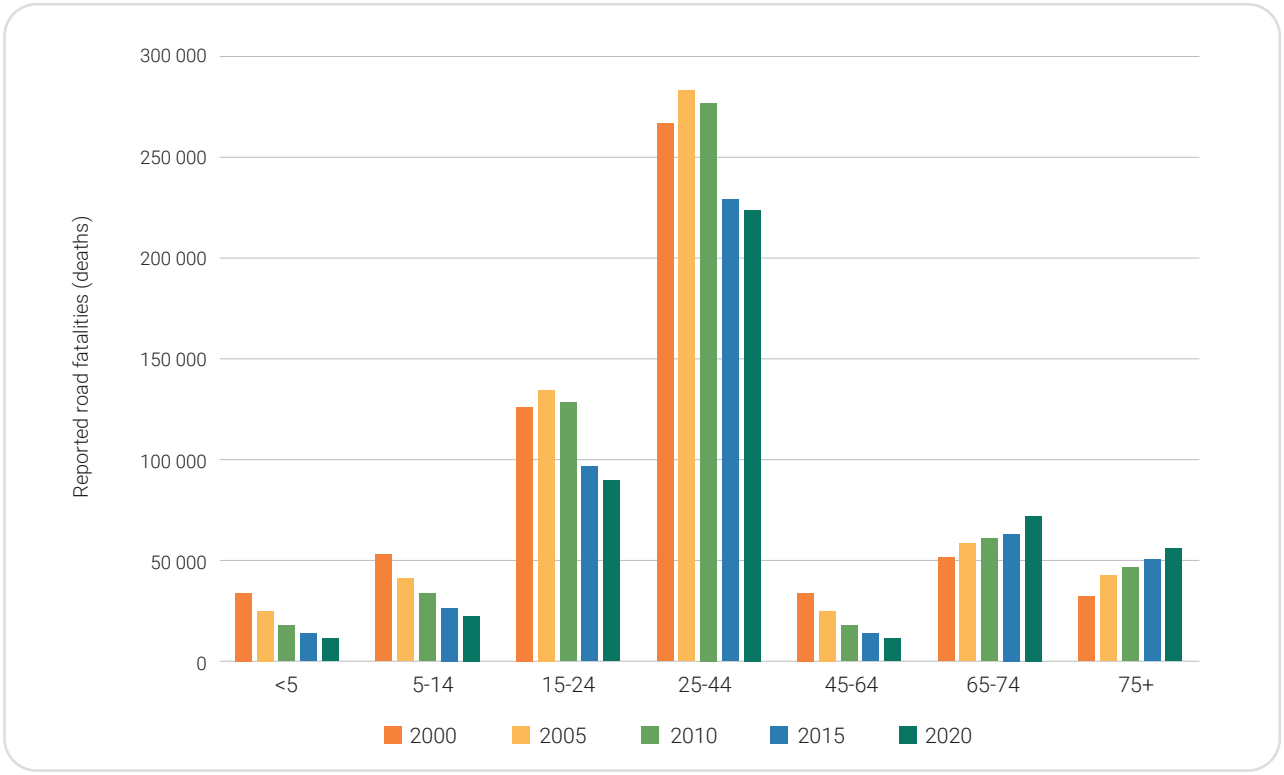
1.4.4. Road safety

Traffic crashes and deaths are significant social impacts of transport activities. The long-term impacts of traffic injury and the social disparities in road accident risk are not well-understood nor documented in all countries. The social impact of traffic crashes can include loss of life and life quality, loss of productivity, job loss, burden of injury, psychological consequences, impact on families, and medical, legal, court and vehicle damage costs. Different social groups in the Asia-Pacific region are also experiencing varying levels of road safety. Figure 1.16 presents the distribution of accumulated road traffic deaths by age group in Asia and the Pacific from 2000 to 2019. It is evident that individuals aged 25-55 accounted for the majority of road traffic deaths during the period, followed by those in the 15-24 age group.

Although the Asia Pacific region has made significant progress in road safety, with the number of road deaths decreasing for all age groups below 64 from 2000 to 2019, there has been a gradual increase in road deaths among older persons (aged 65 and above), resulting from increased vulnerability to injury in a crash as age increases.

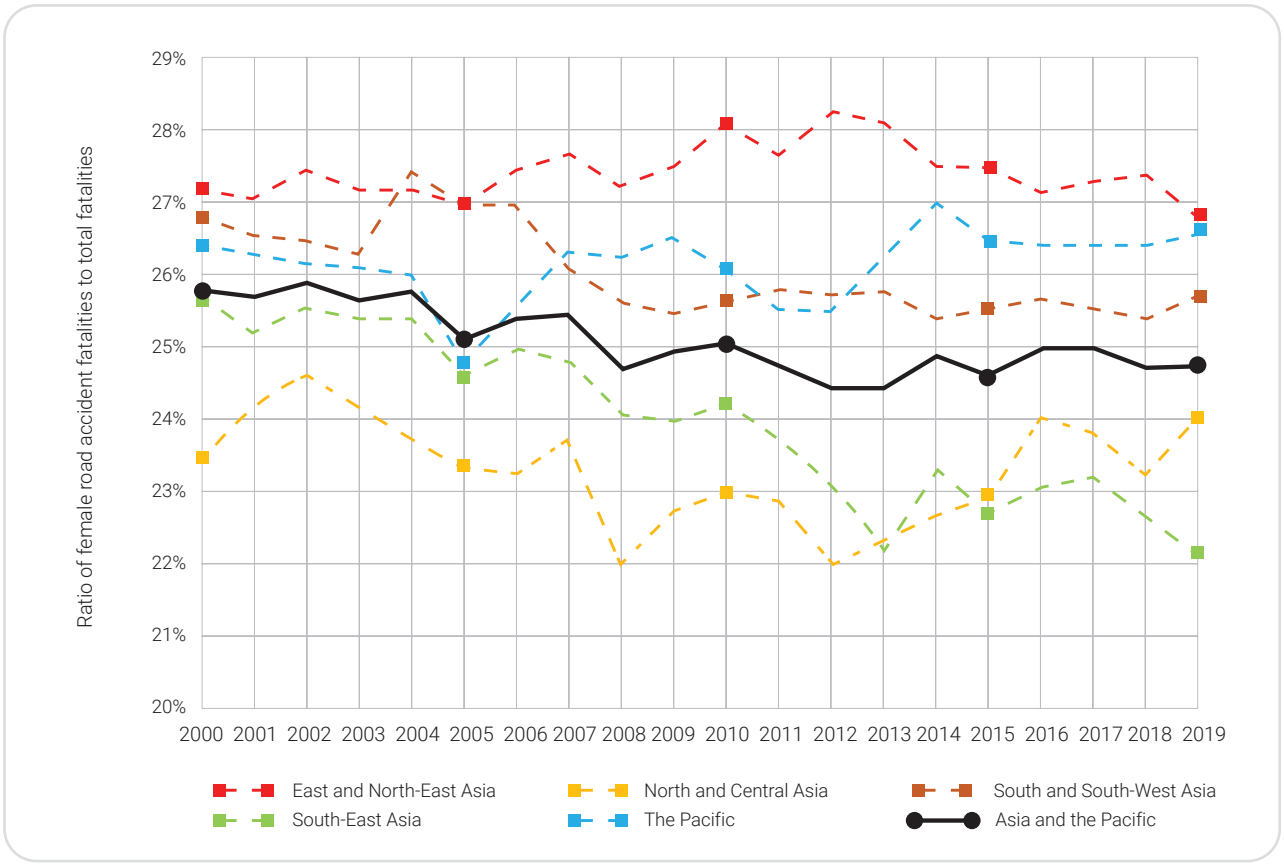
Road safety also affects women and men differently. Figure 1.17 illustrates the variation in the share of female road fatalities in Asia and the Pacific averaged at the subregional level.

Figure 1.16. Road fatalities by age group from 2000 to 2019



Source: Global Burden of Disease Study (2021).

Figure 1.17. Share of female road accidents fatalities by subregion from 2000 to 2019



Source: WHO (2021a).

On average, female road users account for approximately one quarter of road accident fatalities. From 2000 to 2019, the highest ratio of female road fatalities to total fatalities was highest in East and North-East Asia compared to other subregions, while the shares were relatively low for North and Central Asia and South-East Asia. Notably, there was a gradual decrease in the share of female road fatalities during this period in South-East Asia.

Existing research studies suggest that differences in travel patterns and user behaviour between women and men largely explain this discrepancy in involvement in crashes, with men tending to travel greater distances and engaging in more risk-taking driving behaviours than women (Cullen and others, 2021; WHO, 2002). Particularly in developing countries, women typically commute less frequently, travel shorter distances and consequently, are less exposed to road safety risks. However, this pattern reflects deeper issues of limited mobility, access, and opportunity, which result in significant exclusion of women from social and economic life. In addition to the gender-differential travel pattern, a greater acceptance of risk and a disregard for pain and injury, as well as a lack of attention and impatience among male drivers, also contribute to the disparity (WHO, 2002). Despite the higher share of road fatalities among men, women are likely to experience more severe long-term social and economic consequences because of traffic crashes. This disparity is often due to inadequate social and family support, financial difficulties, and uncertainties related to employment (WHO, 2002).

1.5. REGIONAL TRANSPORT POLICY PRIORITIES

With the objective to better understand the transport priorities and challenges in Asia and the Pacific, ESCAP designed and circulated a survey among all member States, members of the ESCAP Transport Research and Education Network and partner organizations between January and March 2024. The "2024 Review of Transport Developments in Asia and the Pacific" survey contributed to the identification of existing challenges, development priorities, implemented policies, and transport capacities and efficiency in the Asia-Pacific region.

As some countries opted to submit collective survey responses among different departments within the same ministry and others submitted more than one completed survey response for the same country, the total set of responses received from 60 respondents did not reflect 60 countries. Out of the 60 survey respondents, 45 represented national governments, and the rest were from academia, international organizations or non-governmental organizations. Twenty-four countries were represented in total, and two-thirds of the respondents were male. Road transport was largely selected as the focus of work, followed by waterways and maritime transport. Approximately two-thirds of the participants were currently working in the transport sector, covering passenger and freight transport.

In the survey, respondents were presented with a range of challenges in the transport sector across seven transport thematic areas.[1] They were then asked to prioritize these challenges by ranking them

1 The structure of the survey mirrored the seven thematic areas outlined in the "Regional Action Programme on Sustainable Transport Development in Asia and the Pacific (2022–2026)" (RAP), which was adopted by the Fourth Ministerial Conference on Transport, held in December 2021. The Regional Action Programme focuses on advancing three overarching objectives, namely efficient and resilient transport and logistics networks and mobility for economic growth, environmentally sustainable transport systems and services, and safe and inclusive transport and mobility. These objectives are further delineated into seven thematic areas: regional land transport connectivity and logistic; maritime and interregional transport connectivity; digitalization of transport; low-carbon mobility and logistics; urban transport; road safety; and inclusive transport and mobility.

according to their countries' experience. This ranking process identified key areas of concern and can guide future policy and decision-making efforts within each thematic area. Survey respondents had the option to select only thematic areas that they would like to respond to based on their expertise or work domain. As a result, the total number of observations may differ across thematic areas.

With regard to transport connectivity, insufficient infrastructure poses a major obstacle to land and maritime connectivity at regional and interregional levels. Figure 1.18 shows that 47 per cent of the respondents ranked insufficient regional land transport capacity encompassing shortages in road, rail, or intermodal infrastructure as the primary challenge. Inefficiency in border crossing procedures and inadequate regional cooperation are the top challenges for the development of regional land transport connectivity. Additionally, 53 per cent of the respondents highlighted the significant infrastructure shortages in ports and along interregional transport corridors; several respondents expressed concerns about geopolitical risks affecting maritime connectivity (figure 1.19).

Figure 1.18. Top three challenges for regional land transport connectivity and logistics

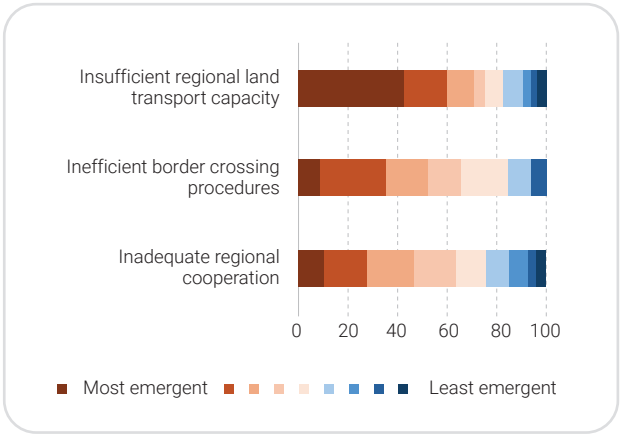
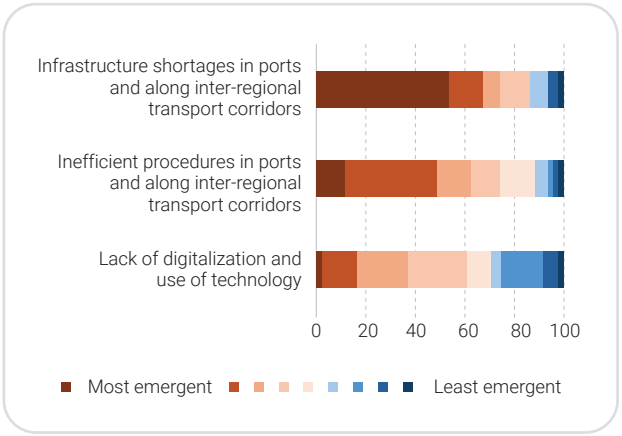


Figure 1.19. Top three challenges for maritime and interregional transport connectivity



Similarly, inadequate public transport capacity remains the foremost challenge in urban areas, followed closely by traffic movement or congestion, while 57 per cent of the respondents emphasized that the lack of financial resources has impeded progress towards transport digitalization (figures 1.20 and 1.21).

Figure 1.20. Top three challenges for urban transport

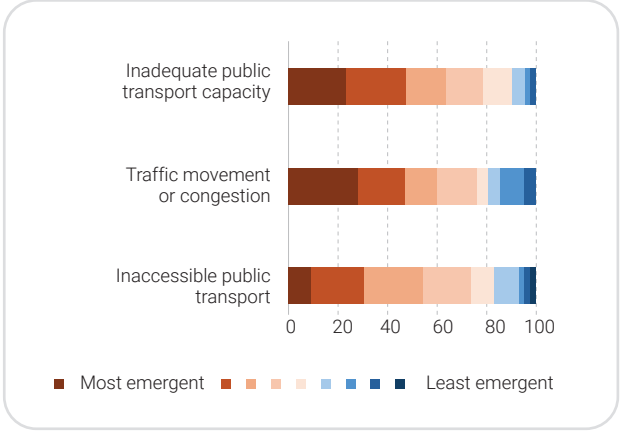


Figure 1.21. Top three challenges for transport digitalization

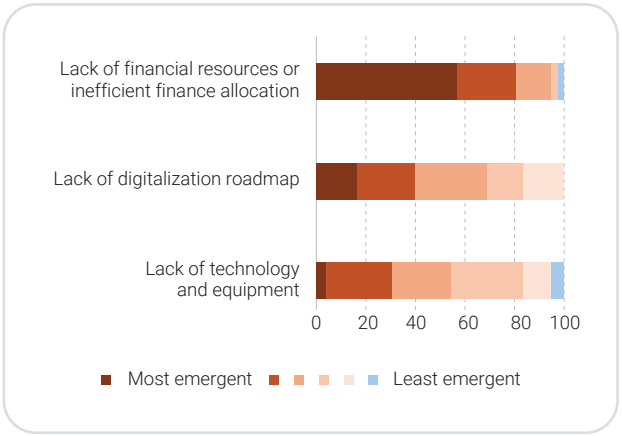


Figure 1.22. Top three challenges for road safety

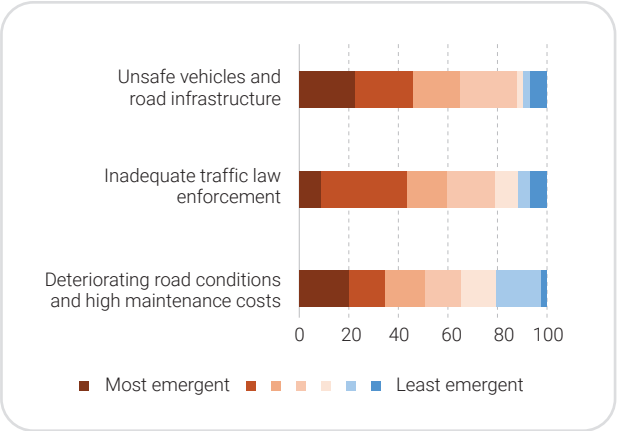


Figure 1.23. Top three challenges for low-carbon mobility and logistics

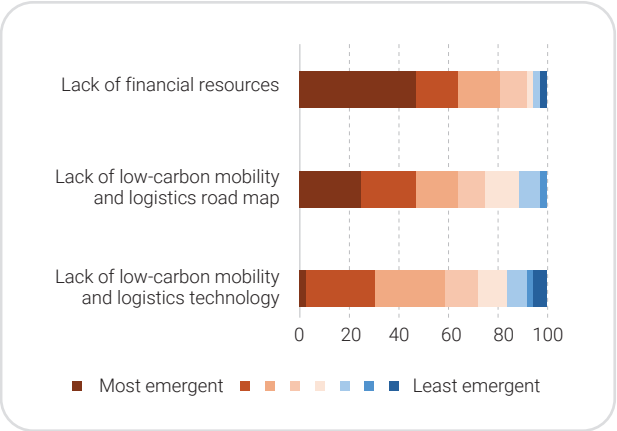
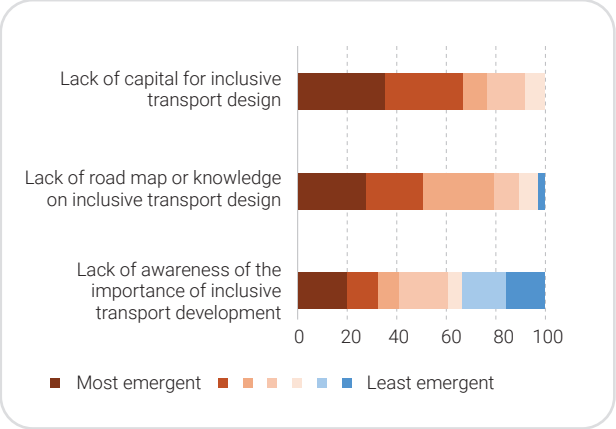


Figure 1.24. Top three challenges in inclusive transport and mobility



Forty-seven per cent of respondents also agreed that the lack of financial resources remains a major challenge for attaining low-carbon mobility and logistics. Unsafe vehicles and road infrastructure continue to be the most pressing issue in addressing road safety concerns. Although it is widely recognized among the survey respondents that the governments in the region have been enhancing national capacity to accommodate the mobility needs of all members of society irrespective of their socioeconomic status, physical abilities or geographical location, 36 per cent of survey participants stressed that there is a notable shortage of funding for inclusive transport design. Another emergent challenge frequently highlighted in the survey is the absence of a clear road map and adequate technology.

Survey respondents were invited to rate several proposed priorities for the transport sector in Asia and the Pacific, of which the top three are summarized in accordance with the seven thematic areas in figures 1.25 and 1.31. Fifty-three per cent of respondents underscored the importance of expanding and enhancing overall regional connectivity and supply chain efficiency for land transport. Several respondents advocated achievement of this through, for instance, streamlining formalities for

landlocked countries, promoting public-private partnerships (PPPs) or bolstering infrastructure investment. Meanwhile, 37 per cent of respondents suggested prioritizing the enhancement of efficient multimodal operations to improve maritime and interregional transport connectivity.

Figure 1.25. Top three priorities for regional land transport connectivity and logistics

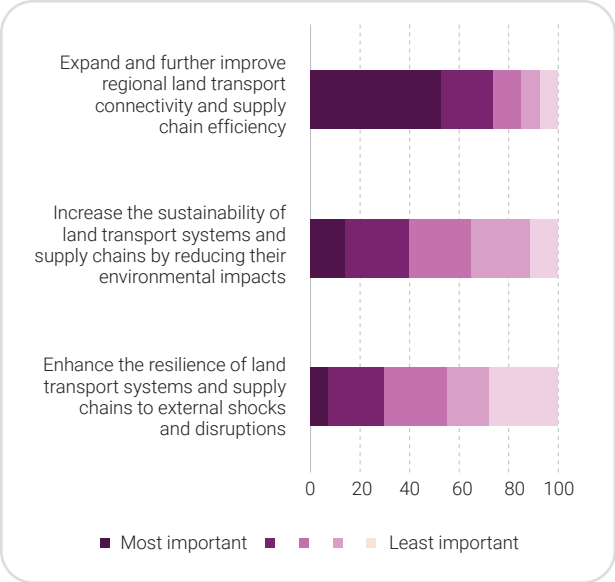


Figure 1.26. Top three priorities for maritime and interregional transport connectivity

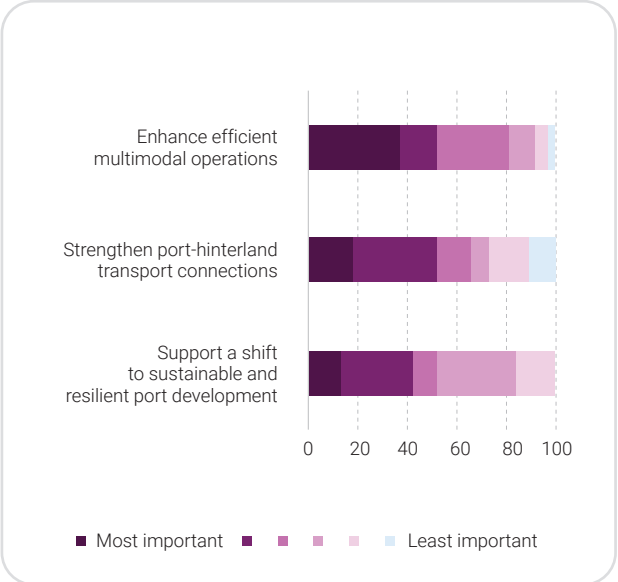


Figure 1.27. Top three priorities for urban transport

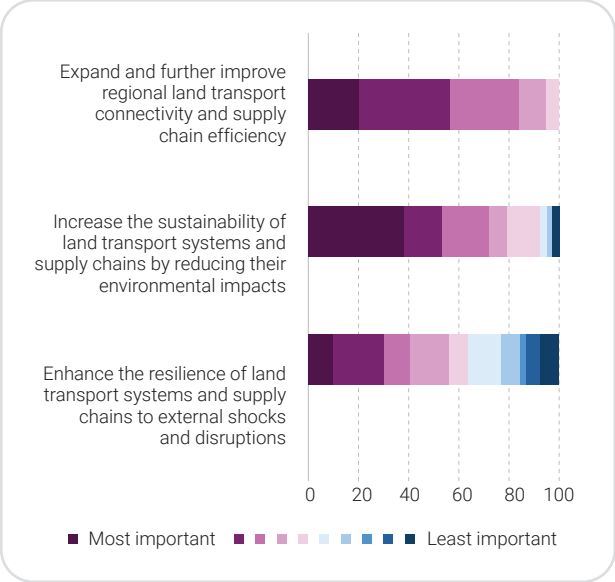
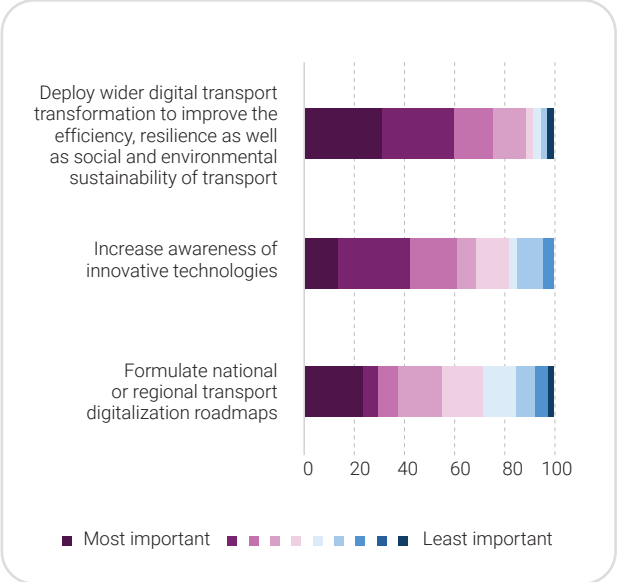


Figure 1.28. Top three priorities for transport digitalization



There is also a strong call for the promotion of efficient, sustainable, and resilient urban transport. To that end, bolstering operational efficiency and capacity in the transport sector must align with environmental sustainability goals to reduce the sector's carbon emissions footprint. Accordingly, the deployment of broader digital transport transformation and the accelerated shift to electric mobility are considered key priorities to advance towards digitalization and low-carbon mobility and logistics. It is crucial for governments to persist with the implementation of safety system interventions as a top priority for road safety measures. Recognizing the transport challenges encountered by various user groups, coupled with allocating more financial resources, are essential steps for implementing inclusive transport policies and initiatives to ensure that transport is accessible to all segments of society.

Figure 1.29. Top three priorities for road safety

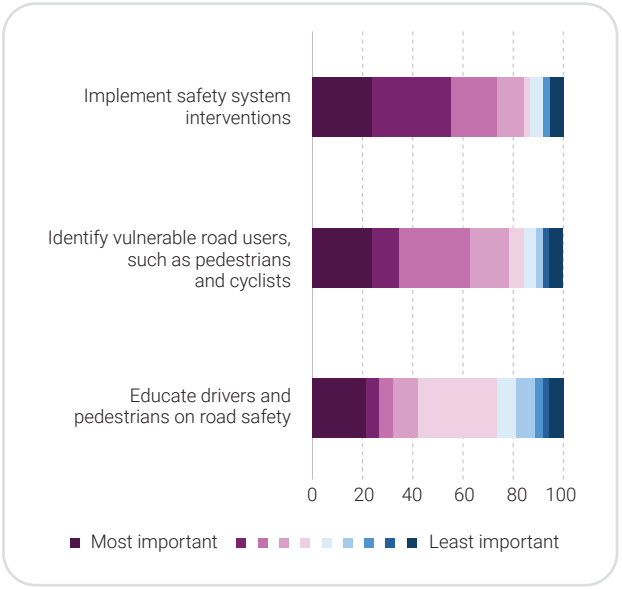


Figure 1.30. Top three priorities for low-carbon mobility and logistics

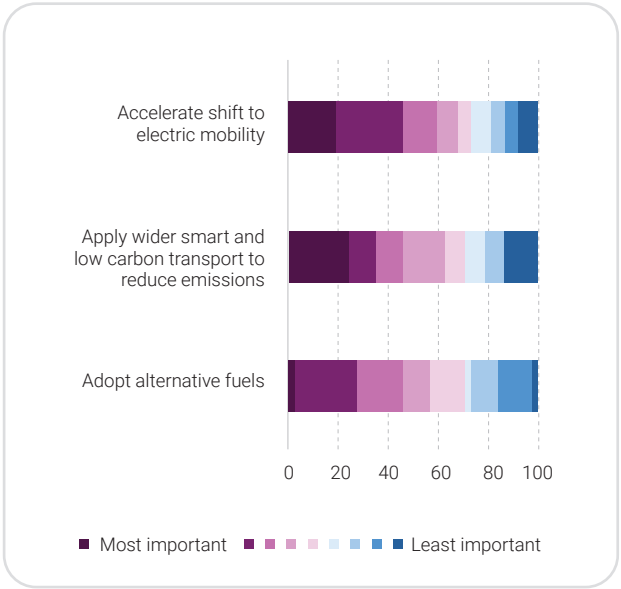


Figure 1.31. Top three priorities in inclusive transport and mobility

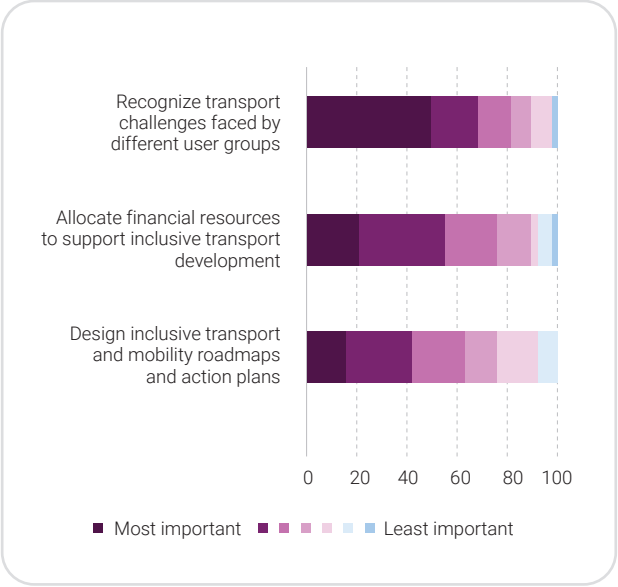


Table 1.2 presents an outline of several selected planned initiatives reflected by the survey respondents, which have been implemented or are being planned, to address some of the challenges in the transport sector.

Table 1.2. Selected examples of implemented policies or initiatives categorised by the seven thematic areas of the ESCAP Regional Action Programme for Sustainable Transport Development (2022–2026)

Thematic area	Examples of policies or initiatives in Asia and the Pacific
Regional land transport connectivity and logistics	• The National Freight and Supply Chain Strategy of Australia has outlined key areas and objectives to guide multimodal freight supply chains of Australia for the next 20 years and beyond. • Bhutan and India are collaborating on a cross-border railway initiative. • Cambodia has initiated the Comprehensive Master Plan on Cambodia Intermodal Transport and Logistics System 2023–2033. • The Persian Gulf – Black Sea Transit Corridor Agreement is aiming to improve transportation links. • The Philippines has initiated strategic infrastructure programmes, including a traffic decongestion programme, seamless and inclusive connectivity via national and local linkages. • The Economic Cooperation Organization is undertaking projects in establishing various corridors, such as the Kazakhstan-Turkmenistan-Islamic Republic of Iran rail corridor, Islamabad-Tehran-Istanbul rail corridor, Almaty-Bandar Abbas rail corridor, Almaty-Tehran-Istanbul rail corridor.
Maritime and interregional transport connectivity	• Cambodia has initiated the Master Plan for Waterborne Transport on the Mekong River System. • The East Coast Rail Link serves as a land bridge connecting Kuantan Port to Port Klang, contributing to the development outlined in the National Port Blueprint 2026–2040 in Malaysia. • The Philippines is developing the Maritime Transportation Information System, which is designed to improve understanding of maritime traffic. In addition, the Maritime Industry Authority launched its Blockchain-Enabled Automated Certification System that allows applications to be processed instantly, enable users to access through web or mobile platforms and support contactless transactions. • Maritime higher education institutions and maritime training institutions continue efforts in monitoring and implementing the STCW code to uphold global competitive standards for seafarers.

Table 1.2. Selected examples of implemented policies or initiatives categorised by the seven thematic areas of the ESCAP Regional Action Programme for Sustainable Transport Development (2022–2026) (cont.)

Thematic area	Examples of policies or initiatives in Asia and the Pacific
Digitalization of transport	• Australia endorsed principles for a national approach to Co-operative Intelligent Transport Systems to facilitate investment and planning. Efforts are underway to refine the National Road Transport Technology Strategy and the 2024–27 National Connected and Automated Vehicle Action Plan, including the development of a comprehensive regulatory framework to ensure the safe and legal operation of automated vehicles on public roads once they become commercially available. • The Ministry of Road Transport and Highways in India launched a Central Assistance Scheme aimed at strengthening the intelligent transport systems in public transport, aiding the State Transport Undertakings or the State Transport Corporations in enhancing the reliability and efficiency of public bus operations.
Low-carbon mobility and logistics	• Armenia has implemented a tariff exemption for the import of electric vehicles from January 2024 until January 2025. • The Australian Transport and Infrastructure Net Zero Roadmap and Action Plan aims to reduce greenhouse gas emissions across all transport modes. The Australian New Vehicle Efficiency Standard was established for fuel cost savings and to improve air quality, the Maritime Emissions Reduction National Action Plan aims to decarbonize the maritime transport sector and contribute towards reducing international shipping emissions. The Jet Zero Council brings together a cross-section of stakeholders from across the aviation sector and provides advice to the Government on the industry's transition to net zero emissions. • Bhutan has launched a road map for sustainable transport with a commitment to increasing the uptake of electric vehicles. This includes replacing the government vehicle fleet with more electric vehicles, installing electric vehicle charging stations in all 20 districts, and implementing the Bhutan Green Transport Project. Additionally, subsidies are being provided to replace 300 internal combustion taxis with electric vehicles. • The Ministry of Road Transport and Highways in India is actively promoting alternative fuels to mitigate the emissions levels from vehicles. The Ministry has notified standards for mass emissions, safety requirements, and the use of fuels, such as hydrogen-compressed natural gas blends, liquefied natural gas and flexible ethanol-gasoline blends, while researching modal mix optimization for potential resource savings, including fuel costs.

Table 1.2. Selected examples of implemented policies or initiatives categorised by the seven thematic areas of the ESCAP Regional Action Programme for Sustainable Transport Development (2022–2026) (cont.)

Thematic area	Examples of policies or initiatives in Asia and the Pacific
Urban transport	• The Ministry of Road Transport and Highways in India supports the State Transport Undertakings or the State Transport Corporations in operating intercity buses, including electric buses, for seamless regional land transport connectivity, while the implementation of the Motor Vehicle Aggregator Guidelines 2020 aims to regulate shared mobility and reduce traffic congestion and pollution. • Malaysia publishes bus data as open-source. The MyLogistic database serves as a reference point for investors and industry players. • The Philippines has constructed the Bus Rapid Transit with a designated lane on the main road of Epifanio de los Santos Avenue.
Road safety	• Armenia and the European Investment Bank signed the Neighborhood Investment Platform Grant Agreement to support the implementation of the Armenia Road Safety Improvement Project. • Australia publishes national road safety data and dashboards, including crash, hospitalized injuries and enforcement dashboards. • The Ministry of Road Transport and Highways in India prioritizes road safety audits, identifies and rectifies blackspots, and develops safe road and construction zones on national highways. The Electronic Detailed Accident Report Project was initiated to establish a central repository for road accident data nationwide. • The Philippines Road Safety Action Plan 2023–2028 aims to improve iRAP Star Ratings of national roads to at least three stars. The Department of Public Works and Highways mandates the inclusion of road safety and traffic management plans in all detailed engineering designs for roads and bridges. Guidelines and standards for road safety design, road signs, pavement markings and bicycle facilities are also being issued.
Inclusive transport and mobility	• Australia is reforming public transport accessibility legislation to enhance safety and accessibility for people with disabilities, using input from the disability community. Efforts are also underway to boost women's representation in the transport sector.

Table 1.2. Selected examples of implemented policies or initiatives categorised by the seven thematic areas of the ESCAP Regional Action Programme for Sustainable Transport Development (2022–2026) (cont.)

Thematic area	Examples of policies or initiatives in Asia and the Pacific
Inclusive transport and mobility	• India launched the Accessibility Guidelines for Bus Terminals and Bus Stops in 2022 to improve public transport accessibility for people with disabilities. • The Philippines has implemented fare discounts, priority lanes and service assistance for persons with disabilities and senior citizens. The Department of Public Works and Highways Strategic Infrastructure Programs aim to promote inclusive transport and mobility, aligned with the Philippine Development Plan 2023–2028. Initiatives include traffic decongestion programs, seamless connectivity projects, and building resilient communities. The Department's policy issuances include guidelines for gender mainstreaming in road infrastructure projects, annual gender and development plans, bicycle facilities, and social and environmental management systems.

These highlighted policy examples underscore the consistent commitment of governments in the region to enhance the capacity and resilience of the transport sector and align them with global sustainable goals. Despite these efforts, challenges in Asia and the Pacific persist, including the lack of appropriate and disaggregated transport data that can support effective policymaking processes, necessitating action not only at the national level but also through regional cooperation. By collaborating on shared challenges, governments can address issues, such as infrastructure development, sustainability and resilience, more comprehensively, leading to a more robust and interconnected transport network and improved services across the region.

CHAPTER

2

THE ROLE OF TRANSPORT IN ACHIEVING THE SUSTAINABLE DEVELOPMENT GOALS

Countries in Asia and the Pacific are encountering varying transport challenges that are preventing them from achieving sustainable development in general, particularly targets relevant to the following SDGs: Goal 3 (good health and well-being), Goal 5 (gender equality), Goal 9 (industry, innovation and infrastructure), Goal 11 (sustainable cities and communities) and Goal 13 (climate action). These five SDGs correspond to the three pillars of sustainability, which are economic (Goal 9), environmental (Goals 11 and 13) and social (Goals 3 and 5). They are grouped accordingly in the following sections, reflecting how regional transport connectivity, transport technology, innovation and digitalization, low-carbon transport, sustainable urban transport, road safety and inclusive transport are directly linked to their achievements, as well as current challenges and status of development.

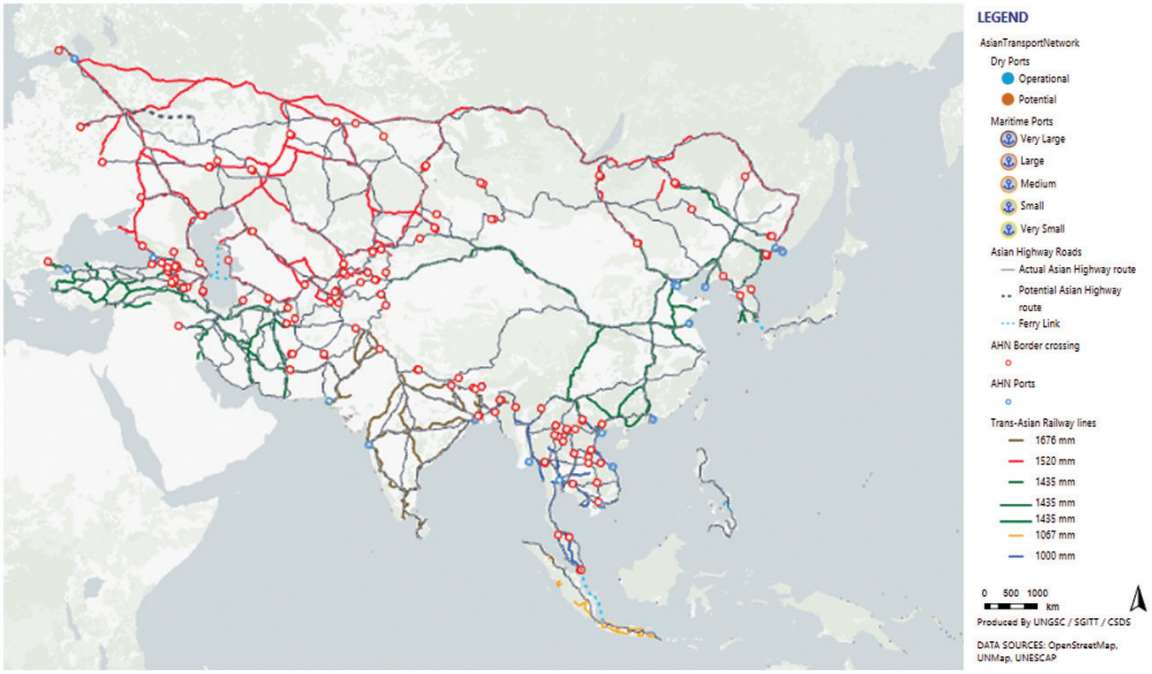
2.1. ECONOMIC SUSTAINABILITY

2.1.1. Advances in regional transport infrastructure connectivity for greater efficiency and resilience

Regional transport connectivity is essential for the performance of international supply chains, as it enables the physical cross-border processes of gathering resources, transforming them into parts and products, distributing finished goods to markets and, in some cases, making these resources available again through recycling and reuse strategies. Advances in the transport infrastructure development (infrastructure connectivity) and in improving its operational environment (operational connectivity) in Asia and the Pacific are an integral part of delivering on SDG 9 (build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation), bearing in mind that greater resiliency in transport connectivity may also lead to higher levels of efficiency in the system, especially with the deployment of ICT (Bazaldua, 2023).

The Asia-Pacific land transport infrastructure and its maritime connections have been mapped out by the countries in the Asian Highway Network, the Trans-Asian Railway Network and dry ports. To date, the regional land transport network in Asia and the Pacific spans over 32 countries in Asia, linking all its subregions and connecting the capitals and major cities of the participating countries (figure 2.1). Governments have earmarked these transport routes and facilities to support the increase in the international transport of passengers and goods because of growing international trade in the ongoing process of globalization and with a view to promote efficient international multimodal transport. Over time, the environmental and resiliency considerations in the development of this regional network in the context of the climate change challenges have grown into a full-fledged concern, further reinforced by the COVID-19 pandemic.

Figure 2.1. Asia-Pacific Land Transport Network, 2024

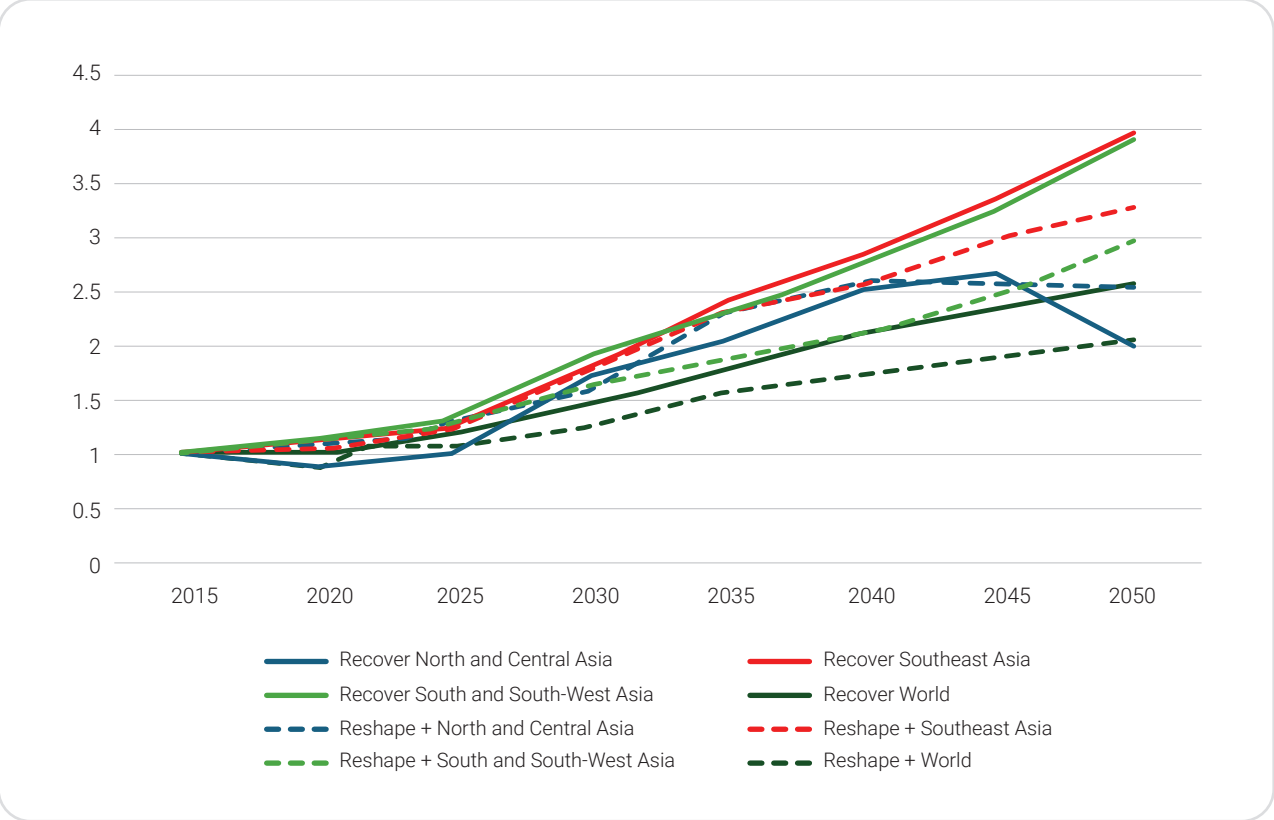


Source: ESCAP (2024b).

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

The demand for regional transport infrastructure continues to grow, despite the setback of the COVID-19 pandemic. In South-East Asia, freight activity in tonne-kilometres is projected to increase by nearly 80 per cent between 2015 and 2030, and to nearly quadruple (factor of 3.9) from the 2015 baseline value by 2050 (ITF, 2022a). In South and South-West Asia, under the current trajectory, total demand for non-urban freight transport is expected to increase by almost a factor of four between 2015 and 2050 (ITF, 2022b). Under the scenarios, which contemplate significant (Reshape) or ambitious (Reshape+) climate change response policies, the total increase comes to 3.1 times and 2.8 times, respectively. In North and Central Asia, by 2050, the freight activity under all three scenarios is projected to more than double the 2015 values (ITF, 2022c) (figure 2.2).

Figure 2.2. Relative change in freight activity in Asia and the world (index=2015)



Sources: ITF (2022a); ITF (2022b); ITF (2022c).

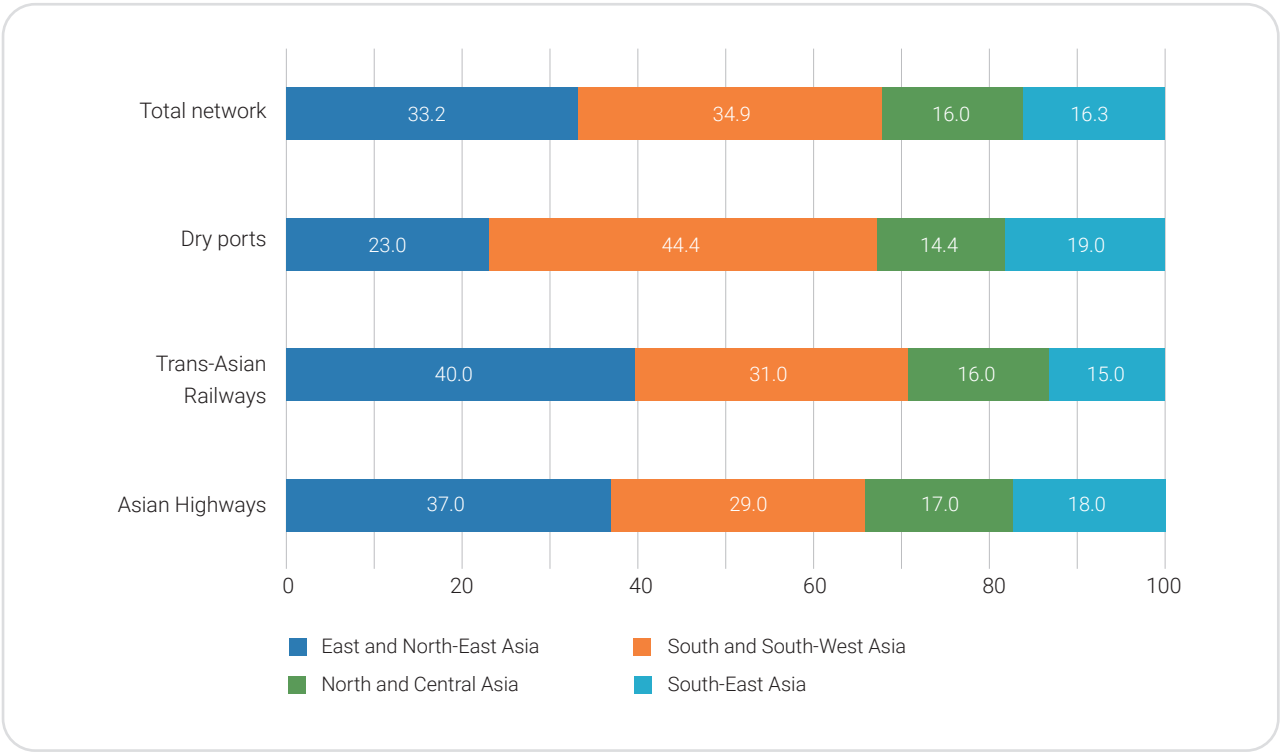
Against this background, this section gives a review of the current status and major trends in the development of the regional land transport infrastructure and its maritime connections, based on existing data related to the implementation of the intergovernmental agreements on the Asian Highway Network, the Trans-Asian Railway Network and on dry ports, as well as other sources of global and regional data on transport connectivity.

2.1.1.1. Current status and trends

The regional transport network consists of 145,000 km of the Asian Highways, 121,000km of Trans-Asian Railways and 275 dry ports, covering all parts of Asia. As 99.7 per cent of the total population of the Asia-Pacific region live along the Asian Highway Network, the GDP of the Asian Highway Network members make up 99.8 per cent of the total GDP of the region.

South and South-West Asia accounts for approximately one-third of the total network each and North and Central Asia and South-East Asia account for approximately 16 per cent of the total network. East and North-East Asia accounts for 40 per cent of the regional railway and 37 per cent of the regional road network, largely because it includes China and the Russian Federation. In turn, South and South-West Asia leads in terms of dry port development (figure 2.3).

Figure 2.3. Current subregional composition of the Asia Pacific land transport network

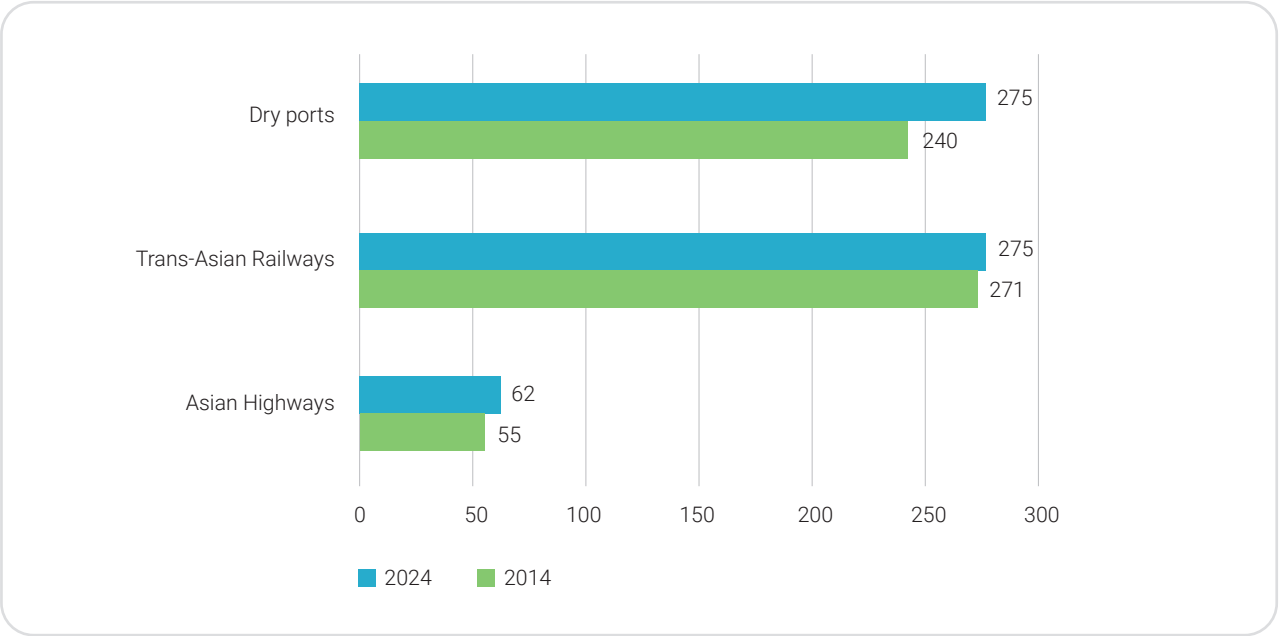


Source: Authors' analysis based on the latest status of the intergovernmental agreements on the Asian Highway Network, Trans-Asian Railway Network and dry ports (2024).

The larger context of the regional transport network development in Asia and the Pacific is constituted by the continued high-paced development of road infrastructure development and the reduction in railway constructions. It is estimated that road kilometres in Asia increased by 3.7 million km between 2000 and 2010 and 5.7 million km between 2010 and 2020. On the other hand, railway lines have expanded from 350,000 km to 490,000 km since 2000, characterized by a significant increase in a few countries and a reduction in others (Gota and Huizenga, 2022a).

The expansion of the national road infrastructure transpires to some extent in the regional network, as eight new Asian Highways and three Trans-Asian Railways have been added since 2014, increasing the number of Trans-Asian Railway lines to 275 in 2024. By and large, the focus was, however, on updating and consolidating the existing Asian Highway and Trans-Asian Railways lines, with a total of 18 Asian Highway and 19 Trans-Asian Railway lines updated during that period (figures 2.7 and 2.8). The number of dry ports during that period increased from 240 to 275.

Figure 2.4. Asian Highway and Trans-Asian Railway networks development from 2014 to 2024



Source: Authors' analysis based on the latest status of the intergovernmental agreements on the Asian Highway Network, Trans-Asian Railway Network and dry ports (2024).

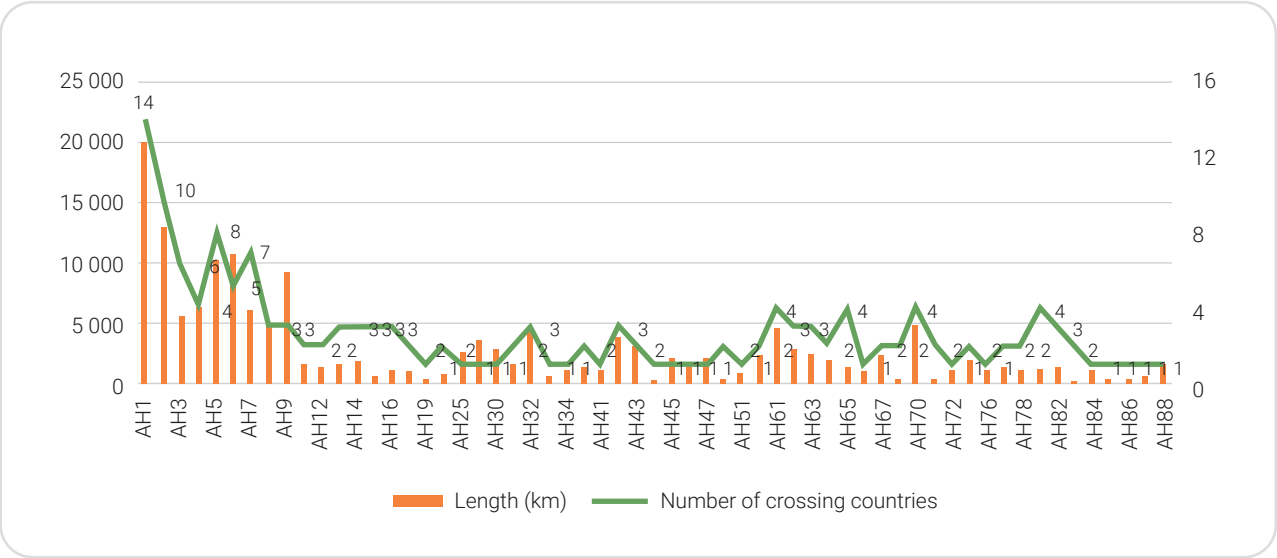
At the regional level, over the past ten years, the main trends in transport infrastructure development can be summarized as follows. These trends are further elaborated in the following sections.

1. Continued development and consolidation of the Asian Highway Network
2. Expanding the railways cross-border potential along the Trans-Asian Railway Network
3. Reinforced multimodal integration through dry port development
4. Advances in maritime connectivity against growing intraregional gaps
5. Growing climate resiliency concerns

2.1.1.2. Asian Highway Network continued development and consolidation

The current configuration of the Asian Highways provides solid coverage in terms of the subregional and intraregional connections. There are currently 29 Asian Highway routes that cross South and South-West Asia, 25 cross North and Central Asia, 24 cross East and North-East Asia, and 17 cross South-East Asia. The majority of the Asian Highway routes (36) are concentrated in one subregion (South and South-West Asia), 19 Asian Highway routes cross through two subregions and seven Asian Highway routes cross through three subregions of Asia. The majority of the Asian Highway routes are shorter than 5,000 km, but ten out of 62 are longer than 10,000 km; Asian Highway Route 1 is the longest route, linking North-East Asia to the European route E80, reaching 20,000 km and crossing 14 Asian countries (figure 2.5).

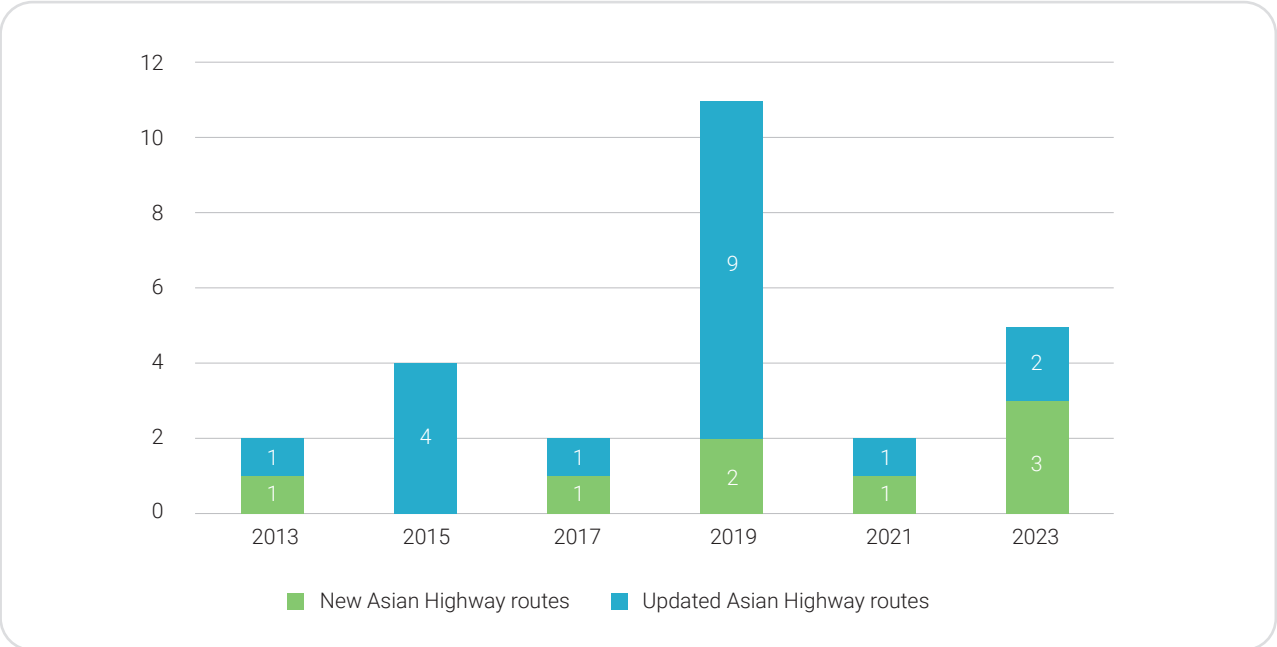
Figure 2.5. Asian Highway Network composition per route in 2024



Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on the Asian Highway Network (2024).

Over the past ten years, the network has continued to develop and started to consolidate some of its segments in longer routes (figure 2.6). The addition of a new main Asian Highway crossing three subregions, Asian Highway 9 in 2019, for example, did not extend the length of the network as it consolidated several existing fragments of the Asian Highways in one itinerary linking West China to Europe through Kazakhstan and the Russian Federation. On the other hand, three new Asian Highway routes were added in the Philippines in 2023, which expanded the Asian Highway Network in South-East Asia to 17 routes.

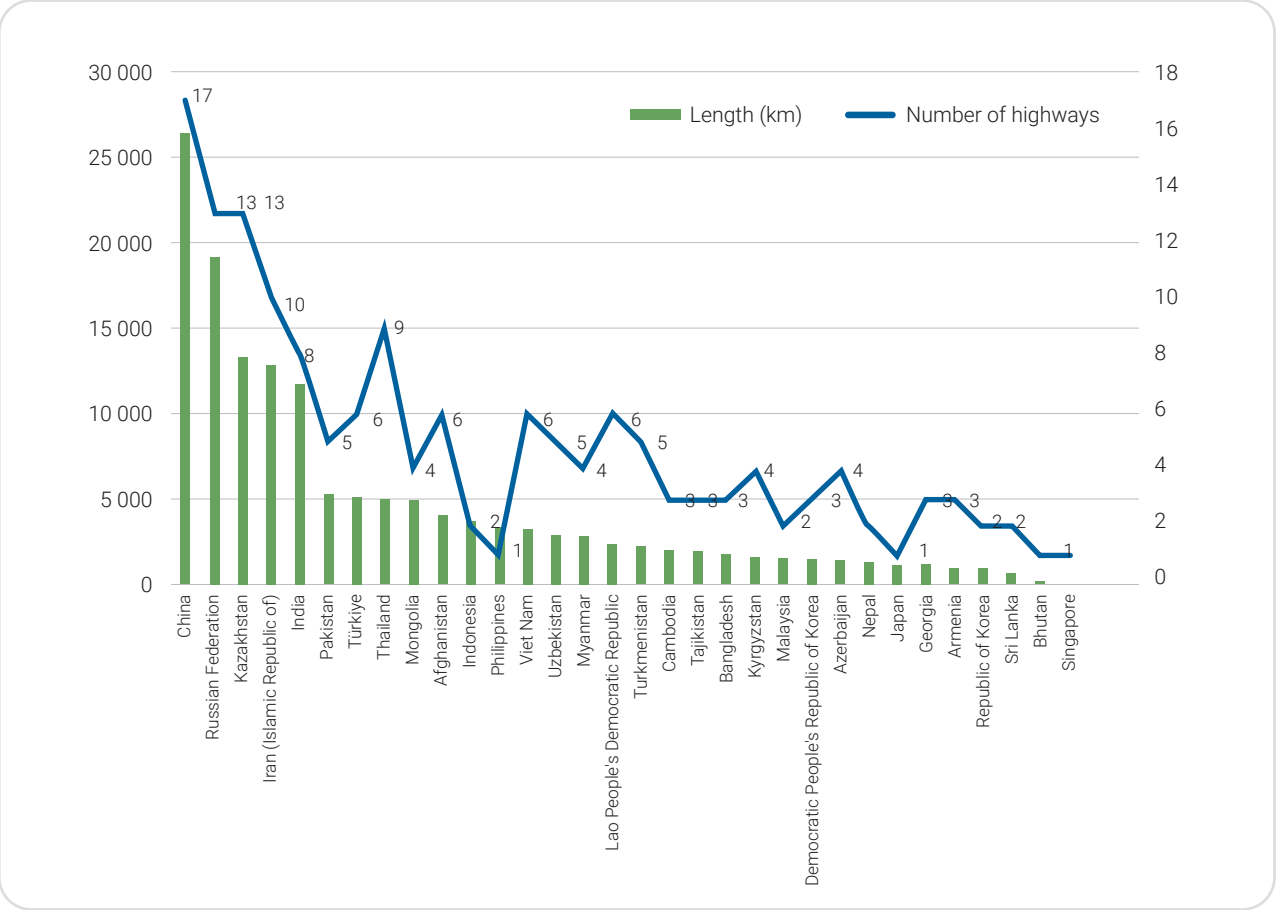
Figure 2.6. Asian Highway Network evolution from 2013 to 2023



Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on the Asian Highway Network (2024).

The Asian Highway Network expansion and consolidation illustrate that its coverage remains more modest in the countries with the greatest connectivity challenges, such as most landlocked developing countries (figure 2.7).

Figure 2.7. Asian Highway Network composition per country in 2024



Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on the Asian Highway Network (2024).

2.1.1.3. Expanding the railways cross-border potential through the Trans-Asian Railway Network

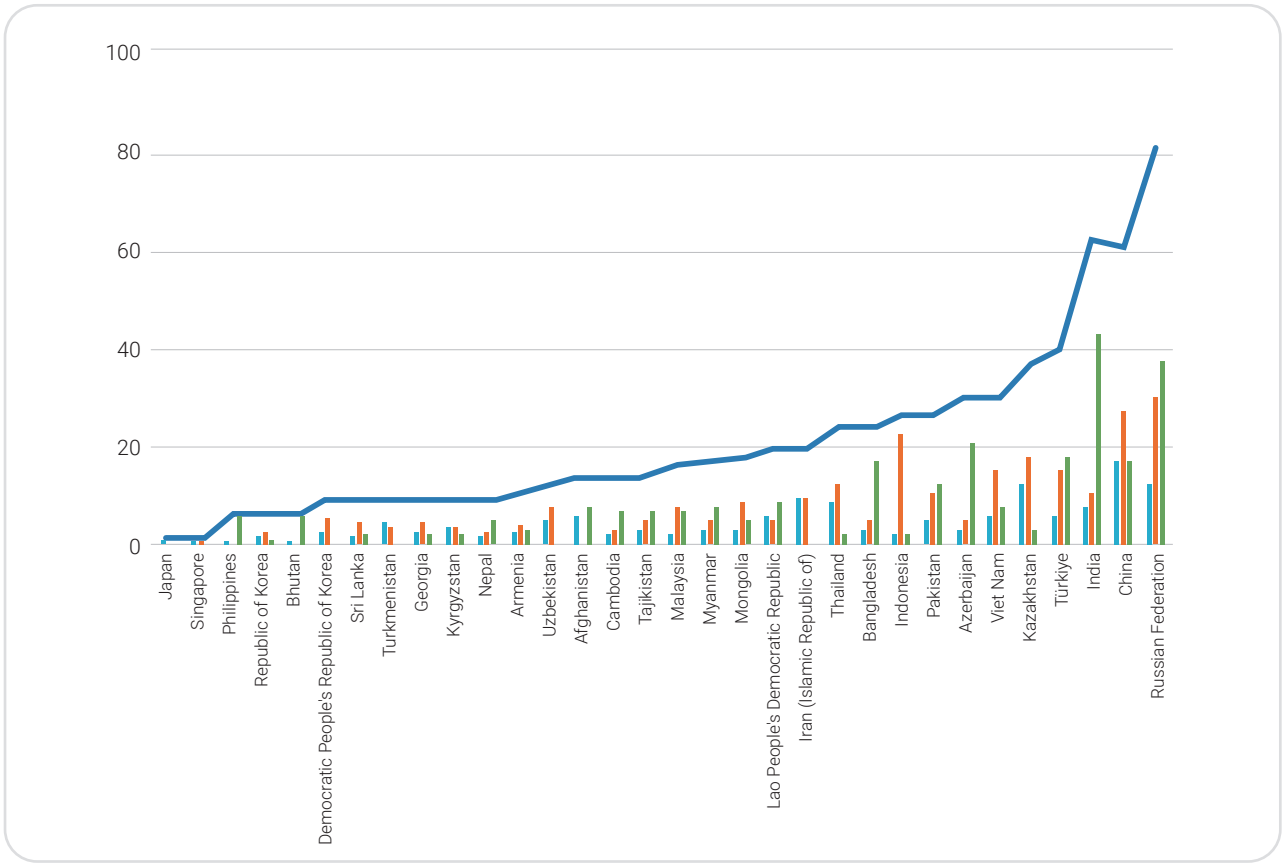
As Asia-Pacific countries have some of the longest railway networks in the world, they continue to hold a high potential for further railway development. The expansion of China-Europe freight rail traffic is a classic example of a breakthrough in railway transport. However, over the past seven years, only two railway lines were added to the regional network, and most changes focused on updating the existing lines (figure 2.8). This confirms the recent analysis of the national rail development in Asia, which suggests that traditionally rail expansion is not catching up with the pace of road construction, and that by 2030, the pace of road expansion is likely to be twice the pace of rail (Gota and Huizenga, 2022). Insufficient railway development has a direct impact on the existing transport costs and delays in Asia and the Pacific, as rail often offers a more economical, resilient and environmentally friendly mode of transport, as opposed to road transport.

Figure 2.8. Trans-Asian Railway Network evolution from 2013 to 2023 (number of routes)

Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on the Trans-Asian Railway Network (2024).

The Russian Federation, China, India, the Islamic Republic of Iran and Kazakhstan hold the longest segments of the network, while landlocked countries, Kazakhstan, Uzbekistan and Turkmenistan, have a higher than average number of Trans-Asian Railway lines (figure 2.9).

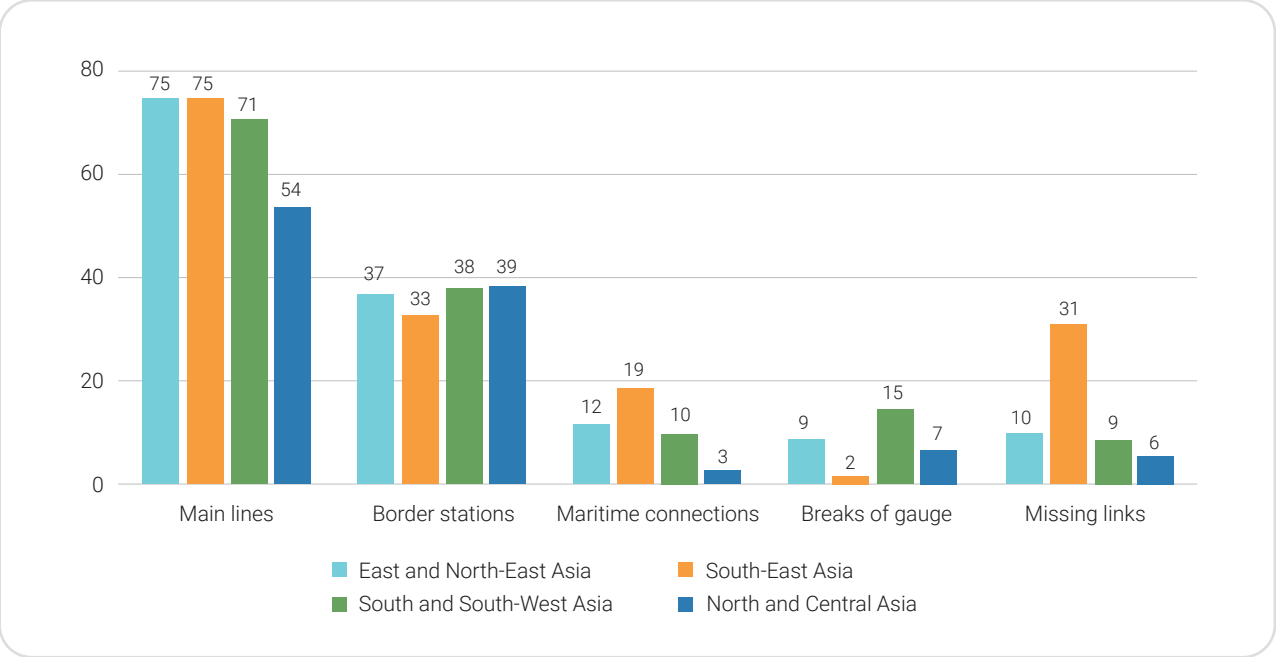
Figure 2.9. Trans-Asian Railway Network composition per country, 2024



Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on the Trans-Asian Railway Network (2024).

As for the subregional composition, East and North-East Asia and South-East Asia contain the most Trans-Asian Railway lines, while numerous missing links remain along the network in all subregions. South-East Asia stands out as a subregion with the highest number of Trans-Asian Railway lines, the highest number of railway maritime connections and the lowest number of breaks of gauge, showing the great potential for rail use. However, it is also characterized as having the highest number of missing links in the Trans-Asian Railway Network. The subregion with the lowest number of Trans-Asian Railway lines is North and Central Asia, which also, understandably, has the lowest number of maritime connections. However, the subregion has the highest number of border stations, an indication of the integrating role of rail in the subregion and has the lowest number of rail missing links (figure 2.10).

Figure 2.10. Trans-Asian railway lines, border stations, maritime connections and missing links



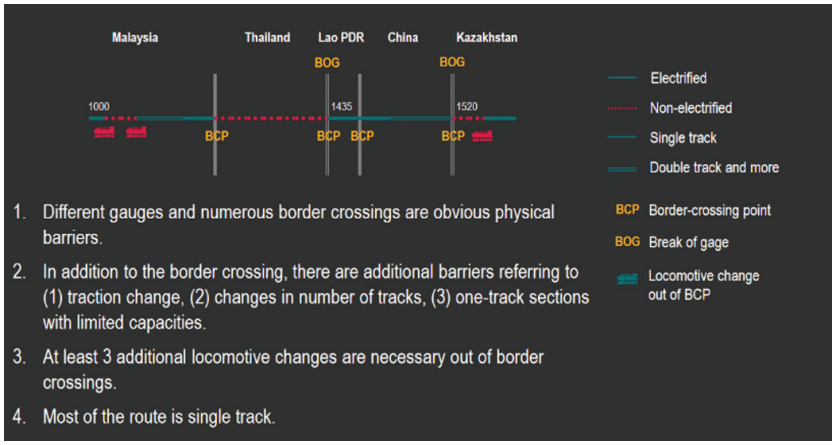
Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on the Trans-Asian Railway Network (2024).

Some missing links along the Trans-Asian Railway Network are being gradually built with the very illustrative example being the China-Lao People's Democratic Republic rail. This link offers a wide impact beyond the South-East Asian railway connectivity and demonstrates the high integrating potential of the railways in the region, linking several subregions and providing an infrastructure foundation for new trade links, especially between North and Central Asia and South-East Asia. The operationalization of this railway route has opened new opportunities for expanding sustainable transport connectivity for countries in South-East Asia. The volume of freight and passengers has increased rapidly, reaching 32.5 million tonnes of cargo and 28 million passenger journeys from December 2021 to January 2024 (Global Times, 2024), leading some experts to observe that this railway link has transformed land use along the corridor, increasing development and economic growth.

At the same time, the most recent analysis of this new infrastructure link suggests the need for much greater regional cooperation to exploit its full potential, as most parts of the route are not

harmonized in terms of regulations and procedures and suffer from lack of technical interoperability and digital interoperability, lack of customs to customs and rail to customs harmonized and digitized interaction, excessive customs and border crossing controls (at each side of the border crossings and not simultaneously) and lack of seamless rolling stock access along the route (figure 2.11). This demonstrates that the continued infrastructure development of railways strongly requires further facilitation, including through digitalization, of cross-border rail operations.

Figure 2.11. Physical barriers along the Malaysia – Thailand – Lao People's Democratic Republic – China – Kazakhstan railway route

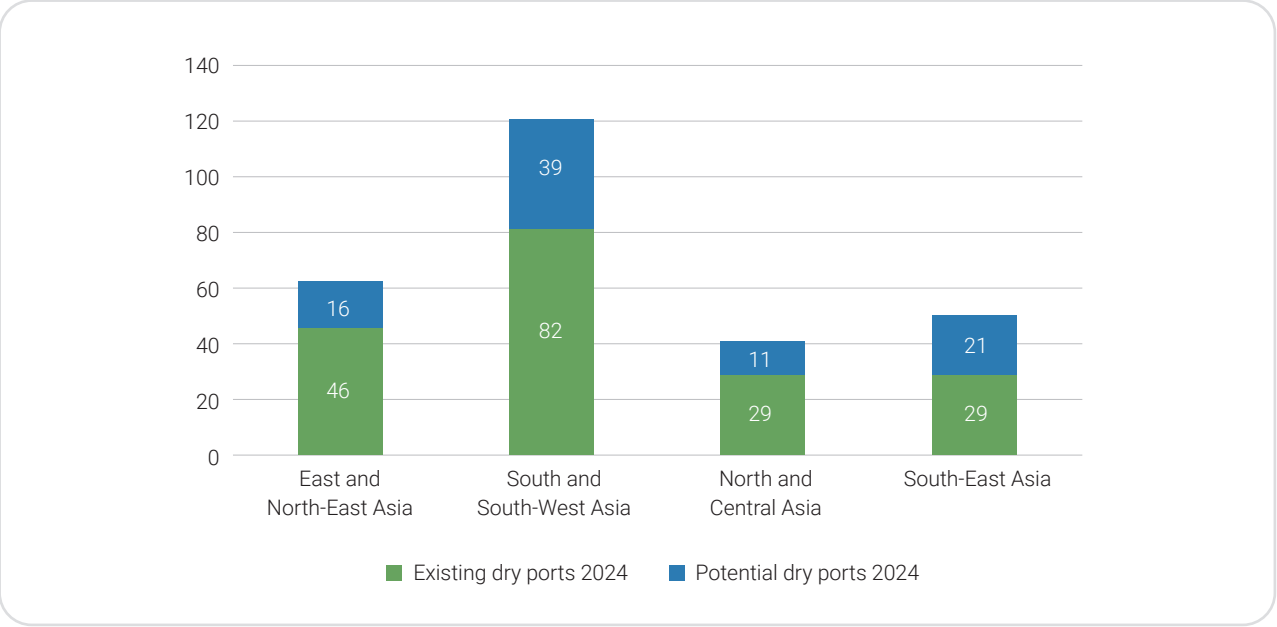


Source: ESCAP (2024c).

2.1.1.4. Reinforced multimodal integration through dry port development

Expanding the role of rail becomes easier when it is used in synergy with other modes of land transport, connecting inland to maritime ports or major production or consumer centres. Dry ports, which provide facilities for switching the transport modes and custom clearance outside of the main border crossing points, are essential for multimodal integration. Currently, there are 275 dry ports in the Asia-Pacific region, of which the majority of existing and potential dry ports are in South and South-West Asia, followed by Central Asia (figures 2.12 and 2.13).

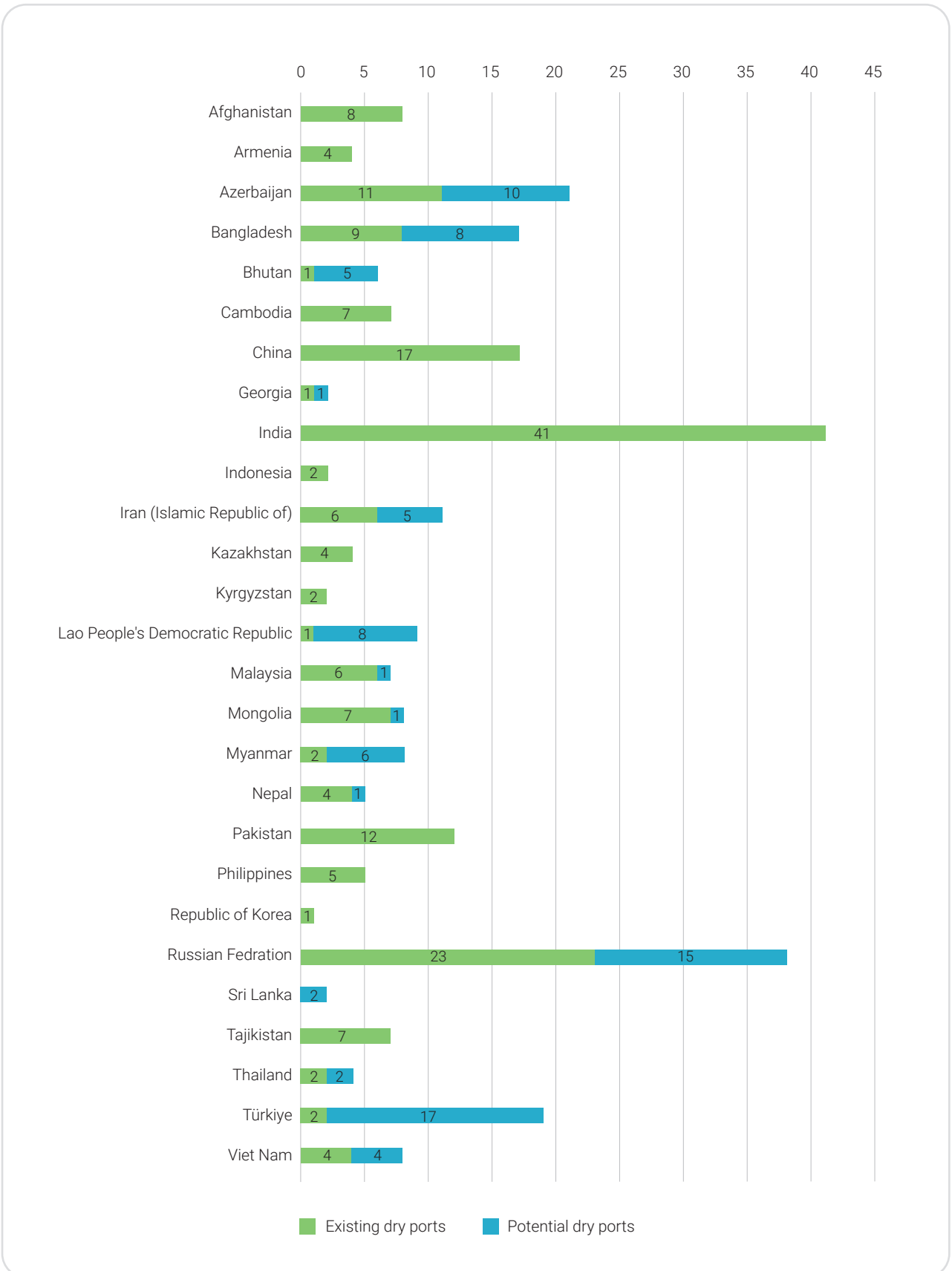
Figure 2.12. Dry ports in Asia and the Pacific by subregion in 2024



Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on Dry Ports (2024).

India, the Russian Federation, Azerbaijan, Türkiye and China are home to the largest number of the dry ports in the region, and unlike the Asian Highway and the Trans-Asian Railway Network, dry port development is very significant in several landlocked developing countries, including, among them, Azerbaijan, Mongolia and the Lao People's Democratic Republic (figure 2.13).

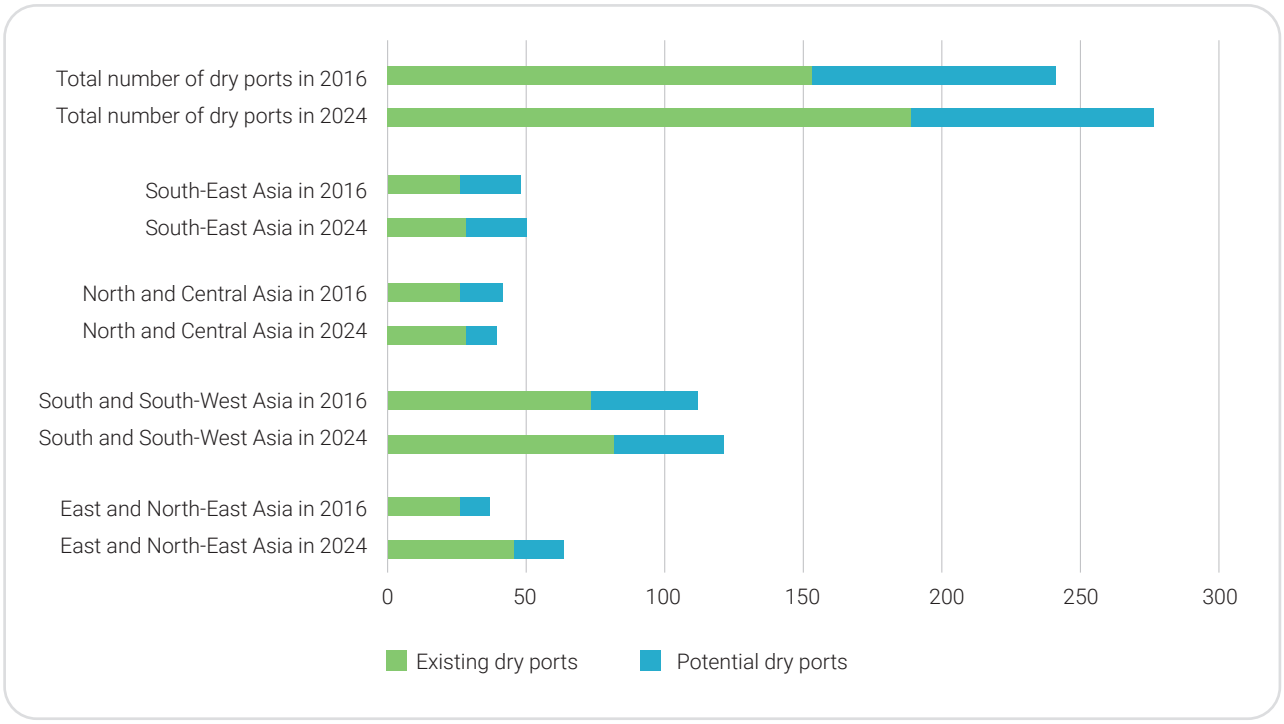
Figure 2.13. Dry ports in Asia and the Pacific by country in 2024



Source: Authors' estimations based on the latest status of the Intergovernmental Agreement on Dry Ports (2024).

The number of dry ports in the region has increased by 14 per cent since 2016 (from 240 to 275), indicating very dynamic dry port development in the region and paving the way to a more balanced modal split in international freight transport operations. However, while the percentage of the potential, namely the ports not yet operational, has decreased slightly (from 36 per cent to 32 per cent), they still comprise approximately one-third of the entire network. This relates to the need for further dry port infrastructure development.

Figure 2.14. Dry ports evolution from 2016 to 2024



Source: Authors' analysis based on the latest status of the Intergovernmental Agreement on Dry Ports (2024).

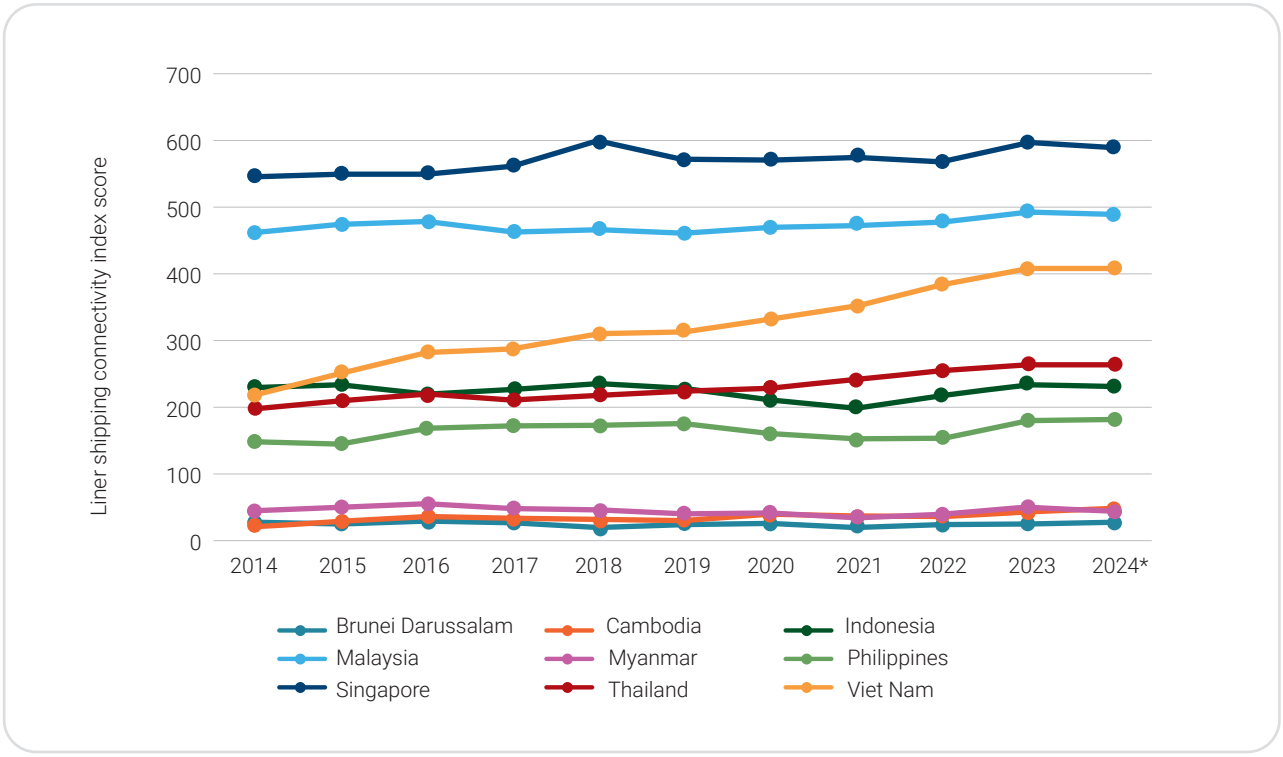
2.1.1.5. Advances in the port development against growing regional connectivity gaps

Continued port infrastructure development is one of the strongest characteristics of Asia-Pacific infrastructure development. As of 2022, the Asia-Pacific region hosts the world's 10 largest container ports and accounts for more than half of the global maritime trade. The world's top 100 container ports ranking by port cargo volume includes 55 ports in 23 ESCAP member States, while 24 ESCAP member States rank among the top 100 in berth productivity by country for all types of hulls. India has emerged as the most productive in this regard, while Thailand has exhibited the most substantial year-over-year increase in productivity. Eleven ports out of 20 with the highest berth productivity per port are in ESCAP member States (ESCAP, 2024d).

The majority of trade, however, is concentrated in a select number of countries. East and North-East Asia and South-East Asia dominate the region's seaborne trade. China continues to wield substantial influence in seaborne trade and South-East Asian countries are expected to expand their presence in this area. The competitiveness of ports in South-East Asian countries has increased, evidenced not only by the growth

in port volumes but also by various indicators, such as the liner shipping connectivity index. Since 2015, most of the Association of Southeast Asian Nations (ASEAN) member States have improved their overall liner shipping connectivity index score, albeit to varying degrees. Notably, the liner shipping connectivity index score for Viet Nam has risen from 314.1 in 2019 to 406 in 2024, and for Thailand, it has increased from 221.7 to 262.2 over the same period. Marginal increases during this time frame have also been recorded for Brunei Darussalam, Indonesia and Myanmar (figure 2.15).

Figure 2.15. Liner shipping connectivity index of ASEAN member States, 2015 – 2024



Notes: UNCTADstat provides data quarterly, with each year's data taken as an average of each quarter. *2024 data are based on the previous three quarters.
Source: UNCTAD (2024).

This progress in maritime connectivity is stark in contrast with the continuing stagnation or very modest progress achieved by Pacific small island developing States with regard to maritime connectivity. The negative impact of COVID-19 on global trade volumes, maritime transportation efficiency and port logistics performance was evident in the Pacific. During the pandemic, the liner shipping connectivity index scores for several of the small island developing States, including, the Cook Islands, New Caledonia, Palau, Solomon Islands, and Tuvalu, declined (table 2.1).

Table 2.1. Liner shipping connectivity index score of the Pacific economies, 2014 – 2024

Islands	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024*
Cook Islands	10.69	10.69	8.41	7.73	7.71	7.73	9.58	9.32	9.32	8.21	8.23
Fiji	49.32	39.56	40.05	42.67	41.53	37.51	37.25	38.00	39.76	40.33	41.75
French Polynesia	30.10	30.88	38.66	39.67	37.74	39.84	40.28	41.54	37.85	39.92	40.92
Kiribati	13.03	14.67	16.69	15.00	12.54	7.58	15.48	15.35	16.05	16.61	16.40
Marshall Islands	17.27	19.65	21.21	22.98	20.35	17.22	23.33	22.82	21.56	21.57	21.62
Micronesia (Federated States of)	7.08	7.65	7.65	8.05	11.11	12.83	14.44	14.97	14.97	14.97	14.98
Nauru	6.06	6.86	5.24	4.48	4.83	4.66	4.55				
New Caledonia	48.84	44.66	45.98	46.16	38.74	37.84	39.96	40.56	40.16	43.45	45.84
Niue							5.76	5.76	5.76	5.76	5.76
Palau	9.08	9.08	9.65	9.26	9.25	8.45	7.76	7.39	6.88	6.88	6.87
Papua New Guinea	44.00	46.44	45.83	48.06	45.69	44.27	44.58	45.52	45.52	48.84	49.47
Samoa	24.51	23.40	27.43	24.30	25.81	29.34	30.99	32.51	32.42	31.43	30.01
Solomon Islands	37.69	35.24	32.90	34.43	34.17	33.5	30.16	29.99	28.42	31.26	30.62
Tonga	24.10	19.70	27.04	28.36	27.26	24.67	24.01	29.05	27.16	28.82	28.93
Tuvalu	8.69	8.33	8.79	5.51	5.43	5.05	4.84	4.37	4.14	4.82	4.83
Vanuatu	28.07	24.77	24.82	23.91	22.54	22.48	23.77	24.03	23.29	24.69	25.15

Notes: UNCTADstat provides data quarterly, with each year's data taken as an average of each quarter.
*2024 data are based on the previous three quarters.
Source: UNCTAD (2024).

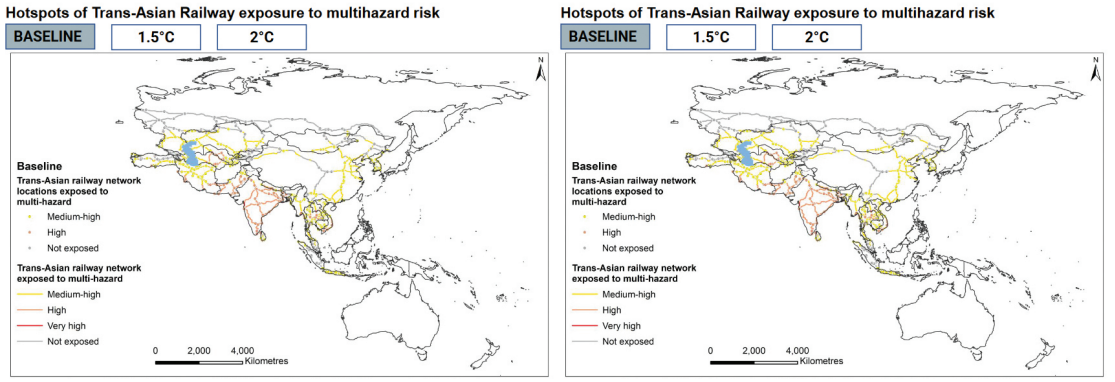
The global shipping and ports market is undergoing significant changes, marked by the deceleration of seaborne cargo growth, heightened competition among ports in the Asia-Pacific region, and transformative shifts, such as stricter decarbonization regulations, and the emergence of autonomous ships and the establishment of green shipping corridors. This evolving landscape presents challenges, particularly for developing countries in the Asia-Pacific region, which may face obstacles in acquiring the necessary capabilities for this paradigm shift. Some ongoing challenges are limited financial resources, technology gaps and operational know-how.

In light of these challenges, it is crucial to advocate international and regional cooperation. Collaborative efforts, including partnerships between public and private sectors, can play a vital role in securing the sustainable future competitiveness of the shipping and port industry in the Asia-Pacific region. As established below, it is critical that additional measures can be considered to address the maritime connectivity gap among the countries in the region.

2.1.1.6. Growing infrastructure resiliency concerns

Asia-Pacific countries face significant challenges related to infrastructure resilience, which is the ability to adapt to climate and geophysical hazards, extreme weather conditions or other disruptions. Between 2004 and 2020, natural disasters caused more than $500 billion in losses across the region, affecting 2.1 billion people (Sirivunnabood, 2020). In the coming years, the risk exposure from natural hazards is expected to increase globally, and the developing economies of Asia and the Pacific are likely to be among the most vulnerable and risk-prone countries. Accordingly, resilience planning, including measures taken to reduce, transfer, and manage climate and disaster risk, is of vital importance in developing Asia-Pacific countries, as they strive to sustain economic development and reduce poverty. A recent policymaker survey in selected parts of Asia has illustrated growing concerns with existing risk and resilience policies (Verschuur, 2024). It has been estimated that 63.4 per cent of Asian highways and 25.9 per cent of Trans-Asian railways are in the existing hotspots of medium-high, high and very high multi-hazard risk. Notably, countries that contain between 12 and 15 per cent of the regional road network, such as China and India, are also characterized by the highest levels of the multi-hazard exposure.

Figure 2.16. Asian Highways and Trans-Asian Railways exposure to multi-hazard risks



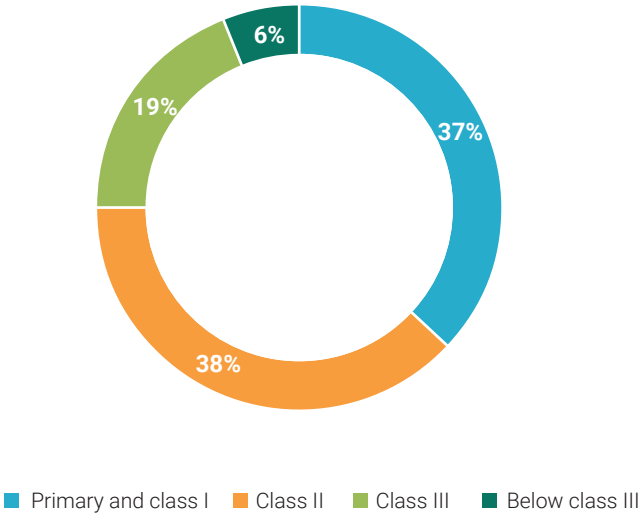
Note: The baseline period is from 1995–2014.

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Sources: ESCAP calculations based on the IPCC WGI Interactive Atlas – Coupled Model Intercomparison project Phase 6 (CMIP6) 2021, ESCAP Asia-Pacific Transport Network (APTN) 2023 and United Nations Geospatial.

Poor infrastructure quality and lack of maintenance imply a serious vulnerability to disruptive events, reinforcing a concern with infrastructure development in Asia and the Pacific. It is currently estimated that 37 per cent of the Asian Highway Network routes are of the highest quality (primary and class I), 38 per cent are class II, and one quarter are class III or below. Road quality also varies substantially by subregion. In North-East Asia and South-West Asia, 60 per cent of the network consists of primary and class I roads. In North and Central Asia, 55 per cent of the network consists of class II roads, while primary and class I roads account for less than 20 per cent. In South Asia, more than one-third of the network consists of class III roads.

Figure 2.17. Distribution of Asian Highway routes by road classification



Source: ESCAP (2022b).

The Resilience of land transport and port infrastructure has become a prominent concern in the further development of the regional transport network at all stages, from selecting route alignment and design considerations to its operationalization, namely balancing efficiency and crisis-response strategies, and, ultimately, its maintenance.

Many countries of the Asian Highway Network have sought to develop green and resilient solutions and technology to upgrade the durability and performance of their roads, but against the background of different road design standards, standardization systems and governance, the solution to each problem has differed significantly among countries. There is a growing concern that varying standards and different regulations aimed at increasing resilience, while benefiting a country's highway network at the national level, may increase the lack of interoperability between neighbouring countries along the Asian Highway Network, slowing the process and effectiveness of cross-border connectivity (ESCAP, 2024b).

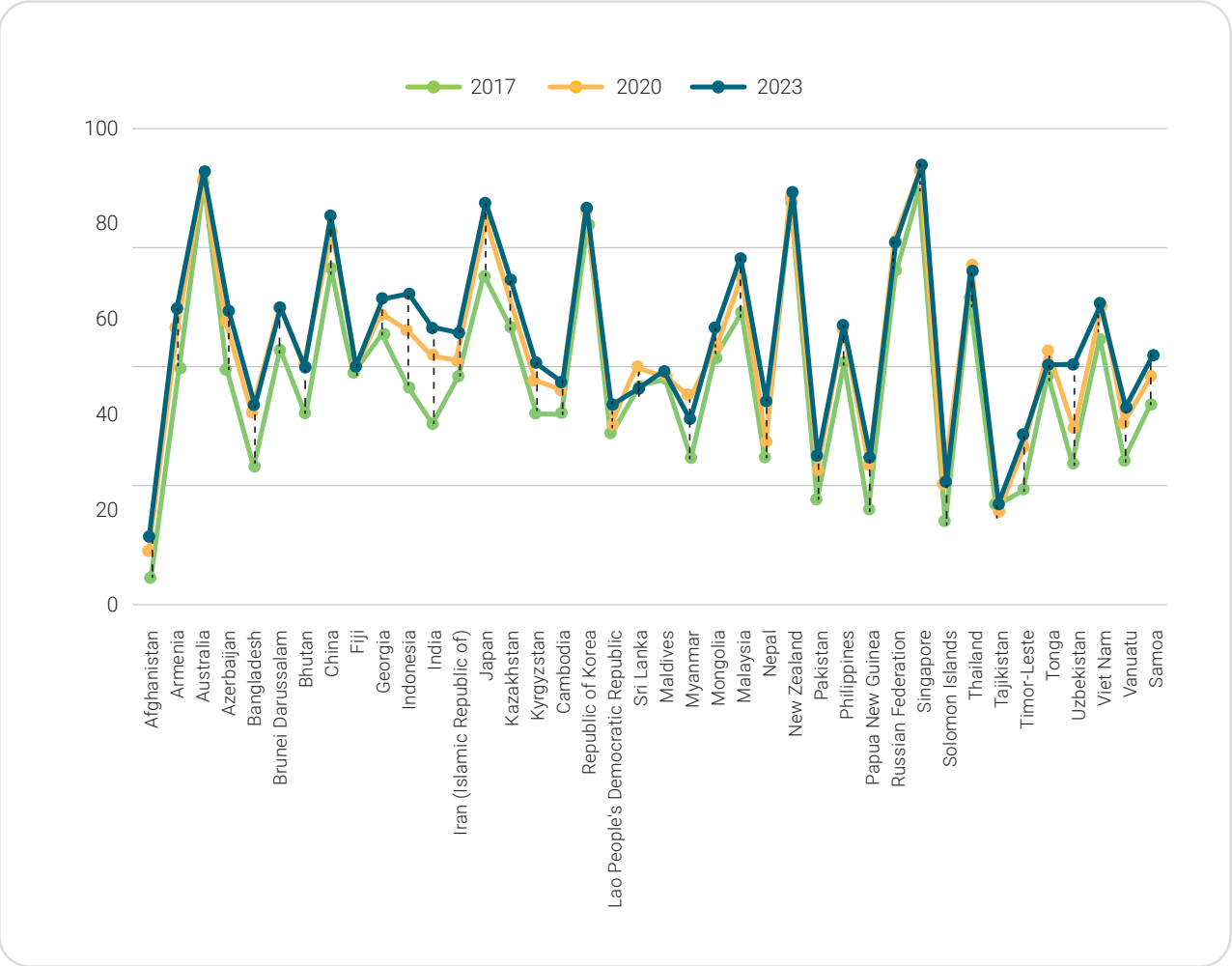
2.1.2. Leveraging transport technology, innovation and digitalization

In the rapidly evolving transport sector, cutting-edge digital technologies are revolutionizing mobility and associated infrastructure, fostering a more connected and sustainable environment. Recent advancements underscore a shift toward inclusive, safe and environmentally sustainable transport options, propelled by digital innovation. Recent trends, such as automated vehicles, Cooperative Intelligent Transport Systems (C-ITS) and digital platforms facilitating digitalization, electrification and automation are transforming the transport ecosystem. They offer a glimpse into a future in which mobility is seamlessly integrated and tailored to user needs. Existing and emerging technologies categorized under "smart transport systems" contribute towards advancing the SDGs and economic sustainability across the Asia-Pacific region.

Smart transport systems employ a range of cutting-edge digital technologies, including data analytics, autonomous systems, artificial intelligence, big data and the Internet of things, which can revolutionize the management, utilization and conceptualization of transport systems and their fundamental infrastructure.

The potential of smart transport systems has been further enhanced through progress made in mobile Internet connectivity. Mobile internet connectivity is a critical enabler of smart transport systems by providing the necessary device for real-time data exchange, user communication, Internet of things integration and enhanced mobility solutions. The Global System for Mobile Communications Association (GSMA) has developed the mobile connectivity index to measure the performance of 173 countries against the key enablers of mobile Internet adoption. Figure 2.18 shows this single composite indicator for selected countries where related data are available. This indicator aggregates four dimensions – infrastructure, affordability, consumer readiness and content/services – in equal weights, which to some extent reflect the readiness in developing smart transport. From 2017 to 2023, the mobile connectivity index increased in the selected countries by at least 0.6 and up to 16.5.

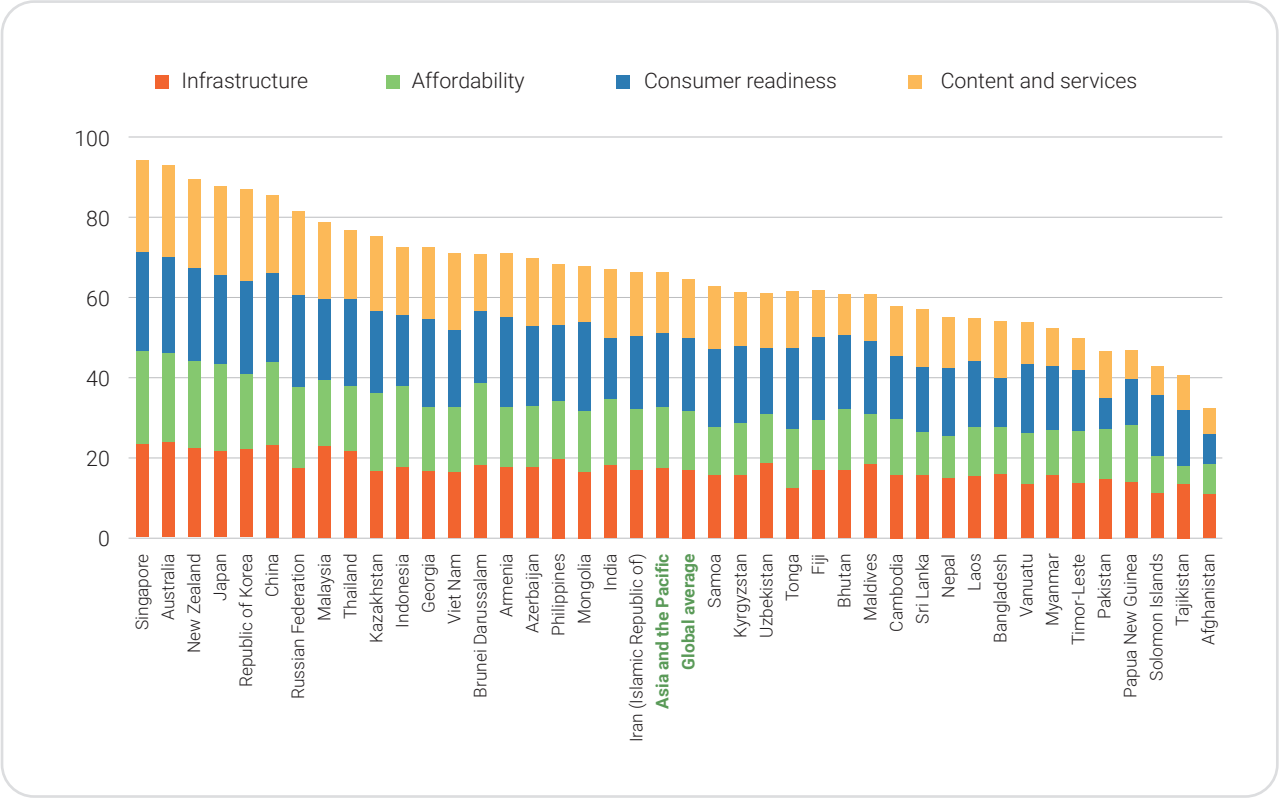
Figure 2.18. Mobile connectivity index from 2017 to 2023



Source: GSMA (2024).

Even though Asia and the Pacific (65.2) is the world leader (63.6) in mobile Internet development, figure 2.19, which gives a snapshot of 2023, shows a significant disparity across the region, ranging from 31.4 to 93.7.

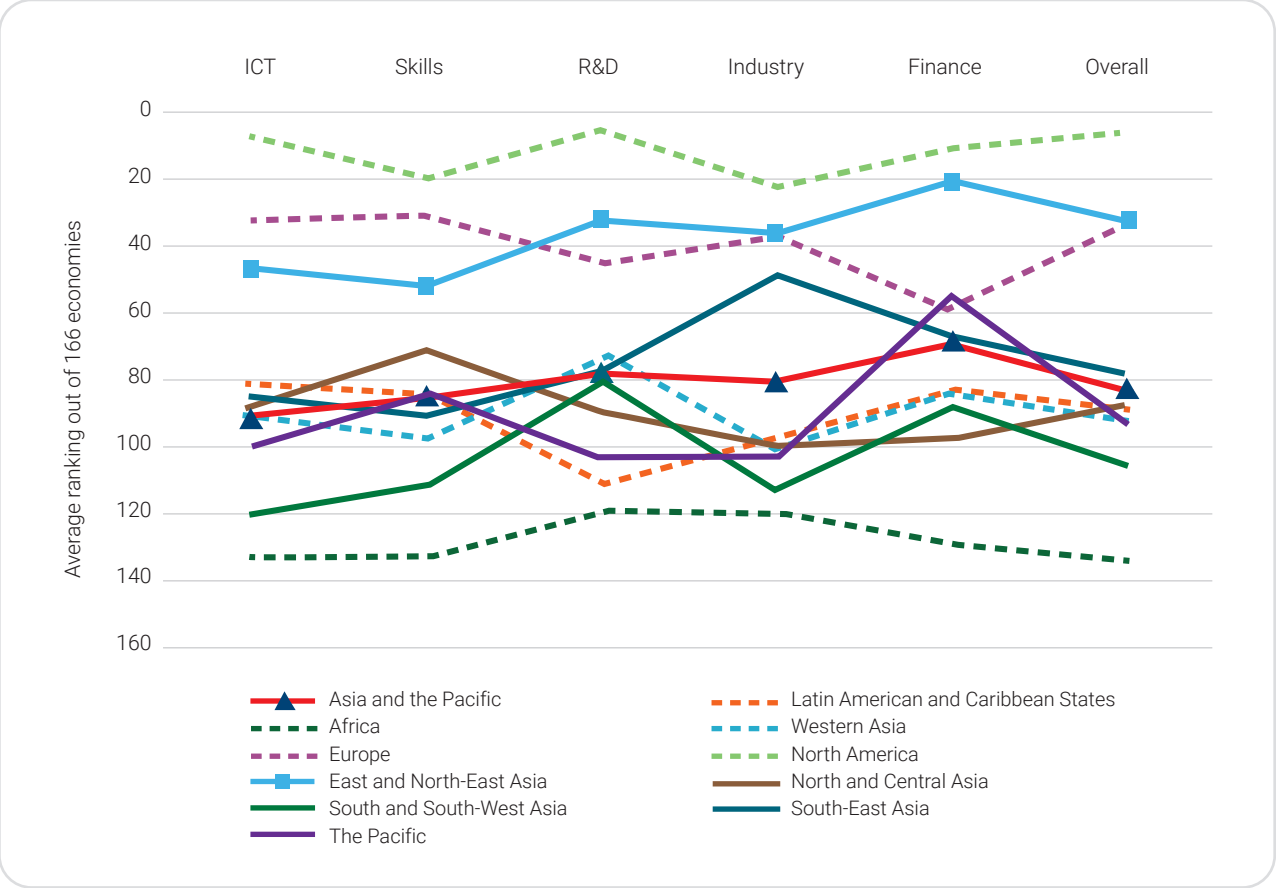
Figure 2.19. Mobile connectivity index in 2023



Source: GSMA (2024).

The frontier technology readiness index, which was developed by the United Nations Conference on Trade and Development (UNCTAD), presents the technological capacities for 17 green and frontier technologies, such as artificial intelligence, Internet of things, big data, Blockchain, 5G and electric vehicles. Five dimensions were selected for the index to measure the capacity to use, adopt and adapt frontier technologies: ICT deployment, skills, research and development (R&D) activity, industry activity and access to finance (UNCTAD, 2023). Figure 2.20 shows the average ranks of the economies in each region. Europe and North America lead in frontier technologies, while the Asia-Pacific region is at a medium level but is generally ahead of other regions. In terms of specific dimensions, Asia and the Pacific has relative advantages in research and development capacity and access to finance but is weak in terms of ICT infrastructure deployment.

Figure 2.20. Regional average ranking of 166 economies' readiness to frontier technologies



Source: UNCTAD (2023).

This section provides a comprehensive and comparable perspective on the potential development of smart transport systems in the region through the lens of mobile Internet connectivity and frontier technology readiness. Given that these indicators indirectly reveal only one aspect of the status for smart transport systems in Asia and the Pacific, more reliable, multifaceted and direct measures need to be presented, which are elaborated in figures 2.23 and 2.24. The developed indicator presented here combines the mobile connectivity index and infrastructure adequacy index considering the nature of smart transport systems.

2.1.2.1. Greater economic sustainability through smarter transport systems

From the viewpoint of economic sustainability, smart transport systems offer various benefits in terms of their effectiveness in enhancing and streamlining operations, while also reducing energy, resources and travel time, all of which contribute towards cost-effective transport solutions. According to an ESCAP study, smart transport systems showed a benefit-cost ratio of 10.09 and approximately $4.3 million of monetized benefits in energy efficiency and emissions reductions through eight case studies in Asia and the Pacific (ESCAP, 2020a). These case studies include four corridor-specific analyses (Vientiane-Bangkok-Kuala Lumpur, Baku-Tbilisi-Yerevan, Tehran-Kabul-Islamabad-Lahore-Karachi and Lautoka-Nadi-Suva) and four city-wide analyses (Bangkok, Baku, New Delhi and Suva).

Smart transport systems contribute towards the achievement of SDGs 9 and 11, or more specifically, targets 9.1, and 11.2, which directly focus on transforming transport infrastructure and services (ATO, 2021) by enhancing the efficiency and reliability of transport networks, while fostering innovation and technological advancement in the transport sector, which drives economic growth, job creation, inclusiveness and equality of access. Smart transport systems, such as adaptive traffic signal control and managed motorways, exemplify established solutions that enhance the efficiency of existing infrastructure without requiring the costly expansion of road capacity (iMOVE, 2024). Smart transport systems prioritize cost reductions through preventative maintenance, efficient energy utilization and accident prevention. This not only enhances economic sustainability, but it also fosters a greener and more sustainable environment (Times Square Smart City, 2023).

Smart transport systems can assist in advancing the targets of SDG 11 through supporting the development of sustainable and resilient cities by supporting real-time traffic monitoring, facilitating artificial intelligence-driven automated public transport, alleviating traffic congestion to enhance mobility, and bolstering transport accessibility and safety, thereby promoting improved urban connectivity (ITU, 2024a). Cost savings can also be gained when inexpensive public transport is efficient enough to compete with private vehicle ownership (Mazur, 2020).

For freight transport and logistics, wider deployment of intelligent transport systems, digitalization and ICT tools will reduce paperwork, human involvement and contribute towards realizing SDGs by paving the way for a more sustainable transport future. Emerging transport services are designed to enhance logistics efficiency, alleviate congestion and champion environmental sustainability. Telematics, arrival time estimation, digital platforms for carriers and transport management system tools are among the innovative solutions revolutionizing transport management. Furthermore, the application of artificial intelligence in the transport sector is transforming how transport is being managed. It has enabled the implementation of predictive maintenance, route optimization and enhanced safety measures, making transport services more reliable and efficient. On the other hand, cloud computing solutions have opened new possibilities for storing and managing vast amounts of data generated through transport-related activities, paving the way for data-driven decision-making and innovation in the industry.

Despite the advantages of transport innovation, it is a complex and challenging process, which requires significant efforts and investments in new technologies, institutional changes and business models. One of the biggest roadblocks to adopting new technologies is the high costs and risks involved. Governments and the private sector often lack the necessary resources and expertise to invest in innovation. Another challenge is the lack of integration, coordination, interoperability and standardization of data and systems across different modes, regions and stakeholders. This leads to inefficiencies, delays and higher costs. Regulatory and legal barriers also limit the deployment and acceptance of innovative solutions. Concerns regarding safety, security, privacy and liability are among the reasons for these barriers.

Nevertheless, there is still significant potential for transport innovation and digitalization to harness. Considering a recent tendency to minimize the provision of new infrastructure, which requires extensive capital and produces negative environmental impacts, smart transport systems can use existing resources and infrastructure sustainably at a modest cost. In this regard, the deployment of smart

transport systems is beneficial to many countries in the Asia-Pacific region where fundamental transport infrastructure and funding resources are limited, particularly in small island developing States and least developed countries that face specific challenges due to either their unique geographic characteristics or relatively limited development of transport infrastructure. These challenges have led to limited accessibility and transport connectivity in small island developing States and least developed countries, and have increased their risks and vulnerability to extreme weather conditions, including the impact of climate change.

2.1.2.2. Emerging trends and challenges

Recent advancements in urban mobility reflect a notable transition towards inclusive, safe and environmentally friendly transport choices driven by digital innovation. The widespread use of digital platforms within the transport ecosystem offers a preview of a future in which mobility is seamlessly integrated, responsive and customized to the needs of users. Several key emerging trends and developments are being investigated, reshaping the structure of mobility and their implications for the efficiency, sustainability and economic viability of transport networks in the region.

Smart mobility

Smart mobility is an advanced form of mobility that encompasses diverse transport technologies, services and modes (ESCAP, 2023b). The various forms of smart mobility are enabled by using smart devices and services in a seamless and interconnected ecosystem. They include e-scooter sharing, bike-sharing, demand-responsive transport, ride-sharing/ride-hailing services and mobility-as-a-service (MaaS). Smart mobility revolutionizes conventional norms by disrupting the traditional distinctions between private transport, public transport and paratransit, offering personalized, user-centric services tailored to individual traveller preferences, with a paradigm shift from the traditional concept of "transport" to that of "mobility" (ESCAP, 2023b). Particularly, the emergence of numerous smart mobility services allows users to plan, book and pay for multi-modal trips using a single mobile application, which reduces the hassle and cost of navigating complex transport networks (ESCAP, 2022c).

Smart mobility solutions help reduce the overall demand for private vehicles, easing traffic congestion and parking shortages in urban areas. They additionally enhance transport accessibility for elderly, disabled, and underserved populations, empowering a broader demographic to use transport services and to engage fully in society. Providing personalized and flexible transport options with smart mobility solutions is consistent with SDGs 9 and 11 in that they encourage more people to use sustainable modes of transport. They are also time, energy and cost-efficient, and do not require the creation of more traditional transport infrastructure. This reduces reliance on private vehicle usage and mitigates traffic congestion and emissions, all of which translate into cost savings and promote further economic sustainability. Smart mobility also offers cost savings by cutting fuel consumption and vehicle maintenance expenses. For example, ride-sharing services reduce individual vehicle ownership costs through shared transport expenses. Furthermore, real-time data provided by smart mobility solutions enables businesses to make data-driven decisions, minimize waste and streamline supply chain processes (Parklio, 2024). With the emergence of various transport options, the demand for integrating these diverse systems into a unified service platform is expanding. Confidence in this

solution is exemplified by the projected global MaaS market size, which is expected to increase from $189 billion in 2022 to $912.4 billion in 2032; the Asia-Pacific region accounted for an estimated 40.5 per cent share in MaaS in 2022 (Precedence Research, 2023a).

Cases across the region include the "National Common Mobility Card", introduced by the Government of India in 2019. This smart card payment method serves as a universal payment solution for travel, parking, and future MaaS applications (Indian Infrastructure, 2022). In 2023, a MaaS platform provider in the Republic of Korea introduced the TagRide service, which is a shared smart mobility payment and revenue balancing platform, that collaborates with existing smart card companies (Min-seo, 2023). Users can conveniently rent and pay for shared e-scooters or bicycles using the system. It is similar to using a bus or subway by tagging a smart card. This system also offers intermodal transfer discounts through a universal payment system.

Co-operative Intelligent Transport Systems and connected and autonomous vehicles

Co-operative Intelligent Transport Systems, a subset of smart transport systems, facilitates communication and data exchange beyond stand-alone systems to enhance efficiency and optimization in transport networks. This technology provides a comprehensive real-time view of the transport environment, improving safety, sustainability, efficiency, and user comfort (ESCAP, 2018). It enables connected vehicle technologies whereby vehicles can communicate with each other and with transport infrastructure in real-time, improving safety, efficiency and convenience for drivers and passengers. Connected vehicle technologies include vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-anything (V2X) connectivity, and advanced driver assistance systems (ADAS), which enhance the overall performance and capabilities of vehicles on the road.

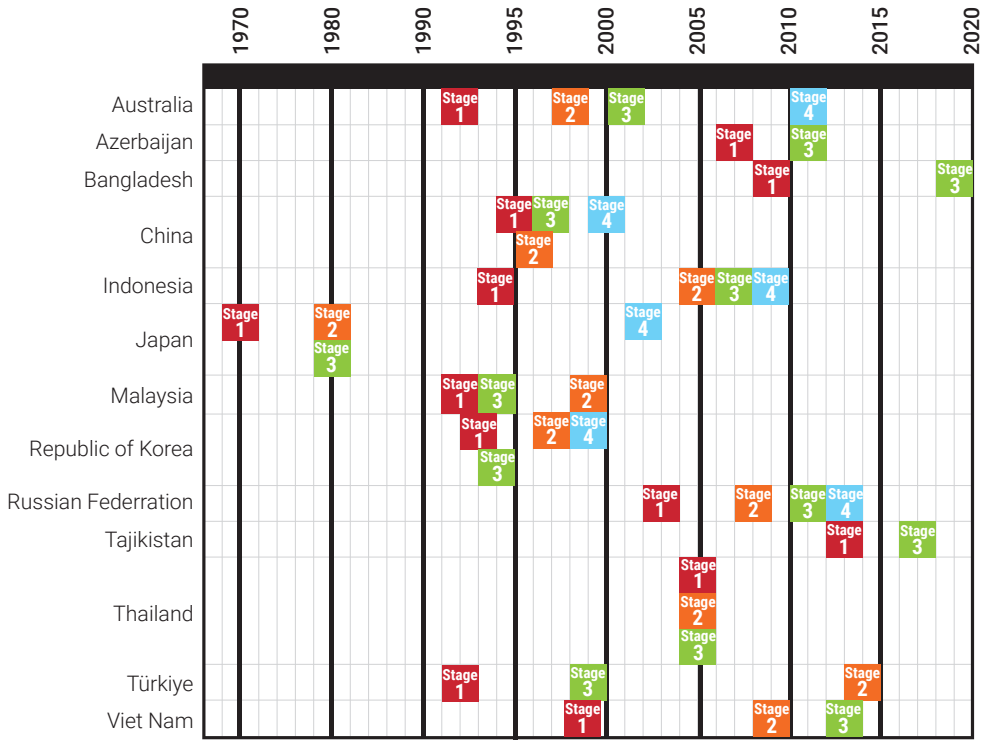
Analysis of V2V and V2I technology, namely "intersection movement assist" and "left turn assist", suggests a potential 50 per cent reduction, on average, in crashes, injuries and fatalities. Incorporating additional V2V and V2I safety applications could save even more lives. Moreover, pedestrian crash avoidance and mitigation systems could potentially reduce up to 46 per cent of pedestrian-related crashes. Together, these applications could eventually prevent or reduce the severity of up to 80 per cent of non-alcohol-related crashes, resulting in significant cost savings (Kryuchkov, 2021). By providing real-time traffic information and hazard warnings, connected vehicle technologies help drivers make safer and more informed decisions on the road, reducing the risk of crashes and collisions, and improving economic sustainability.

Autonomous vehicle technologies also have the potential to revolutionize the way people and goods are transported, offering numerous benefits in terms of safety, efficiency and accessibility. These technologies include such features as self-driving cars and trucks, which enable vehicles to navigate and operate without human intervention, reducing the risk of crashes and improving overall traffic flow. Simulation analysis suggests that connected and automated vehicles (CAVs) can increase road network capacity by 30 per cent and reduce travel time by over half (Raposo and others, 2019). Market research predicts a 15.4 per cent compound annual growth rate for the global connected car market from 2024 to 2033 and that the Asia-Pacific market will grow at a 15.6 per cent annual rate, reaching $63.37 billion by 2033 from $14.93 billion in 2023 (Precedence Research, 2024).

Some Asia-Pacific countries have made various efforts to realize such a pivotal shift early. For example, China showcases a proactive stance on automated vehicles with Beijing granting licences for fully driverless robotaxi services. A Chinese tech company and a start-up are allowed to operate an automated vehicle fleet in a major city (Yingying, 2023). Automated vehicle testing in Beijing starting in 2022 is underway in three phases, including human safety driver; human safety driver with a rear seat passenger; and full self-driving without a safety driver.

Although various efforts are being made for emerging technologies in smart transport systems, several challenges and issues that hinder the widespread deployment of smart transport systems and their corresponding policies have also been observed. The disparity of this deployment is a representative example (figure 2.21) that notes different stages of smart transport development in several Asia-Pacific countries.

Figure 2.21. Timeline of smart transport development in selected Asia-Pacific countries



Source: ESCAP (2019).

Implications on freight transport connectivity and logistics

The impact of innovation on freight transport and connectivity affects all modes, including road, rail, dry ports and maritime transport. The road transport industry in the Asia-Pacific region is undergoing significant changes based on the introduction of new technologies and innovations in digitalization, low-carbon mobility and smart transport systems. The COVID-19 pandemic has heightened the need for contactless mobility, which has, in turn, accelerated the adoption of new technologies that improve service delivery and support sustainable and environmentally friendly transport. Digitalization in road transport involves using modern ICT to gather, process and share data related to transportation operations. This includes real-time information on the goods being transported, the vehicle used, the route taken, the driver's working hours and other job-related activities. The latest trends in digitalization and automation in road transport primarily centres on automating processes and optimizing transport networks. Digital platforms for carriers have emerged, and there is a growing interest in using artificial intelligence for transportation processes and logistics. Studies indicate that artificial intelligence in transport is set to grow at a compound annual rate of 22.7 per cent between 2022 and 2032. The market size is valued at $3.67 billion and is set to breach $23 billion by 2032 (Precedence Research, 2023b). Artificial intelligence-based solutions in the supply chain improve logistics costs by 15 per cent and service levels by 65 per cent (Alicke and others, 2021).

Implementing modern technologies in road transport has numerous benefits for carriers and customers. These innovative technologies enable transport companies to increase the number of deliveries without raising costs. Automation and digitalization in road transport streamline the order lead time and enhance cargo control. The advantages of modern technologies in road transport are priceless and vital for maintaining a high level of service and remaining competitive in the market.

Facilitating transit transport has been a constant challenge for countries in the region, particularly for landlocked developing countries. Electronic transit transport systems can help these countries reduce transit costs and support the transformation of landlocked developing countries into land-linked countries.

The COVID-19 pandemic and geopolitical challenges have resulted in some setbacks for countries. However, they have also provided an opportunity for those countries to make further adjustments and accelerate the digitalization of transit transport. Many countries in the region have already taken steps to digitalize transit operations. In South Asia, India and Nepal have taken steps to use innovative technologies to facilitate transit transport. Based on the concept provided by the secure cross-border transport model (ESCAP, 2012) developed by ESCAP and shown to be successful in testing tracking technologies along the transit route between India and Nepal, a pilot project on electronic cargo tracking (ADB, 2018) was carried out. It has resulted in reduced transit transport costs for landlocked Nepal. Electronic cargo tracking systems have been in use for some time and are gaining new momentum. The global vehicle tracking system market size was valued at $21.54 billion in 2022 and is expected to increase at a compound annual growth rate of 14.1 per cent over the forecast period of 2023–2030 (Grand View Research, 2022).

For rail transport, new technologies and digital tools have improved the efficiency, safety and sustainability of rail's movement of goods and passengers. Digitalization is no longer considered

optional; instead, it is recognized to be essential to ensure increased competitiveness of rail transport by improving operational efficiency, reducing energy consumption, enhancing customer experience, and integrating seamlessly with other modes of transport.

Rail digitalization can transform the railway industry by enabling predictive maintenance, digital platforms for railway operations and big data analytics. However, harnessing the opportunities arising from rail digitalization presents a significant challenge, especially considering the differences in the development status of railways in various countries in the Asia-Pacific region. The digital divide and the uneven availability of telecommunication infrastructure in different countries in the region must also be considered. Furthermore, data protection and cybersecurity issues need to be addressed by sharing best practices. Appropriate legislation, software and technical instruments must be used to safeguard this data, as cybersecurity is a significant concern in rail digitalization initiatives.

Legacy rail infrastructure is also a significant challenge faced by the railways in the region. Changes are needed not only in the equipment, but also in operational and maintenance practices. For instance, replacing mechanical interlocking systems with electronic versions is costly and requires careful planning to avoid traffic disruptions. Adopting automatic block systems presents a similar challenge. In addition, there is the challenge of ensuring that all departments involved in managing various aspects of rail transportation can communicate effectively. The vast amount of data that will be generated due to digitalization makes this task more complex. Comprehensive, sustained and coordinated measures must be implemented at the national, subnational and regional levels to overcome these challenges.

The need for enhanced efficiency, visibility, and connectivity in logistics operations primarily pushes forward the increasing digitalization of dry ports in Asia and the Pacific. This digital transformation is expected to gain further momentum in the coming years. Adopting a more comprehensive approach to developing dry ports as a component of multimodal transport corridors, particularly between Asia and Europe and different subregions in Asia and the Pacific, is necessary. Digital solutions and new technologies can help achieve this. For example, advanced tracking and monitoring systems are increasingly being used in dry ports and multimodal transport hubs. These technologies, which include satellite positioning systems, radio frequency identification systems and sensors, provide real-time visibility of cargo movements. Stakeholders can track the location, condition and status of shipments throughout the supply chain, enabling better planning, improved security, and proactive issue resolution.

The trend of digitalizing dry ports and multimodal transport facilities has become prominent. One area of development is the use of electronic documentation and paperless processes. Digital platforms and electronic data interchange systems have become key enablers for this, allowing for the secure and efficient exchange of shipping documents, which enhances overall operational efficiency. Additionally, digital platforms and port community systems are being increasingly employed to promote seamless communication, standardization and the integration of documentation, customs clearance and logistics planning. These initiatives have paved the way for enhanced information-sharing and, reduced bottlenecks, and have provided greater transparency in the overall supply chain.

The utilization of smart containers and sensors allows for real-time monitoring of freight. Automated stacking cranes and robotic process automation have also reduced human errors and improved productivity. Dry port operators and multimodal hubs are exploring the potential of blockchain

technology, which has emerged as a promising tool to enhance transparency and security in the supply chain process. Furthermore, they are integrating their services with "single window" and digital trade facilitation platforms to streamline the process further.

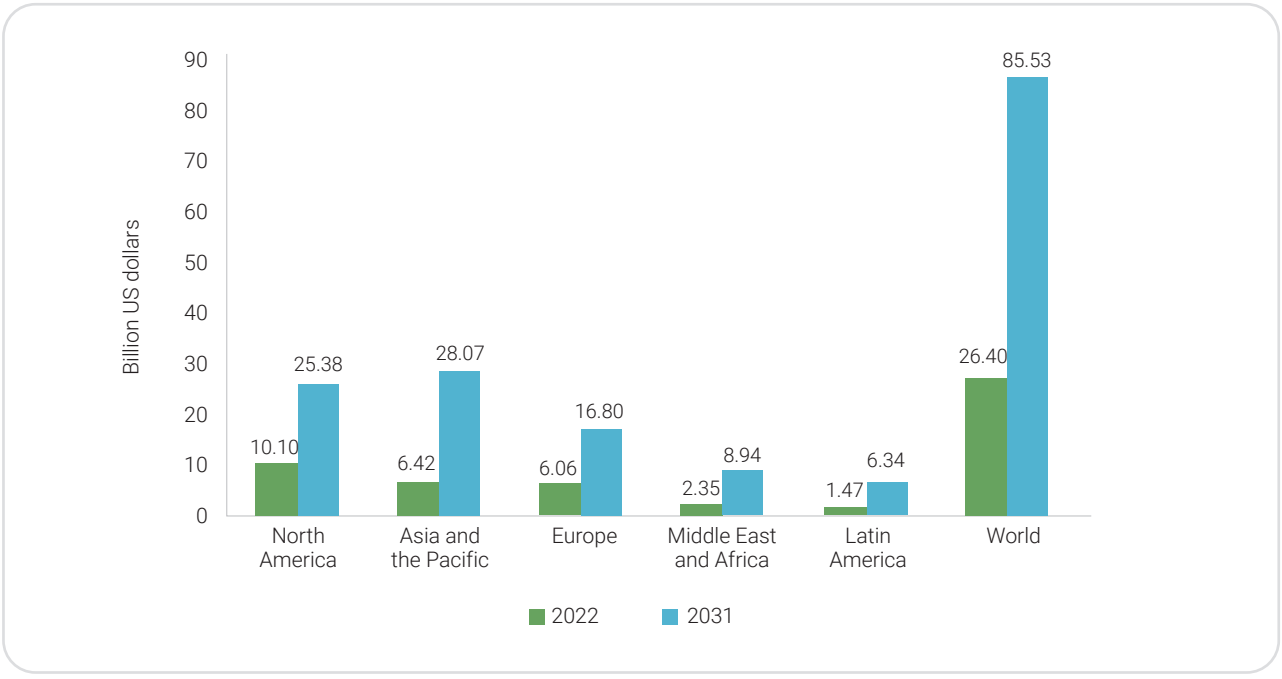
Lastly, the maritime transport sector has also benefited from innovation trends. The digitalization of ports will make their operations more efficient through the sharing of reliable data with relevant stakeholders, such as real-time information on port conditions or cargo based on a digital platform that processes documents electronically instead of paper. In addition, building automation facilities processing delivered cargo would be possible within schedule. Smart ports have the potential to mitigate the adverse impact of shipping activities on the environment with digital solutions and new technologies. To this end, eco-friendly ships or cargo handling equipment can be introduced, policies can be adopted to minimize pollutant emissions, and waste management practices can be optimized for sustainability. The most effective strategies to achieve this goal are those that minimize the carbon footprint, enhance air quality, and rely on ICT and digital solutions. By doing so, seamless logistics can be ensured, which is an essential component in integrating port operations and activities into supply chains more efficiently.

2.1.2.3. Development patterns and case studies

Continuous growth of smart transport systems with good momentum

The rising adoption of smart transport systems in Asia and the Pacific is evident by its projected market expansion from $6.42 billion to $28.07 billion between 2022 and 2031, assuming an annual growth rate of 17.8 per cent, as indicated in figure 2.22. Market growth is driven by factors, such as rising road fatalities, environmental pollution concerns, fleet operation and the swift evolution of smart cities (Global Data, 2023).

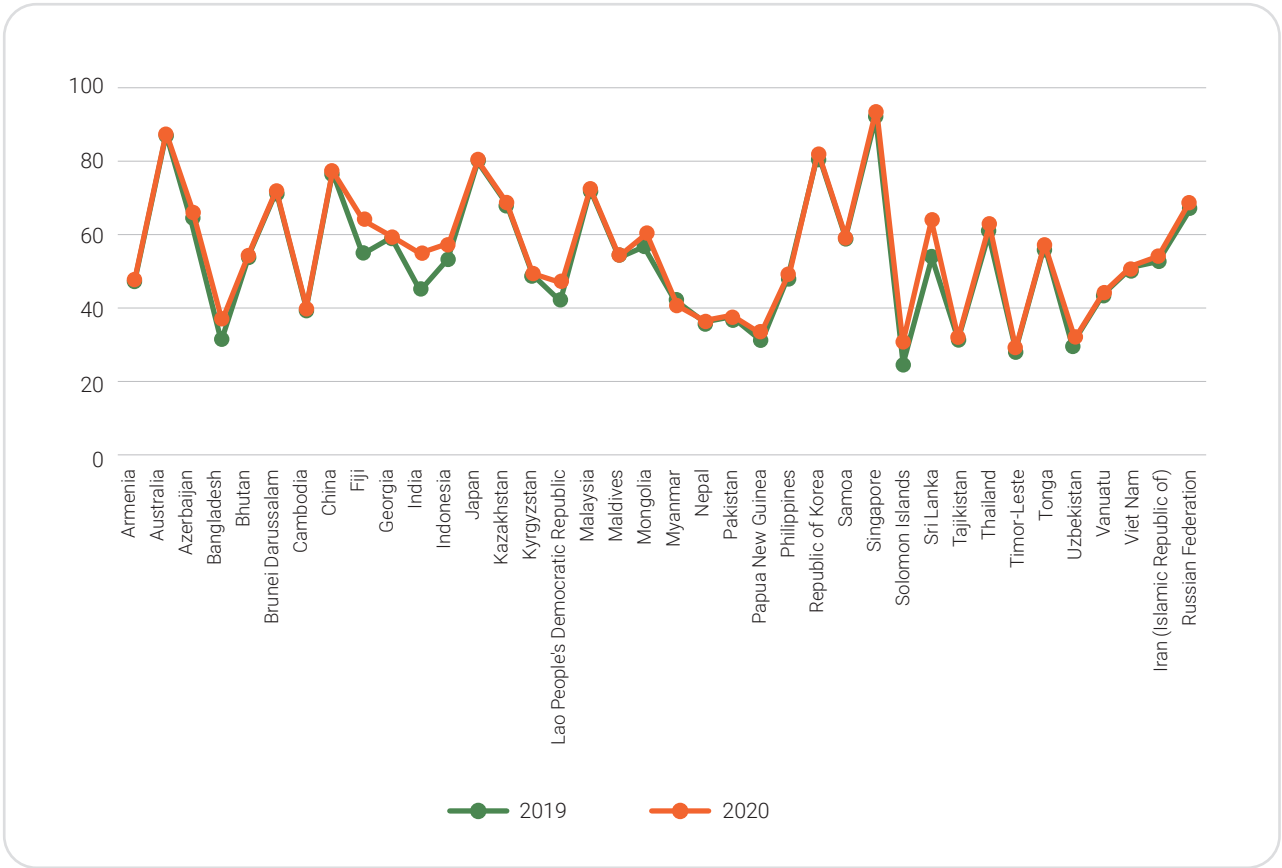
Figure 2.22. Intelligent transport systems market sizes by regions, 2022–2031



Sources: Author's calculation based on data from Transparency Market Research (2021); ESCAP (2023c).

To better understand current trends, a new indirect measurement of smart transport systems has been proposed, which combines the mobile connectivity index and infrastructure adequacy index, considering the nature of smart transport systems. The infrastructure adequacy index is the weighted sum of adequacy of road network, adequacy of airports and adequacy of the power network, which are directly related to smart transport systems. It is noted that this indirect measurement may not specifically reflect the actual development patterns of smart transport systems and might reflect only some dimensions. Nevertheless, at the very least, this can be a reference to observe the development change between 2019 and 2020, and a development gap among selected countries in this region in an indirect way. Figure 2.23 presents the varying pattern by each selected country from 2019 to 2020, but overall, the status of smart transport systems was improved in selected countries by a maximum of 10 and an average of two with the scale of this indirect measurement. Among selected countries, the minimum and maximum levels of smart transport systems were 24 and 94 in 2019, which were slightly increased in 2020 to 29 and 95, respectively. However, it was noted that the development gap among selected countries (24 vs. 94 in 2019 and 29 vs. 95 in 2020) was still large in both years, which is aligned with the different timelines of smart transport development in figure 2.21.

Figure 2.23. Indirect measurement of smart transport systems by countries



Source: Author's calculations based on data from ATO (2022a).

From a different aspect, all subregions with average and median metrics showed an increase in smart transport development based on the proposed indirect measurement. Among the five subregions, East and North-East Asia attained the highest score (73.5 in 2019 and 75.4 in 2020 on average, 77.2 in 2019 and 78.5 in 2020 in median) while South and South-West Asia attained the lowest score (45.5 in 2019 and 49.2 in 2020 on average, 49 in 2019 and 54 in 2020 in median). However, the gap between these two subregions was reduced from 28 in 2019 to 26.2 in 2020 (average) and from 28.2 in 2019 to 24.5 in 2020 (median).

Figure 2.24. Indirect measurement of smart transport systems by subregions

Source: Author's calculation based on data from ATO (2022a).

To delve deeper into the potential contributions of smart transport systems regarding the efficiency and economic sustainability of transport networks, which align with SDGs 9 and 11, it is instructive to examine specific examples from the following four major applications.

1. **Advanced Traffic Management Systems (ATMS):** The global ATMS market is projected to expand at a compound annual growth rate of 14.4 per cent from 2021 to 2028, and the market size is expected to reach $75.4 billion by 2028, compared to $28.2 billion in 2020 (MarkWide Research, 2024). In 2022, ATMS contributed to more than 30 per cent of the smart transport market due to increasing urbanization and population, which resulted in heightened demand for traffic management systems (Global Data, 2023). ATMS positively affect the SDGs by reducing carbon emissions and fuel consumption and decreasing vehicle operating costs and maintenance costs for road infrastructure, resulting in economic advantages that align with SDGs 9 and 11

(Glne Traffic, 2023). Notable cases are in China, where recent ATMS advancements involve the utilization of artificial intelligence to enhance the performance of traffic signal control systems in urban intersections. In the Beijing Economic-Technological Development Area (E-Town), real-time traffic flow analysis at 332 intersections has led to a 30 per cent reduction in average signal control delay through dynamic signal plan adjustments (People's Daily Online, 2023). Meanwhile, in the Chennai metropolitan area of India, a recent project has commenced, incorporating adaptive traffic signalling at more than 160 intersections to optimize traffic flows. Additionally, red light violation detection and traffic incident detection systems will be installed at more than 50 intersections in this area (The Hindu, 2023).

2. **Advanced Traffic Information Systems (ATIS):** ATIS enhance the overall efficiency and convenience of transport networks with real-time traffic updates, information on parking availability, route guidance, public transport information and roadside weather conditions, resulting in reduced travel time, fuel usage and cost (ESCAP, 2019). Studies have demonstrated that drivers using ATIS experience varying levels of benefits, with estimated travel time savings ranging from 7 per cent to 20 per cent, depending on the road network. Additionally, system performance can improve by 1 per cent to as high as 55 per cent in terms of overall time savings across networks, depending on the level of market penetration (Zhang and Verhoef, 2006).

3. **Advanced Public Transport Systems (APTS):** APTS will improve service reliability and efficiency, attracting more passengers and generating revenue for transport operators. Additionally, they improve social equity by ensuring that public transport services are accessible to all residents, including those with disabilities and low incomes, thereby promoting inclusive urban development and advancing SDGs 9 and 11. Through the provision of seamless multimodal connectivity and user-friendly services, APTS encourage more use of public transport, reducing the overall demand and direct and indirect costs associated with road infrastructure, parking facilities and increased greenhouse gases. Globally, cities are enhancing public transport networks, incorporating autonomous features to cut operating expenses and deploying shared vehicle fleets for increased flexibility and accessibility. Internet of things-enabled infrastructure data aids planners in expanding capacity and enhancing reliability, ensuring that mass transit remains competitive with private vehicles and mobility services (Bouton and others, 2017). As urban populations continue to rise, reliance on public transport will inevitably increase, underscoring the growing importance of APTS and other emerging technologies to improve efficiency, decrease costs and promote economic sustainability. The Viabus app of Thailand attracted more than 2 million regular users in 2021, offering comprehensive coverage of public transport. Utilizing real-time data, it updates routes, traffic conditions, and travel times, including information on cancelled stops, stalled vehicles, route changes and road closures. The app significantly has reduced passenger waiting times by more than 7.7 billion minutes, yielding an economic value of approximately 5 billion baht ($150 million). This underscores the substantial impact of transport technology on economic efficiency, with ample room for further enhancements (Pipitsombut, 2021).

4. **Commercial vehicle operation (CVO):** By optimizing freight routes and delivery schedules, CVO technologies help to streamline freight logistics and supply chain management, thereby reducing congestion and emissions and minimizing the environmental footprint of logistics operations. They also enhance supply chain resilience by providing real-time visibility and control over cargo

movements, enabling companies to respond quickly to disruptions, mitigate risks and reduce costs. With the advancement of technologies, autonomous trucks can eliminate the need for human drivers, thus addressing labour shortages and enabling companies to seize missed profit opportunities. Additionally, autonomous trucks operate efficiently, leading to a potential 10 per cent reduction in fuel consumption for trucks, resulting in substantial cost savings (Krishnamurthi, 2020). As an example, as of 2022, the market size of the Chinese smart logistics industry reached 699.5 billion yuan ($100 billion), with 52 billion yuan invested in 2021 alone (Zhang, 2024).

Development patterns and best cases in transport connectivity and logistics

The transport industry is undergoing a transformation due to the rapid advancement of digital technologies, which has been accelerated by the COVID-19 pandemic. Several factors are driving this transformation, including, among them, using digital tools, decarbonization, changes in behaviour due to the pandemic and climate concerns. As a result, more and more players in the industry are committed to achieving a net-zero carbon footprint and significant changes are happening in the structure of value-added chains. The use of electric cars and autonomous vehicles is expected to rise as concerns over environmental sustainability and safety continue to increase. Transport infrastructure and operational connectivity will likely become increasingly automated and smart using advanced technologies.

Governments and the private sector are adapting to new opportunities and challenges while adopting digital tools and solutions to increase and further streamline operations and reduce costs. As examples, China is implementing the National Strategy for Innovation-driven Development (2016–2030) to promote the development and application of smart transport systems, such as intelligent vehicles, connected infrastructure, and big data platforms. The Ministry of Transport and the Ministry of Science and Technology have jointly issued a guideline that maps out key transport technology based on innovation for China through 2035 (The State Council, 2021). China Railway has released an outline of its railway plan (Global Times, 2020). This plan defines the development goals and major tasks that China Railway aims to achieve by 2035 and 2050, including a national railway network. China Railway also plans to use 5G technology and the Baidu Navigation Satellite System to create a smart railway.

The Government of India introduced a National Master Plan for Multi-modal Connectivity called PM Gati Shakti (National Portal of the Government of India, 2021) on 13 October 2021, which is essentially a digital platform to bring 16 ministries, including the one for railways and roadways, together for integrated planning and coordinated implementation of infrastructure connectivity projects. The Indian Railways is using the Real-Time Train Information System for computerized chart preparation and passenger train data.

In early November 2023, the Government of the Russian Federation approved a strategy for the digital transformation of the transport industry in Russia until 2030 (Russian Federation, Ministry of Digital Development, Communications and Mass Media, 2023). On 19 December 2023, the Russian Federation also presented its National Digital Platform for Freight Transportation and launched the National Digital Transport and Logistics Platform (Russian Federation, Ministry of Transport, 2024). In addition, a driverless truck project was launched on 14 June 2023, aiming to develop a business model for driverless truck traffic. Similarly, the "Unmanned Trains" and "Virtual Coupling" projects are envisaged

in railway transport. Intertran (Russian Railways, 2020) is an information system launched by the Russian Railways to support intermodal transport through digitalization and the use of electronic documents.

The KORAIL Logistics Information System is an online platform that provides comprehensive information on rail freight services in the Republic of Korea (Korea Railroad, 2021). Its goal is to enhance the efficiency of freight operations, benefiting businesses and consumers. This system is designed to enhance the efficiency and transparency of rail freight operations by providing real-time data and facilitating better logistics planning.

Singapore has initiated the Land Transport Master Plan – 2040 (Singapore Land Transport Authority, 2020) to transform the transport sector into a more efficient, convenient, and sustainable system. It will use digital solutions, such as autonomous vehicles, mobility-as-a-service and smart traffic management. The plan also aims to create an inclusive transport ecosystem.

The 20-year transport system development strategy from 2018 to 2037 of Thailand focuses on innovation, management, green and safe transport, and inclusivity (Thongkamkoo, 2018). The strategy is part of the country's 20-year national strategy, which aims to make Thailand a high-income country by 2037. It is based on the vision of Thailand becoming a regional logistics hub and improving its transport network.

Regarding seaports, China, Singapore and the Republic of Korea have become hub ports resulting from their effective operations and maintenance through port digitalization or transformation into smart ports. For instance, China uses smart devices and platforms to facilitate coordination and automation of cargo handling and clearance in ports and terminals. Other countries, such as Indonesia, Malaysia, Thailand and Viet Nam, are investing in upgrading their ports and terminals, building new transport networks and implementing digital technologies to optimize port operations and improve connectivity with other countries. Myanmar and Cambodia have launched port information systems using electronic data information and introduced port automation.

2.1.2.4. Regional initiatives and cooperation on sustainable transport

Expedient policy intervention is critical to furthering the wider deployment of smart transport systems in Asia and the Pacific. Policy and regulatory frameworks developed by ESCAP can guide countries to establish national plans, policies and regulations. Given that smart mobility and transport big data are regarded as some of the key upcoming emerging technologies, methodological guidelines developed by ESCAP can also provide a specific focus to assess and formulate relevant policies and strategies in Asia and the Pacific. These guidelines can pave the way towards adopting these new technologies by integrating existing transport systems smoothly and efficiently in member States across the region.

The need for a coordinated regional strategy in advancing smart transport systems is evident because of the disparities among countries in the region. These disparities can reduce efficiency and productivity for smart transport systems among member States. To assist in enabling regional cooperation by addressing these disparities, a regional road map on smart transport systems developed by ESCAP can help countries transition towards sustainable smart transport systems.

Implementing transport digitalization in the region can bring numerous benefits, including, among them, improved efficiency, reduced costs and enhanced safety. To fully harness these benefits, stakeholders need to work together in a sustained and coordinated effort. This requires collaboration among national, subregional, and regional partners and support from the development community. Policy advocacy, partnership building, high-level political support and capacity-building programmes for transport officials are crucial to achieve this. This will enable them to effectively manage the transition to digital transport and ensure that the region can fully take advantage of the opportunities that digitalization can present. To this end, countries have engaged in several multilateral initiatives with transport digitalization as a priority.

For example, the Digital Silk Road part of the Belt and Road Initiative, is focused on the technology dimension. It extends from the ocean floor to outer space and enables artificial intelligence, big data applications, and other strategic technologies (ESCAP, 2021b). The Digital Silk Road is a transformative digital initiative that aims to enhance global connectivity through infrastructure development, leveraging digital technologies. It comprises several key aspects, including, among them, infrastructure investment, high-tech areas, global reach, and training and knowledge transfer, including investment in telecommunications networks, artificial intelligence, cloud computing, e-commerce, mobile payment systems, surveillance technology and smart cities.

South-East Asian countries are implementing the ASEAN Customs Transit System, which plays a crucial role in promoting efficient and hassle-free cross-border trade within the ASEAN region by simplifying and harmonizing customs procedures for traders transporting goods across ASEAN member States. The initiative aligns with the broader goal of establishing an ASEAN Economic Community, which promotes the free flow of goods, services, investment, skilled labor and capital in the region (ASEAN, 2021).

The ASEAN Customs Transit System is a computerized customs transit management system that allows traders to transport goods freely through participating ASEAN countries by completing only one customs formality. This eliminates the need to pay duties and taxes at each border crossing, streamlining cross-border trade. In addition, private sector engagement has also been a focus, with efforts to build partnerships along key transport corridors. The system is now operational along the North-South corridor, which includes Malaysia, Singapore and Thailand, and along the East-West corridor through Cambodia, the Lao People's Democratic Republic, Myanmar and Viet Nam.

Similarly, the members of the Eurasian Economic Union (EAEU) signed an agreement on using navigation seals in April 2022, which serves as an important step to improve the efficiency and traceability of goods transportation. The agreement aims to ensure that goods are being legally transported within the domestic market of EAEU through a tracking process for transportation using navigation seals. Implementing this agreement will make EAEU member States more appealing for transit, strengthen regional connectivity and ensure that goods are being legally transported within the EAEU territory. This agreement will also minimize control measures by customs and other regulatory authorities. It became effective in April 2023 (EAEU, 2022).

2.2. ENVIRONMENTAL SUSTAINABILITY

As a result of growing transport demand, including the use of private vehicles and heavy-duty vehicles for road freight, advancing vehicle and fuel technologies may not be enough to reduce greenhouse emissions, as the growth of motor vehicles can easily surpass any technological improvements made for air pollution and CO_2 emission decreases in transport to occur. Policies are needed that can lead to reductions in vehicle use, distance travelled and shifts in transport modal share, along with improvements in vehicle efficiency and fuel intensity. This section is focused on the environmental sustainability of transport, focusing on the linkages between transport and SDGs 11 and 13, namely urban sustainable and low-carbon transport development, respectively.

2.2.1. Development of low-carbon transport pathways

The development and implementation of national low-carbon transport pathways can help guide countries to better align their transport and climate goals, which can be further linked to regional or global targets. Current pathways and effective policies implemented in Asia and the Pacific that can achieve a low-carbon emission transport future are highlighted in this section.

2.2.1.1. Introduction

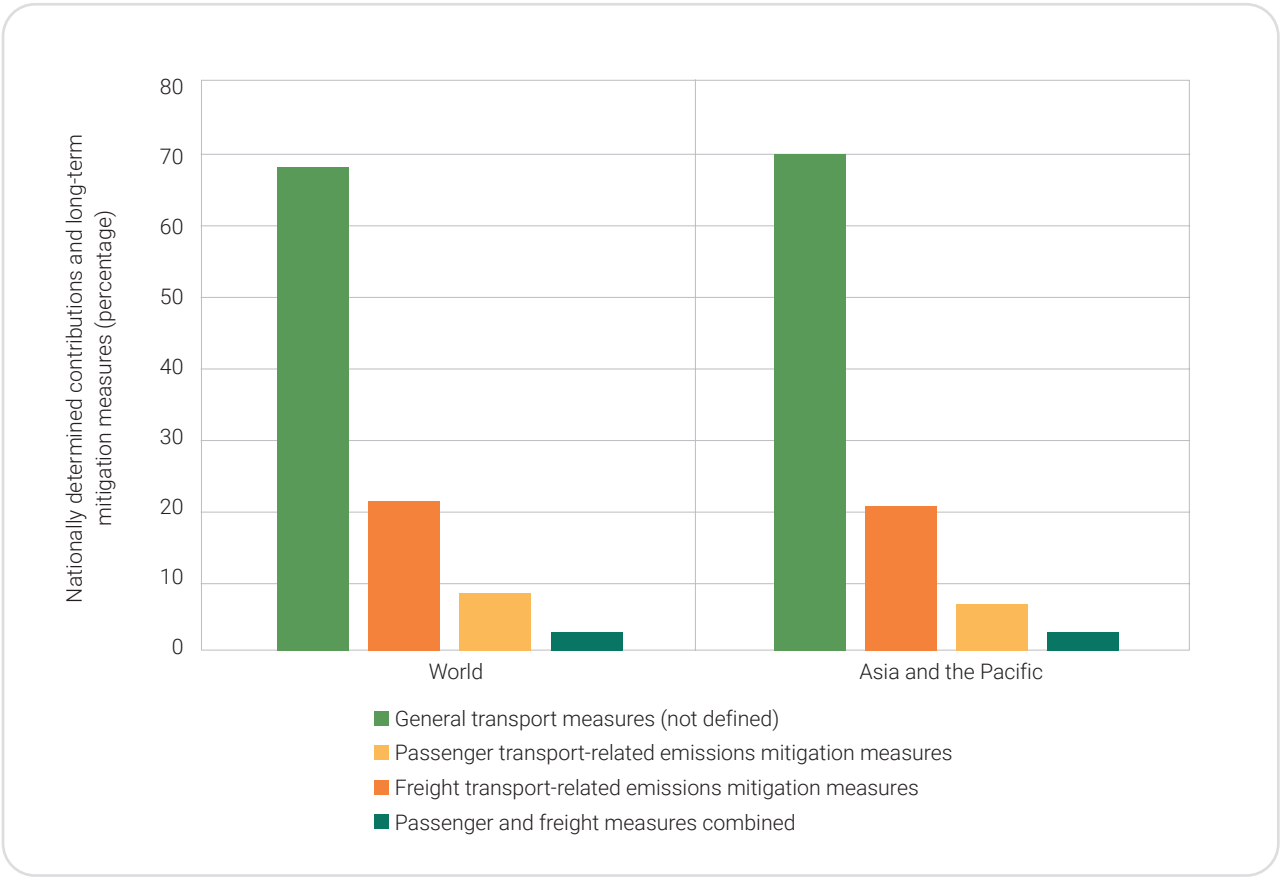
The transport sector plays a critical role in reducing regional and global CO_2 emissions, which requires deep partnerships between transport and other line ministries to better align SDG 13 and the goals of the Paris Agreement, notably the nationally determined contributions and long-term low-emission development strategies. Such processes have been developed to trigger national action and help showcase action already happening around the world and vice versa. However, despite substantial progress in the first round of the nationally determined contributions updates, they still fall short of delivering the changes required in the transport sector (GIZ and SLOCAT, 2023).

The adoption of the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement signed by 196 countries in 2015, has created political momentum for climate change mitigation, across all sectors. This has resulted in countries submitting their plans for climate action known as the nationally determined contributions by 2020. Its goal is to limit global warming to well below 2 degrees Celsius, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. Out of the 194 countries that have submitted their nationally determined contributions, 98 per cent have mentioned transport, while 84 per cent of the nationally determined contributions include transport measures, yet only 33 per cent have indicated specific transport CO_2 mitigation targets (ITF, 2024b).

Out of the 51 Asia-Pacific countries that have submitted their nationally determined contributions, 38 of them have specified transport measures, including transport emission reduction targets from just a handful of countries. Nevertheless, transport measures mentioned in the region's nationally determined contributions are primarily focused on the promotion of public bus transport, alternative energy sources and electric mobility (ESCAP, 2024e), freight transport has received little attention not just in the Asia and the Pacific nationally determined contributions, but in all submitted nationally determined contributions. Freight measures mentioned in the nationally determined contributions predominantly focus on modal

shifts from road to rail or waterways and improving fuel efficiency (figure 2.25), though greater specificity is required for freight-related initiatives. The percentage of countries in Asia and the Pacific that have indicated general transport measures (70 per cent) in their nationally determined contributions is slightly higher than the global percentage, though the percentage of freight transport-related measures in the region are lower compared to the global percentage.

Figure 2.25. Nationally determined contributions and long-term mitigation measures, the world and Asia and the Pacific



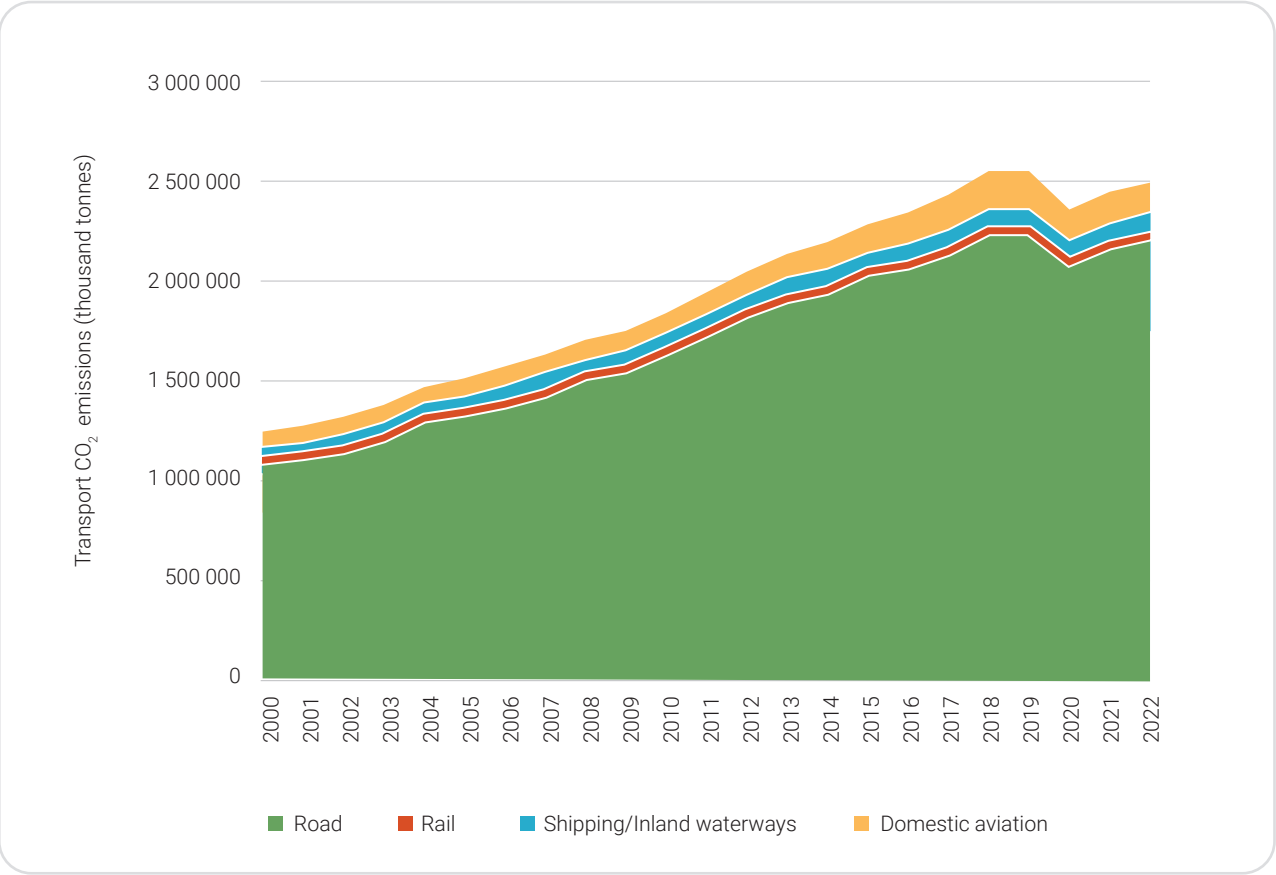
Source: GIZ Transit and SLOCAT (2023).

Improving the environmental sustainability of transport is crucial for advancing the 2030 Agenda for Sustainable Development and the Paris Agreement. The escalating volume of carbon emissions from passenger and freight vehicles, urban congestion, road deaths and air pollution pose significant challenges across the Asia-Pacific region, hindering progress towards attaining the SDGs. Despite some strides, No SDGs in Asia and the Pacific are currently on track for fulfilment by 2030, with regression evident for several Goals, including Goal 13 on climate action (ESCAP, 2024f).

2.2.1.2. Current status, trends and pathways

Globally, the transport sector has experienced the highest growth in carbon emissions since 2010, with the most rapid increases occurring in Asia and the Pacific (IEA, 2021) (figure 2.26).

Figure 2.26. Transport carbon dioxide emissions by mode in Asia and the Pacific from 2000 to 2022



Source: EDGAR (2022).

Notably, emissions from freight transport have surged at double the rate of those from passenger transport. Within the region, road freight accounts for approximately 58 per cent of transport sector emissions, with road transport accounting for about 74 per cent of these emissions (ITF, 2021). The modal split in freight transport varies widely across countries because of geographical, economic and infrastructural factors, but the predominant mode remains to be road transport. Urban freight transport, representing 15 per cent of domestic freight activity, disproportionately generates 30-50 per cent of carbon emissions due to frequent, low-volume deliveries in congested urban settings (IEA, 2017).

Climate change presents specific threats to the transport sector, as global and regional supply chains are vulnerable to natural hazards. The resulting disruptions impose significant economic costs, particularly

in Asia and the Pacific, where road and rail assets could face annual damages estimated at $3.1 billion to $22 billion (ATO, 2022a).

Countries in Asia and the Pacific are in general committed to the decarbonization of their road, rail, aviation and maritime transport sectors, with plans to electrify transport modes across the sector as a whole (ESCAP, 2024e). A variety of low-carbon and sustainable transport initiatives already exist in many countries, underscoring individual national commitments to reduce CO_2 emissions. These initiatives prioritize different transport modes or subsectors depending on the specific challenges faced by each country.

Asia-Pacific countries also have set different national greenhouse gas emission reduction targets and timelines, which will influence the rate at which transport CO_2 emissions will be reduced. Some countries, such as Malaysia, have developed specific targets within the transport sector, such as for urban public transport, electric vehicles and alternative fuels, while others have focused on national emission reduction targets for the entire economy or sector. Most national transport policies also contain sustainability or low-carbon transport strategies, but their priorities vary depending on the main sources of transport-related CO_2 emissions in each country. Policies to support non-motorized transport modes walking and biking, are equally important as the development of electric mobility.

Despite differences in transport demand, infrastructure needs, transport regulations and policies, levels of economic development and commitment to climate mitigation, most countries in the Asia Pacific region have several common priorities, such as greater coordination and cooperation between ministries; the development of regional policy frameworks; the provision of technological support; the identification of low-carbon transport financing solutions; and mechanisms to encourage modal shift from private vehicles to public transport (ESCAP, 2024e). Regional cooperation will continue to serve a critical role in enabling countries in the Asia Pacific region to exchange knowledge and develop mechanisms to help them achieve their respective low-carbon transport targets, ultimately advancing the goals of the Paris Agreement.

2.2.1.3. Review of current gaps in meeting low transport carbon goals

Most countries in Asia and the Pacific already have formulated national transport and climate change action plans and road maps, often with ambitious goals and targets. However, some still lack the capacity to develop specific targets and timelines to align policies with these goals. In particular, the gaps in technical, institutional and financial support that countries encounter require more precise targets and mitigation timelines to support these action plans. These should then be aligned with nationally determined contributions and long-term low-emission development strategies to guide the transition to low-carbon transport in an efficient and inclusive manner, especially since long-term ambition for mitigating climate change in the transport sector remains insufficient.

While net-zero emissions pledges exist, only a few countries in the region have outlined clear targets and timelines for them in their nationally determined contributions or in other policy documents. Notably, Bhutan, Maldives and Papua New Guinea have reported targets, but most have not specified a timeline for peaking economy-wide emissions, reflecting a significant gap in the region's climate ambition (GIZ Transport and SLOCAT Partnership, 2023). Moreover, only a few countries have explicitly specified

national climate targets for the transport sector. Bangladesh, Bhutan, Cambodia, Marshall Islands, Mongolia and Sri Lanka have directly included explicit transport emission reduction targets in their nationally determined contributions (GIZ Transport and SLOCAT Partnership, 2023).

More ambitious low-carbon transport targets need to be determined for countries in the Asia-Pacific region, especially since CO_2 emissions from the transport sector must fall by more than 3 per cent by 2030 to be decarbonized by 2050 (IEA, 2023). Strong regulations and fiscal incentives and considerable investment in infrastructure to enable low- and zero-emission vehicle operations and modal shifts, are needed to achieve these emissions reductions (ESCAP, 2024e).

2.2.1.4. Climate finance for low-carbon transport

Transitioning to low-carbon transport requires substantial funding; current estimates for such funding are as high as $8 trillion in the Asia-Pacific region alone through 2030 (ADB, 2017). The disparity in infrastructure needs across subregions underscores the diverse economic impacts and necessitates tailored strategies. Current investment patterns show a disproportionately low share of climate funds allocated to sustainable transport solutions. Since 2003, the transport sector has accounted for approximately 7 per cent of total lending by the multilateral climate change funds in the region (cumulative since 2003). This imbalance is particularly concerning for low-income countries, as they only receive about 1 per cent of transport-related multilateral climate change funds lending (ATO, 2022a).

To address these challenges, a diversified funding strategy combining public and private sources is crucial. Blended finance, green bonds and PPPs can attract diverse investors, while innovative financial products tap into new capital sources. The wholesale model of financing offers a scalable approach to fund subprojects and leverage resources. However, financial barriers, policy uncertainties and market challenges hinder investment in low-carbon transport. Addressing these barriers requires policy alignment, capacity-building, and the development of investor matching platforms. Modifying funding approaches to include subsidies, incentives, carbon pricing and international climate finance can further accelerate the transition to low-carbon transport, fostering sustainable economic growth and environmental preservation across the region.

Climate finance mechanisms play a crucial role in promoting low-carbon transport by providing the necessary funding and incentives to overcome financial barriers. An effective climate finance mechanism for low-carbon transport needs to encompass a variety of financial instruments, policies and institutional arrangements to ensure that the necessary capital is available and effectively used for climate-related low-carbon transport projects, such as public transport development, active mobility infrastructure, and shared and e-mobility. Through government grants, carbon pricing, green bonds, PPPs, international finance and consumer incentives, these mechanisms support the transition to sustainable transport systems that reduce emissions, foster economic growth, and improve public health and equity. The identification of climate financing mechanisms for low-carbon transport, including directing investments of $1.4 trillion to $2.1 trillion annually towards sustainable transport infrastructure could help facilitate this transition (ESCAP, 2021c). Additionally, to effectively transition towards a more sustainable transport system, it is imperative to adopt a comprehensive and integrated approach that encompasses passenger and freight transport. This approach should focus on several critical areas

to drive meaningful progress and achieve long-term environmental and economic benefits. The following policy insights highlight some of the key solutions to reducing carbon emissions from passenger and freight transport.

In addition, strong policy support and regulatory frameworks are essential for creating an enabling environment for low-carbon transport financing. Policy alignment through collaboration between ministries enables cohesive planning and implementation of strategies. This synergy streamlines resources, avoids duplication and ensures a unified approach towards common goals.

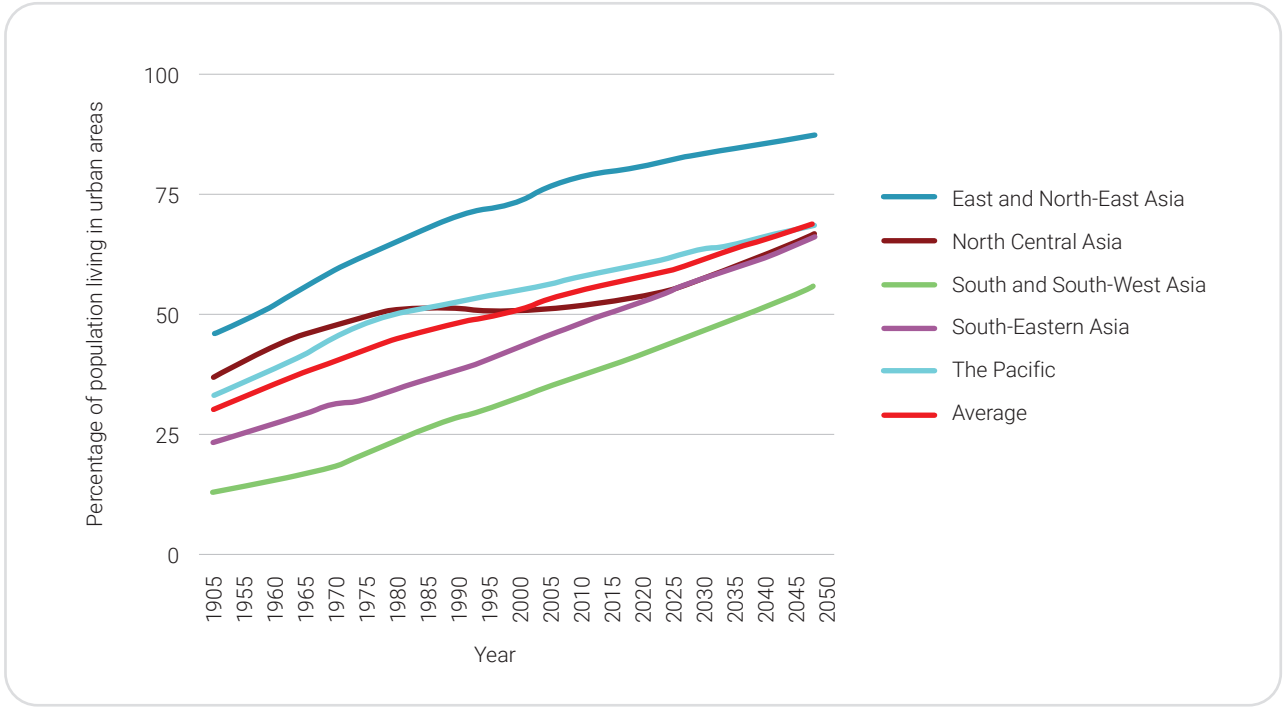
2.2.2. Sustainable urban transport

Sustainable urban transport holds the key to the attainment of the overall sustainability of cities in Asia and the Pacific, contributing directly to the achievement of SDG 11, as rapid population growth and urbanization are taking place in this region and job and economic opportunities prevail. Sustainable urban transport solutions are, therefore, crucial to mitigate the growing congestion and pollution in the region's sprawling urban centres.

2.2.2.1. Introduction

The Asia-Pacific region's urban population, which has been among the fastest growing in the world over the past 40 years, (ADB, 2022) is expected to increase by 50 per cent by 2050 (figure 2.27), while demand for urban passenger transport more broadly is expected to rise by 350 per cent in the same period (ITF, 2021).

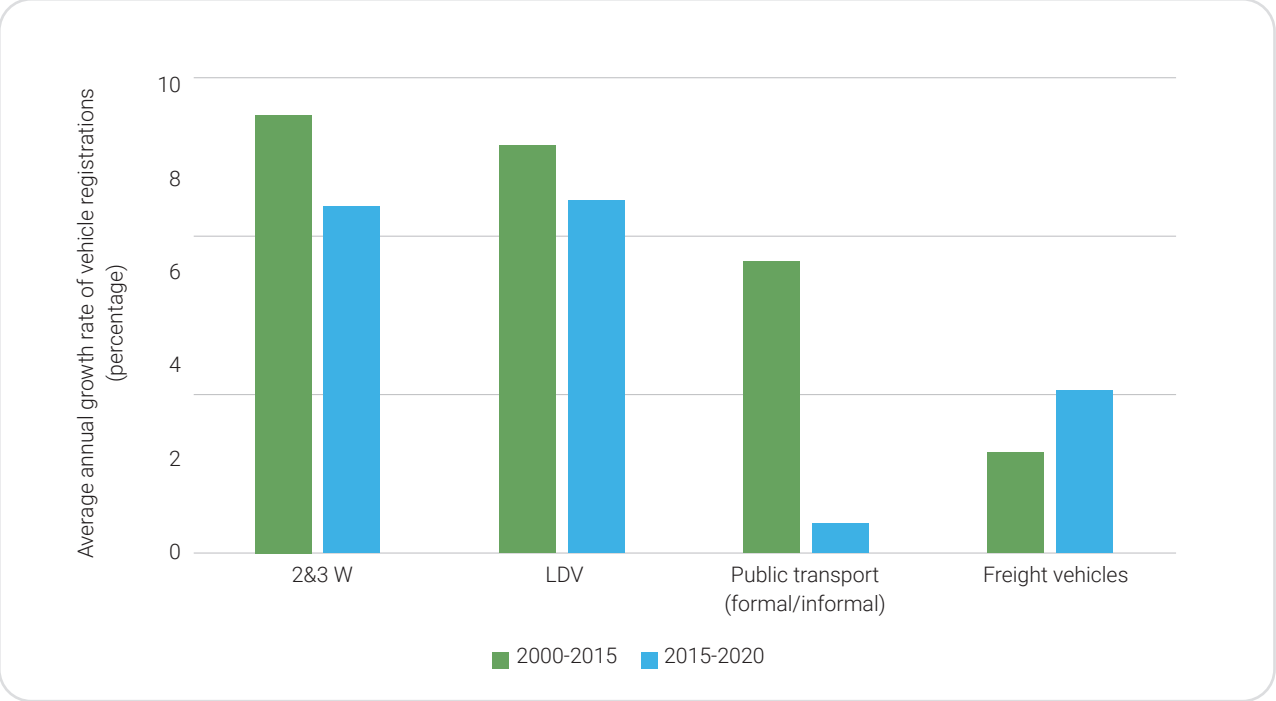
Figure 2.27. Percentage of Asia-Pacific population living in urban areas, projection to 2050, by ESCAP subregions



Source: United Nations Department of Economic and Social Affairs (2018).

The rapid rate of urbanization is putting pressure on urban transport systems and prompting the need for further investments to improve the capacity of these transport systems (ESCAP, 2017). In many cities, the demand for urban transport is exceeding the ability of authorities to manage this growth in ways that mitigate negative externalities and ensure access and social inclusion. In addition to accommodating a greater urban population, public transport can help to reduce greenhouse gas emissions from urban transport. The low vehicular emissions of buses are indicative of the role of public transport, especially electric buses, for reducing carbon and air pollutant emissions in congested urban areas. This is because these vehicles offer the most significant emission reduction potential, especially on a per-passenger basis, owing to the high mileage, high capacity, and a long-life span of these vehicles. Despite this, growth in public transport vehicles in Asia and the Pacific has almost completely stagnated, increasing only 0.6 per cent annually between 2015 and 2020, versus 5.5 per cent between 2000 and 2015 (figure 2.28).

Figure 2.28. Average annual growth rates by vehicle mode in Asia based on vehicle registrations (2000–2020)



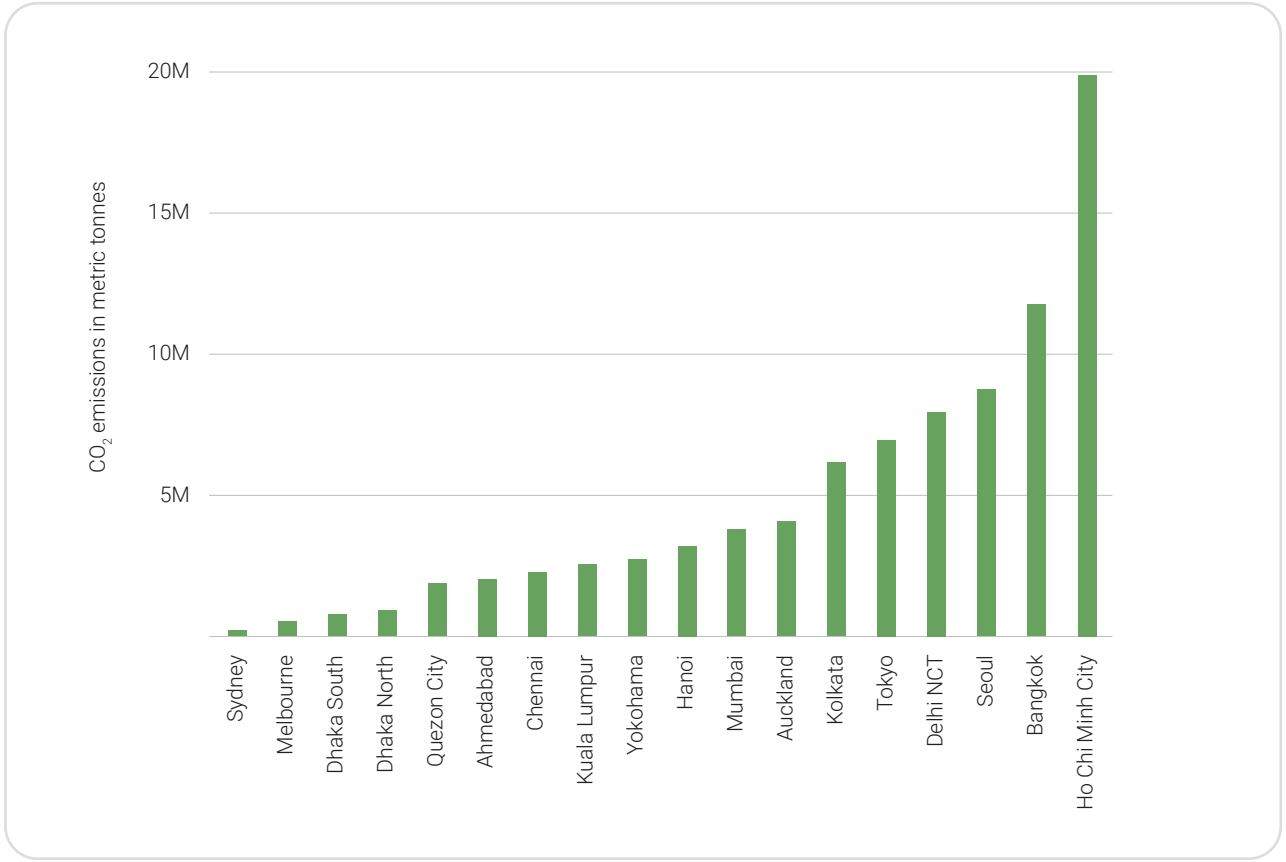
Source: ATO (2022a).

Another significant challenge for cities in the region is their increasing density and expansion towards their peripheries, which can lead to unplanned urban growth or the development of metropolitan areas with multiple satellite cities that outpace the existing transport networks. While denser areas offer opportunities for more efficient use of transport infrastructure, cost-effective public transport systems, and compact distribution networks for energy and other services, they also pose greater challenges in managing greenhouse gas emissions, due to air pollution and congestion from a larger, concentrated number of motor vehicles. Connecting periphery communities to greater transport systems is dependent on first- and last-mile connections. In particular, informal transport plays an important role in providing first- and last-mile connectivity to public transport and, in some cases, this poses challenges pertaining to

safety and decarbonization because the limited oversight of this sector often means that these fleets operate without adherence to vehicle standards or emissions regulations.

As a result, informal transport has been estimated to have the second largest share of greenhouse gas emissions after private vehicle use (ITF, 2021). The average CO_2 emissions for Asia-Pacific cities included in the C40 dataset is 4,747,628 metric tonnes. Emissions from Sydney and Melbourne are well below this average, whereas emissions from Bangkok and Ho Chi Minh City are double and triple this amount respectively (figure 2.29).

Figure 2.29. Carbon dioxide emissions from on-road transport in Asia-Pacific cities



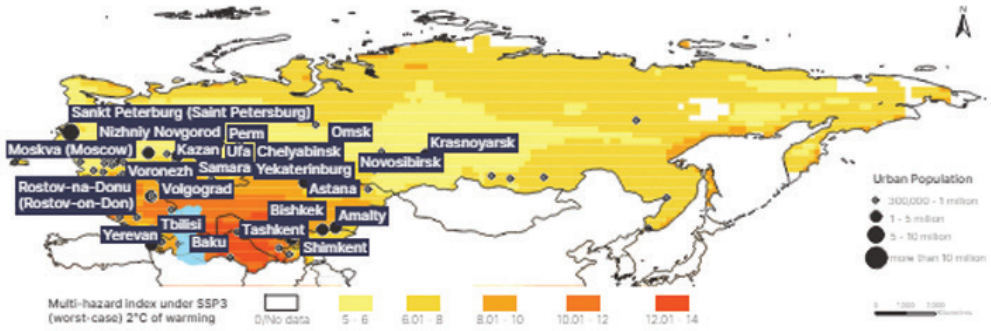
Source: C40 (2024).

In addition to contributing to emissions, cities in the region are also exposed to climate change impacts. Partly owing to its extensive coastlines, the region is more vulnerable to coastal flooding than any other region in the world, which particularly affects transport systems and services. Of the 25 most exposed cities in the world to a one-metre sea level rise, 19 are in Asia (IPCC, 2021). Many cities are in areas where multi-hazard risks are growing rapidly. In the Asia-Pacific region, it is estimated that the population in the "extreme-risk" and climate disaster areas is expected to increase by more than 50 per cent in 26 cities and by 35 to 50 per cent in 72 cities between 2015 and 2030. As a result, the number of city dwellers exposed to extreme and high risks is likely to increase significantly (ESCAP, 2020b).

Increased frequency and intensity of extreme storm surges and waves, droughts or river floods, increased temperatures and extreme temperature variability can cause damage and disruption to transport systems and infrastructure. Such impacts include port and coastal road inundation or submersion, access restrictions, deterioration of the condition and structural integrity of road pavements, and the rapid failure of bridges and railway tracks. This has corresponding implications for urban populations whose access to mobility becomes increasingly compromised, thus limiting access to jobs, health care and other basic services, and necessitates systemic adaptation measures to reduce vulnerabilities and increase the resilience of transport systems to climatic impacts.

This encompasses the physical robustness of infrastructures and the overall transport systems' ability to prevent and mitigate damage, maintain functionality and recover quickly at minimal cost. From an economic perspective, adaptation measures can help reduce the operational and rehabilitation costs incurred by incremental climatic changes or extreme weather events. Climate-adapted and resilient transport projects are being promoted by multilateral development banks and other development actors, often with loans being contingent upon adaptation or resilience planning. Various methodologies have also been employed to estimate vulnerabilities and the likelihood and nature of disruptive events across the region to help countries better prepare for any extreme weather conditions and other disruptions (figure 2.30).

Figure 2.30. Urban population exposure to multi-hazard risk (SSP3 2^{0}C warming scenario) in North and Central Asia



Sources: ESCAP calculations based on IPCC WGI Interactive Atlas - Coupled Model Intercomparison Project Phase 6 (CMIP6) 2021, Urban Agglomeration Population for 2020 and UN Geospatial. been agreed upon by the parties.

Notes: Multi-hazard data consist of
1) Annual consecutive dry days
2) Annual maximum 5-day precipitation
3) Annual surface wind and
4) Annual days with maximum temperature more than 35°C.

Disclaimer: The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

In recent years, active transport modes, such as walking and cycling, as well as shared mobility and micromobility have gained increasing recognition in the region though their implementation faces significant challenges. When properly supported with investments, policies, and incentives, these modes of mobility have the potential for mitigating congestion on dense and congested urban roads,

as well as for supporting access to public transport and broader inclusive transport objectives. In addition to easing traffic, walking and cycling create vibrant urban spaces, promote public health, and contribute to more sustainable cities. Despite these benefits, the uptake of active transport modes remains very low in many Asian cities, with cyclists and pedestrians comprising two per cent and 13 per cent of journeys in 2015, compared to 3.3 per cent and 12.2 per cent in 2020 (ATO, 2022b), respectively. This decline in active transport can be largely attributed to urban planning practices that prioritize personal vehicle use, making private vehicle use the easiest and safest option for accessing services, irrespective of journey length.

2.2.2.2. Current status of sustainable urban transport in Asia and the Pacific

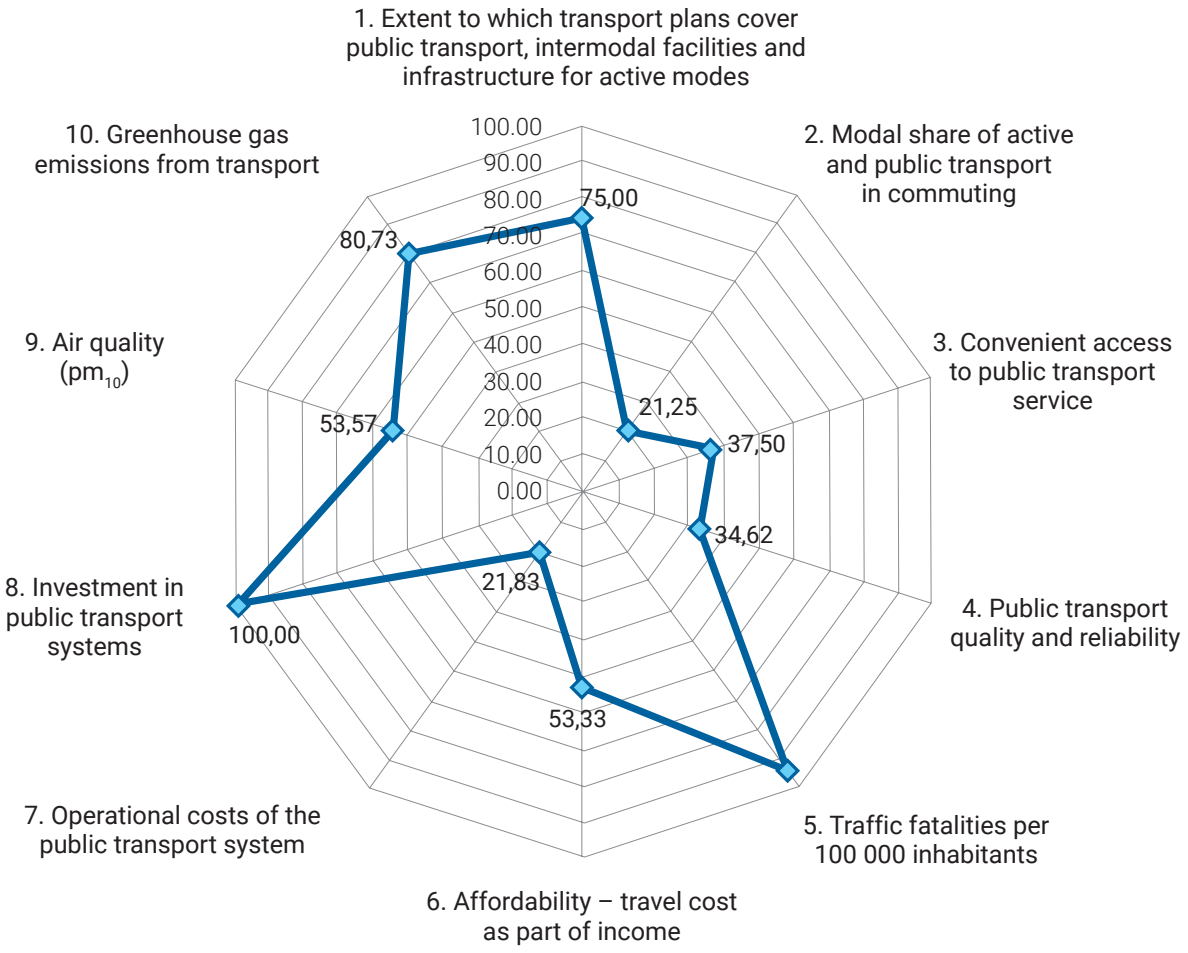
The ESCAP Sustainable Urban Transport Index (SUTI), which is an EXCEL-based tool that can help summarize, track and compare the performance of sustainable urban transport systems in cities, uses a framework of ten indicators (table 2.2) to assess the social, economic and environmental dimensions of sustainable urban transport systems and services in cities across the Asia-Pacific region (ESCAP, 2022d).

Table 2.2. ESCAP sustainable urban transport index indicators

No.	Indicator	Measurement	A-S-I Strategy
1	Extent to which transport plans cover public transport, Intermadal facilities, and infrastructure for active modes	0-16 scale	Shift
2	Modal share of active and public transport in commuting	Per cent of trip/ mode share	Shift
3	Convenient access to public transport service	Per cent of the population	Shift
4	Public transport quality and reliability	Per cent satisfied	Shift
5	Traffic fatalities per 100,000 inhabitants	No. of fatalities	Improve
6	Affordability—travel costs as part of income	Per cent of income	Improve
7	Operational costs of the public transport systems	Cost recovery ratio	Shift/ Improve
8	Investment in public transport systems	Per cent of total investment	Shift
9	Air quality (PM_{10})	ug/m^3	Avoid/Shift/ Improve
10	Greenhouse gas emissions from transport	Tons	Avoid/Shift/ Improve

Once the indicators have been calculated for a city, they are plotted onto a spider diagramme, whereby each "corner" represents one of the ten indicators, and the rings show the levels of performance for that indicator, from minimum score (center) to maximum score (outer rim) (figure 2.31). Indicators on different scales are normalized and the performance of each indicator is compared on a scale of 1-100. SUTI is derived by geometric aggregation of ten indicators, based on equal weighting. This enables city planners to immediately observe areas where it performs well. The index has already been implemented in nearly 30 cities across all subregions of Asia and the Pacific.

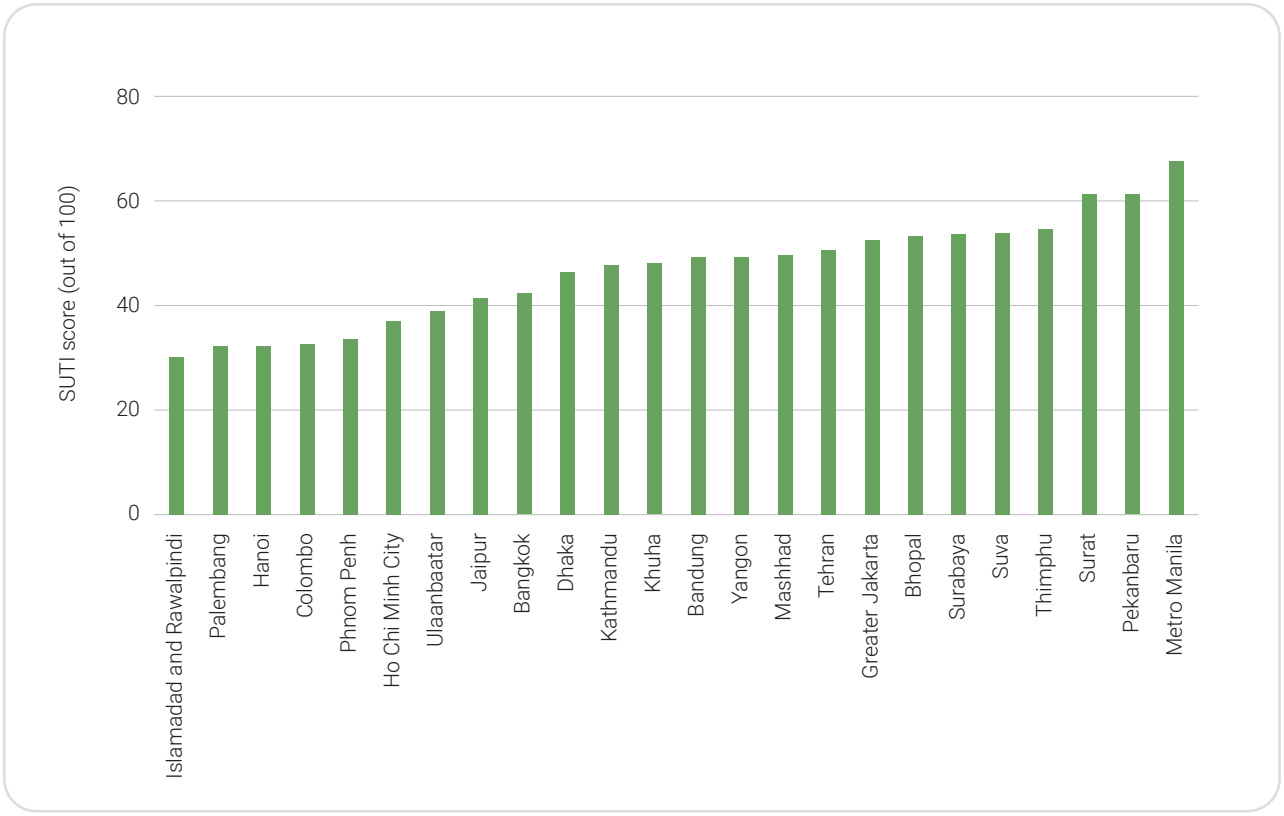
Figure 2.31. Example of a Sustainable Urban Transport Index spider diagramme reflecting all ten sustainable urban transport indicators



Source: ESCAP (2022d).

Across 24 cities in the region, the average SUTI score is 46. The scores range from 30 for Islamabad and Rawalpindi to 67 for Metro Manila (figure 2.32).

Figure 2.32. Sustainable Urban Transport Index scores for selected Asia-Pacific cities

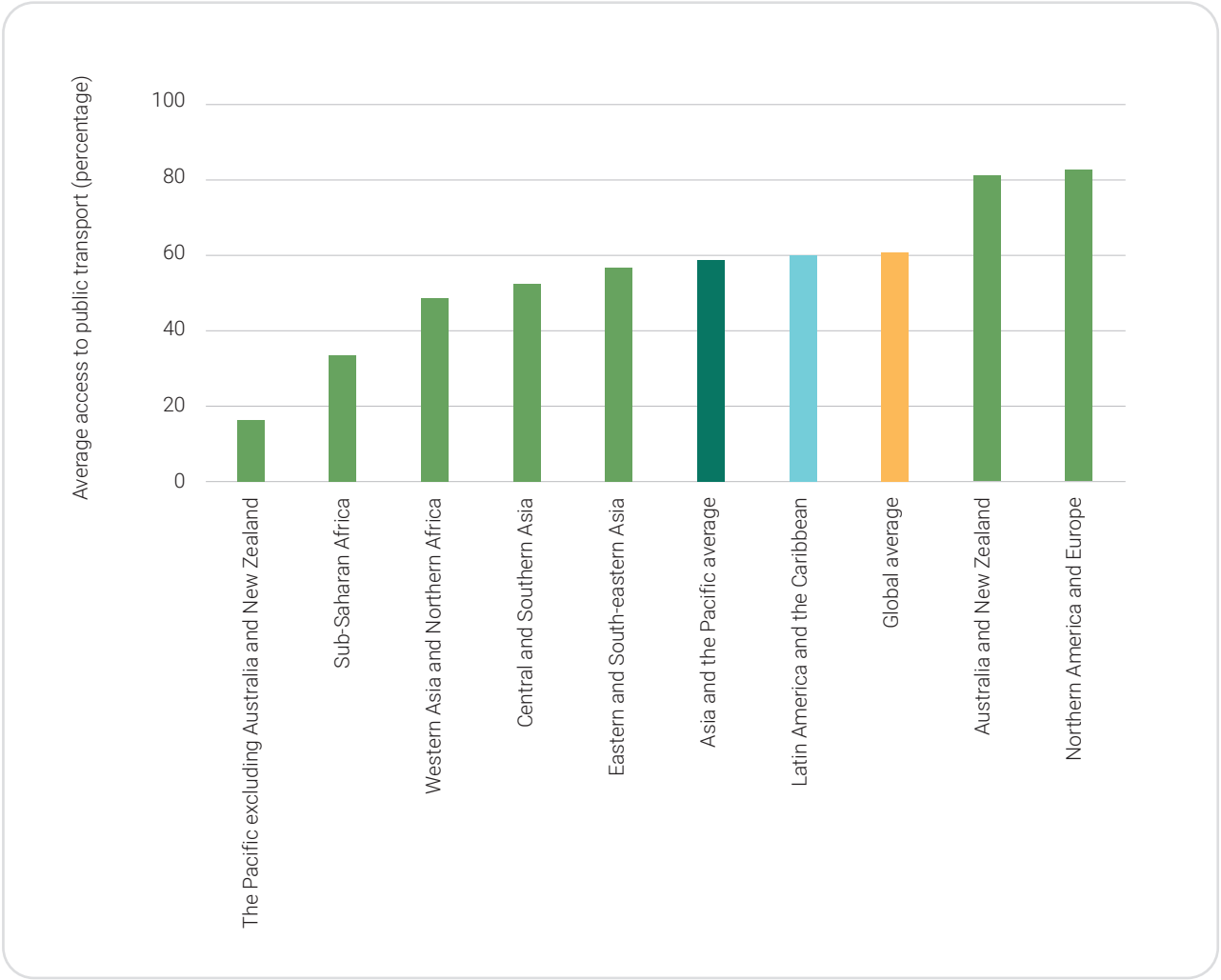


Source: ESCAP (2022d).

Accessibility

Sustainable Development Goal 11, target 2 aims "to 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". Progress towards reaching this target is measured by the proportion of the population that has convenient access to public transport (indicator 11.2.1). For this indicator, public transport is considered convenient for those living within 500 metres (for low-capacity public transport systems) and 1,000 metres (for high-capacity public transport systems) walkable distance of the nearest stop. According to the latest data on indicator 11.2.1, as collected by the United Nations Human Settlements Programme (UN-Habitat), the Asia-Pacific region is at the same level as the global average of 61 per cent for access to public transport – with a regional average of 59 per cent (figure 2.33).

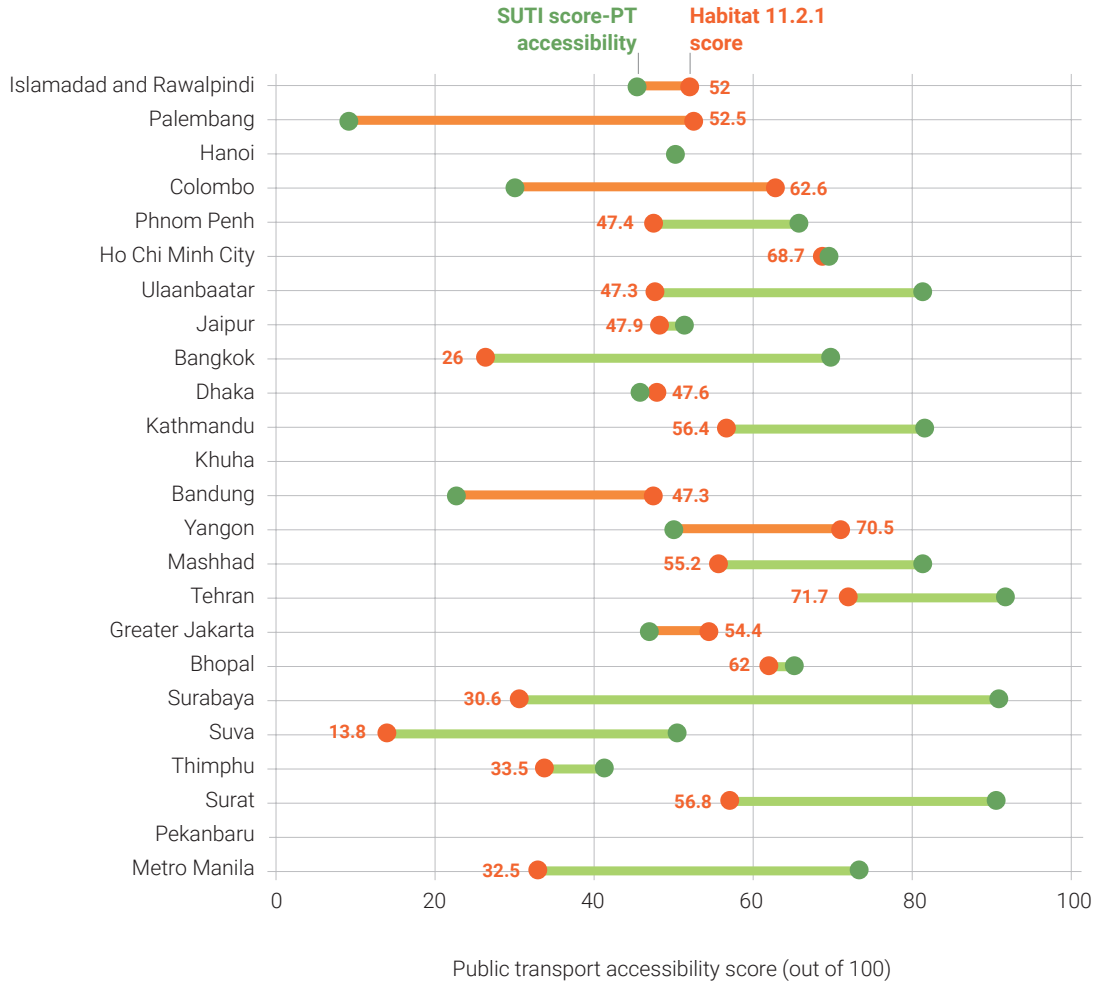
Figure 2.33. Regional average access to public transport



Source: UN-Habitat (2024).

The difference between the reporting of formal and informal transport use might account for the discrepancy between the SDG 11.2.1 indicator data and the data on convenient access to public transport collected under SUTI (figure 2.34).

Figure 2.34. Comparison of Sustainable Urban Transport Index indicator vs. Sustainable Development Goals indicator 11.2.1 for selected Asia-Pacific cities

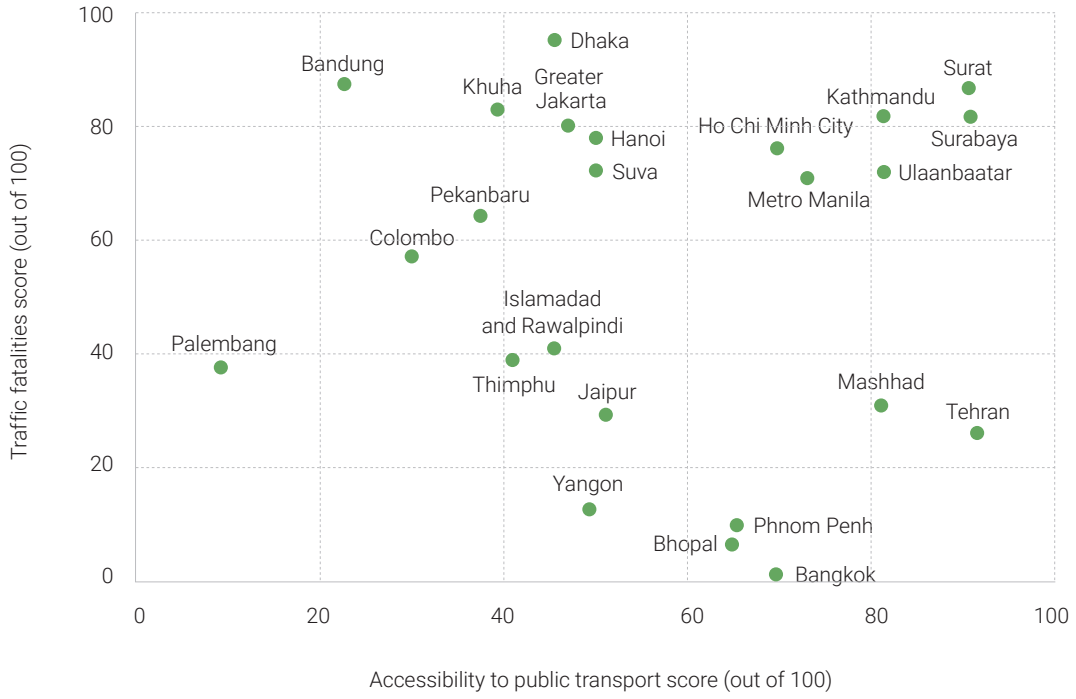


Sources: ESCAP (2022d) and UN-Habitat (2024).

Though convenient access to public transport per se is an insufficient measure to determine overall urban transport sustainability, it remains a critical indicator in relation to which conclusions can be drawn about various urban transport challenges. For example, it highlights the first- and last-mile problem, commonly discussed in the literature, which refers to the difficulties urban commuters face when travelling between public transport stops and the origin or final destination of their journey. Informal transport modes, such as communal for-hire vehicles and motorbikes that travel along smaller routes branching out from main transport hubs, are quite common across the region and play a vital role in providing low-cost mobility services to a large number of people between points that are not served, or are inefficiently served, by public transport. On the one hand, this effectively addresses the accessibility concern, as highlighted in earlier sections. However, a comparison of SUTI indicators suggests that

cities with a two and three-wheeler based informal transport system tend to score highly in the index on accessibility to public transport but report a high number of traffic fatalities (figure 2.35).

Figure 2.35. Accessibility to public transport and traffic fatalities in 24 Asia-Pacific cities



Sources: ESCAP (2022d)
Note: Based on the Sustainable Urban Transport Index data collected by ESCAP

First- and last-mile access problems are thought to occur primarily when origins and destinations lie outside the distance an individual is typically willing to walk to or from public transport. Solving the first and last mile access can increase public transport ridership and ultimately reduce transport emissions. Analysis of the Sustainable Urban Transport Index suggests that higher investment in public transport can support higher modal shares of public and active transport, although the correlation is weak (figure 2.36).

Out of the 24 cities analysed, Dhaka, Mashhad and Metro Manila have a high score for the modal shares of active and public transport and investments in public transport. On the other hand, Bangkok, Greater Jakarta and Surabaya defy the trend. These three cities have high investments in public transport (almost a score of 100), but a low score for the modal share of active and public transport, which implies the need for complementing policies.

Figure 2.36. Correlation between investment in public transport and modal share of active and public transport

Source: ESCAP (2022d).

Improved access to public transport, including for women, older persons and persons with disabilities, would expectedly have significant domino effects on the uptake of active mobility and could contribute towards reducing reliance on private motorized transport. It would, therefore, also have a positive effect on decarbonization efforts. Coupled with bus electrification and increases in urban rail, the decarbonization potential for Asia-Pacific cities can be quite significant.

Electrification of urban transport

The Intergovernmental Panel on Climate Change views the electrification of road transport vehicles as a powerful low-carbon transport strategy. While e-mobility scale-up goals and strategies are already in place in many countries or included in submitted nationally determined contributions, many implementation challenges and barriers remain in the region.

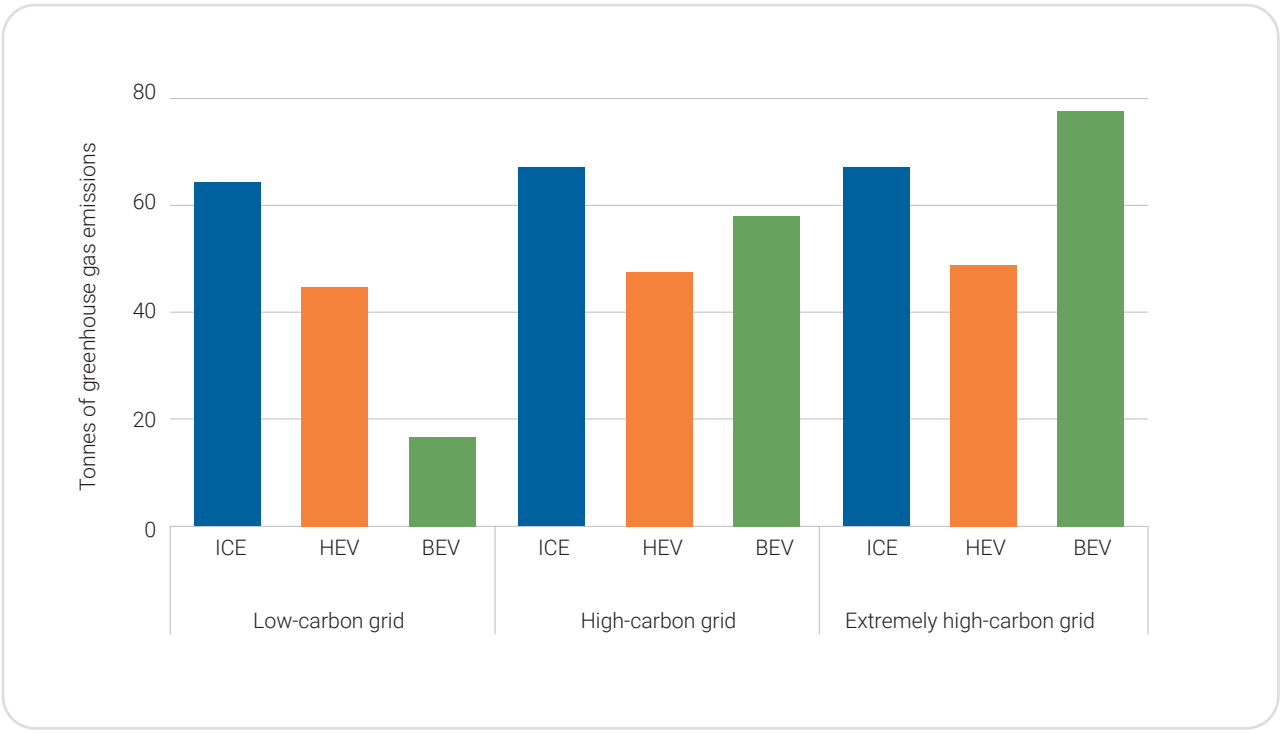
There are nearly 700,000 electric buses worldwide, 95 per cent of which are in China (IEA, 2022). In Thailand, registrations of electric buses increased by 709 per cent from 2017 to 2022 (ESCAP, 2023d), while India has supported the deployment of 5,600 electric buses in 64 cities under the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme. In Moscow, only electric buses are being purchased to add to the 1,000 currently in operation (Green Car Congress, 2021). ADB plans to assist Davao City, Philippines, with a loan to procure 380 electric buses as part of a wider pilot for overhauling

the country's public transport system and reduce greenhouse emissions from public transport in the city by 60 per cent (ADB, 2023).

However, barriers persist, namely substantial upfront costs, vehicle availability and operational constraints. The availability of charging infrastructure presents numerous challenges. Of the 1.8 million public electric vehicle chargers worldwide, 83 per cent of them are concentrated in China, the Republic of Korea, the United States, the Netherlands and France (Chiang and Grütter, 2023). This issue becomes more pronounced in the context of electric buses, which necessitate higher capacity chargers.

Furthermore, the environmental impact of electric vehicles depends on the carbon intensity of the energy grid, necessitating the use of cleaner, renewable energy in the Asia-Pacific region, which currently relies on coal for 57 per cent of electricity generation. In countries with low-carbon intensities that use renewable resources, electric buses could reduce well-to-wheel greenhouse gas emissions by 80 per cent compared to internal combustion engine buses. However, in countries with the highest carbon intensities that depend on fossil fuels for electricity generation, battery electric vehicle buses could increase greenhouse gas emissions by 16 per cent (figure 2.37) (Eichberger, 2021). The adoption of electric vehicles is estimated to increase global electricity demand by 5.2 per cent in 2040; this emphasizes the need to support the electric vehicle transition with renewable sources (BloombergNEF, 2020), especially in countries that already have an abundant supply of renewable energy.

Figure 2.37. Life-cycle emissions by grid carbon intensity (tonnes of greenhouse gas emissions)



Source: Eichberger (2021).

Notes: ICE, internal combustion engine; HEV, hybrid electric vehicle; BEV, battery electric vehicle

The transition to electric mobility can yield benefits beyond just public buses. For example, India, Thailand and Indonesia are the largest micro e-mobility markets with the highest numbers of two-wheeler electric vehicle sales. Proactively integrating these small electric vehicles as feeders into electric mass transit, where feasible, can promote the shift from private cars and bolster the role of public transport as the backbone of the urban mobility system through broader first and last mile coverage, while simultaneously meeting digitalization, accessibility and inclusion objectives.

Often, public transport stops and stations are not the final destination and active modes, such as walking, cycling and micro-mobility modes have the potential to complete the trip. To complement public transport with active mobility, the public transport stops must also be appealing. Ensuring accessible and safe first- and last-mile transport (walking and cycling) routes requires infrastructure designed with cyclists and pedestrians in mind. This entails, for example, sidewalks and bus stops without hazardous crossings or obstacles due to inadequate infrastructure. Stations and bus stops should provide a pleasant, socially and physically secure environment. To encourage the use of bicycles and micro-mobility vehicles, such as electric scooters or electric bicycles to a public transport station or bus stop, it is crucial to provide adequate and safe parking facilities for all types of vehicles (Ohlund and others, 2021).

2.3. SOCIAL SUSTAINABILITY

This section presents the social sustainability of transport, linking to SDG 3: Ensure healthy lives and promote well-being for all at all ages, specifically target 3.6 on halving the number of global deaths and injuries from road traffic accidents and SDG 5: Achieve gender equality and empower all women and girls, focusing on improving gender equality in the transport sector through greater social inclusion. Emerging trends and priorities relevant to these two Goals are discussed.

2.3.1. Review of road safety in Asia and the Pacific

In recent years, road safety has moved from being perceived as a "transport" or "health" problem to being recognized as a critical development issue with wide-reaching implications for sustainable development. Not only do road crashes cause extensive human suffering and other social problems, as noted in Section 1.4.4 above, but they also result in tangible economic losses to victims, families and nations. According to the World Health Organization (WHO), an estimated 1.19 million fatalities globally in 2021 were due to road traffic crashes (WHO, 2023a), with an estimated 92 per cent of these deaths occurring in low- and middle-income countries. Notably, this figure is projected to rise to 500 million fatalities over the next decade (WHO, 2021b).

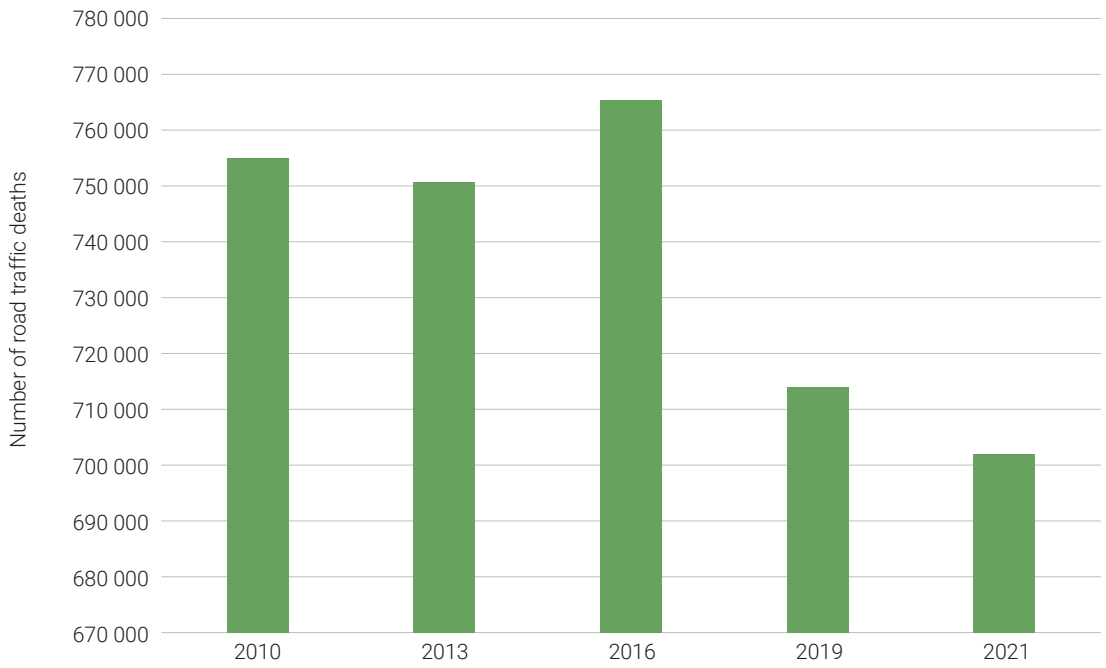
These trends have led the international community to include road safety in SDG 3 to "Ensure healthy lives and promote well-being for all at all ages" with target 3.6 explicitly calling for the number of global deaths and injuries from road traffic crashes to be halved by 2030. This target was reaffirmed in 2023 during which the General Assembly in its resolution 74/299 proclaimed the period 2021–2030 as the Second Decade of Action for Road Safety. SDG 11 "Make cities and human settlements inclusive, safe, resilient and sustainable" also refers to road safety in its target SDG 11.2. The multi-faceted impacts of road safety suggest that improving road safety can also support the achievement of other goals, such as SDG 1 (No poverty) by reducing the economic burden of road traffic injuries on families and

communities, and SDG 13 (Climate action) by promoting sustainable transport solutions that reduce emissions and improve air quality.

2.3.1.1. Status of road safety in Asia and the Pacific

The Asia-Pacific region accounts for approximately 59 per cent of global road traffic deaths. While recent trends suggest that the absolute number of fatalities has been trending lower since 2016 (figure 2.38), the COVID-19 pandemic caused so many disruptions to transport systems around the world that it is difficult to conclude whether this trend is continuing or has been reversed.

Figure 2.38. Total number of road traffic deaths in the Asia-Pacific region (2010–2021)



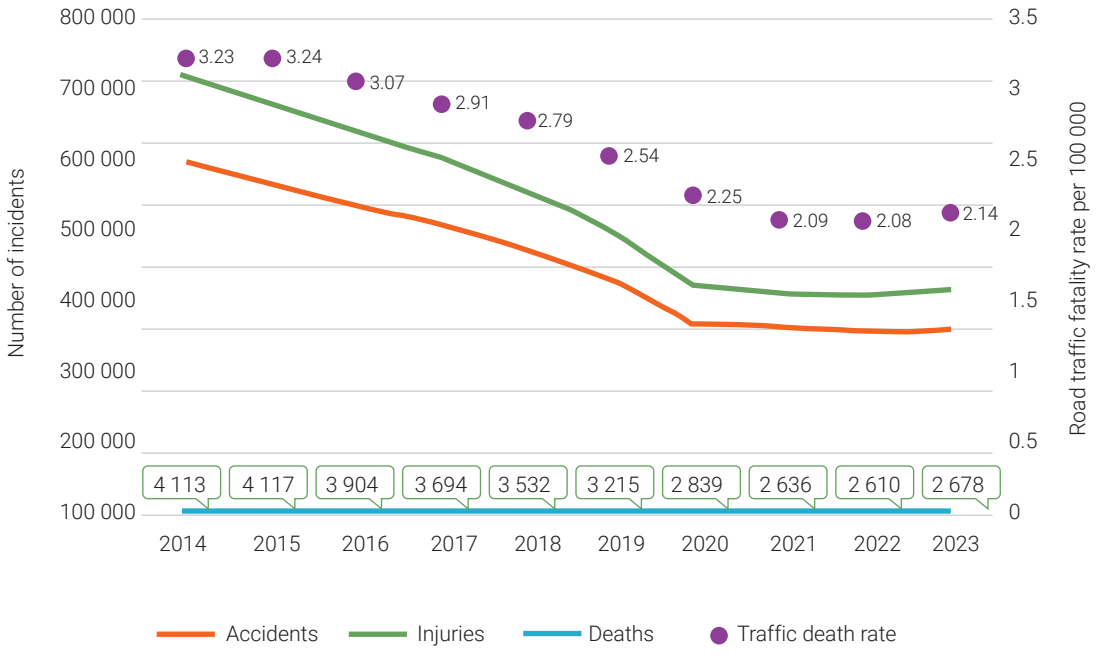
Source: WHO (2024).

On the one hand, travel restrictions during the COVID-19 pandemic had a downward impact on the number of road traffic fatalities in 2020 and 2021 in most countries. Furthermore, some researchers have predicted that the pandemic would permanently change people's mobility preferences, as well as how societies and markets have organized their economic and social activities (Tirachini and Cats, 2020). For example, researchers had suggested that more people could permanently shift from public to private transport modes, while for others, the work-from-home models had become the norm (at least in cities where workers had good Internet connectivity). However, the data suggest that different countries had experienced different outcomes, so it is too early to conclude what the impacts of the pandemic will be on road safety in the longer-term (box 2.1).

Box 2.1. What were the long-term impacts of the COVID-19 pandemic disruptions on road safety?

During the COVID-19 pandemic, many governments had imposed restrictions on people's movements and activities, while some closed public transport systems altogether. One outcome of these policies was a drop in the number of road traffic crashes. In Japan, for example, road traffic fatalities declined by nearly 12 per cent between 2019 and 2020, more than the 9 per cent between 2018 and 2019, which was significantly more than the 4.4 per cent decline between 2017 and 2018 (figure 2.39). Interestingly, the number of crashes appears to have plateaued since 2020, with only a slight upward tick in 2023, even though most people had resumed their pre-COVID mobility patterns by early 2022.

Figure 2.39. Road safety trends in Japan, 2014–2023



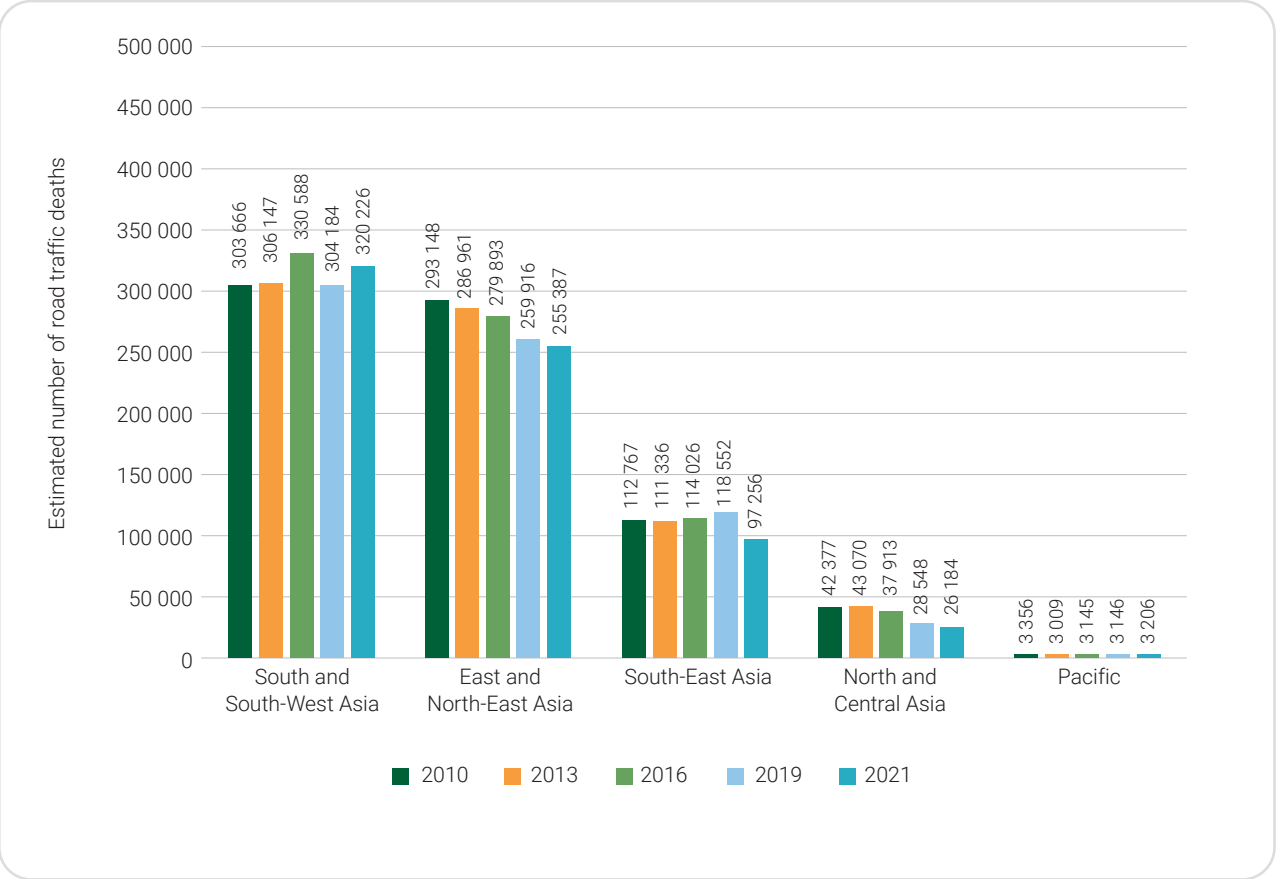
Source: National Police Agency of Japan (n.d.).

On the other hand, government-imposed travel restrictions and fear of getting COVID-19 prompted many consumers to shift from physical shopping to online purchases. This catalysed the spread of courier services in many South-East Asian cities, which may partly explain the surge in road traffic crashes involving two- and three-wheel vehicles in some Asian countries. However, without more data on the number of these vehicles and further analysis, it is difficult to confirm this hypothesis.

Sources: National Police Agency (n.d.); Yamamoto and others (2022).

A breakdown by subregion reveals that in 2021, the highest number of deaths occurred in South and South-West Asia, followed by East and North-East Asia, South-East Asia, North and Central Asia, and the Pacific subregion (figure 2.40).

Figure 2.40. Aggregate number of road traffic deaths, by ESCAP subregion

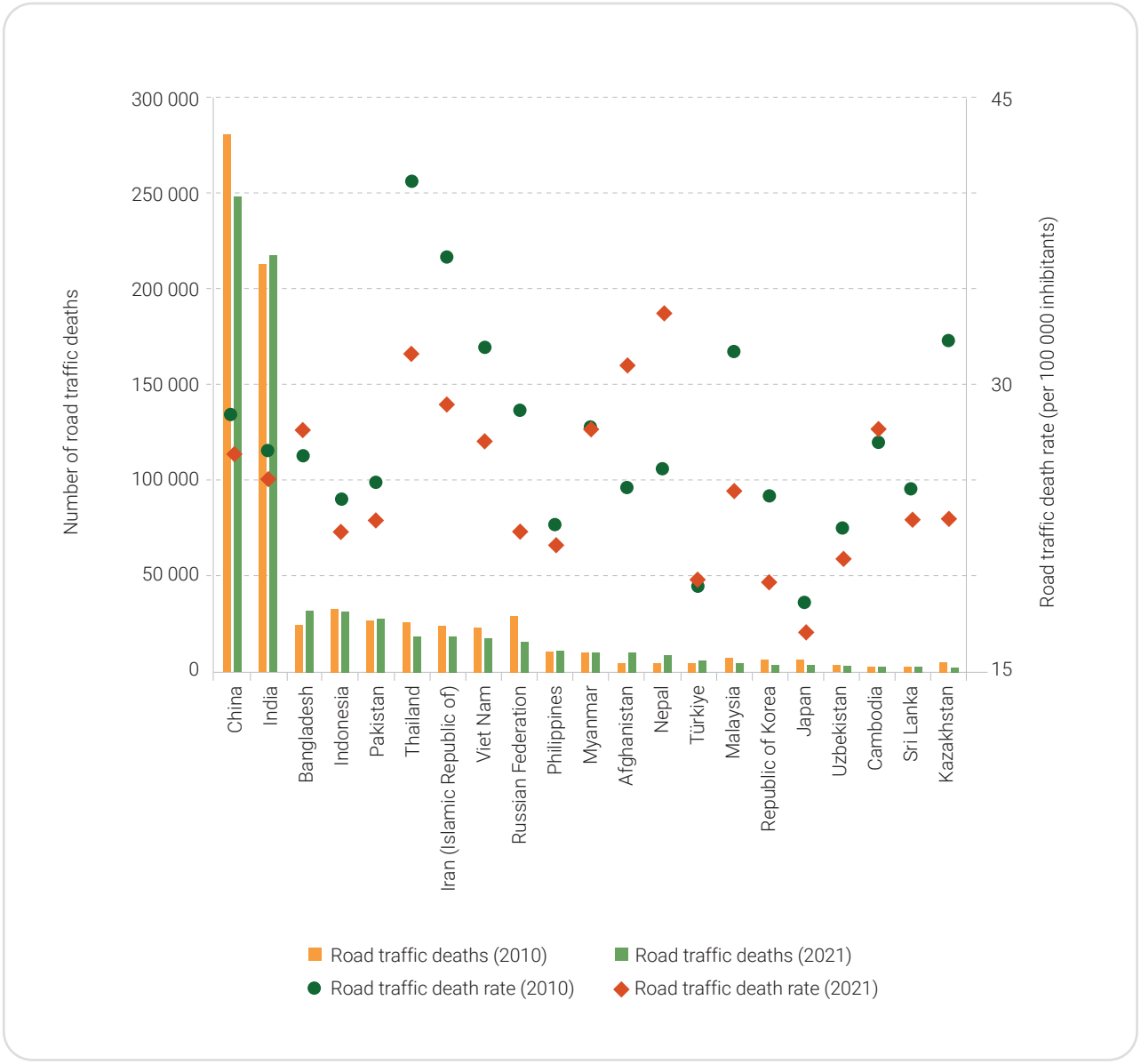


Source: WHO (2024).

In the East and North-East Asia and North and Central Asia subregions, road traffic deaths are trending lower in the South and South-West Asia subregion, the number of road traffic deaths fell in 2019 and rose again in 2021, while in the South-East Asia subregion, they rose gradually and then fell in 2021. However, it is important to note that India (216,618 deaths) and China (248,099 deaths) accounted for roughly 68 per cent and 97 per cent of road traffic deaths in the South and South-West Asia subregion and East and North-East Asia subregion, respectively. In the Pacific subregion, the number of road traffic deaths eased between 2010 and 2021.

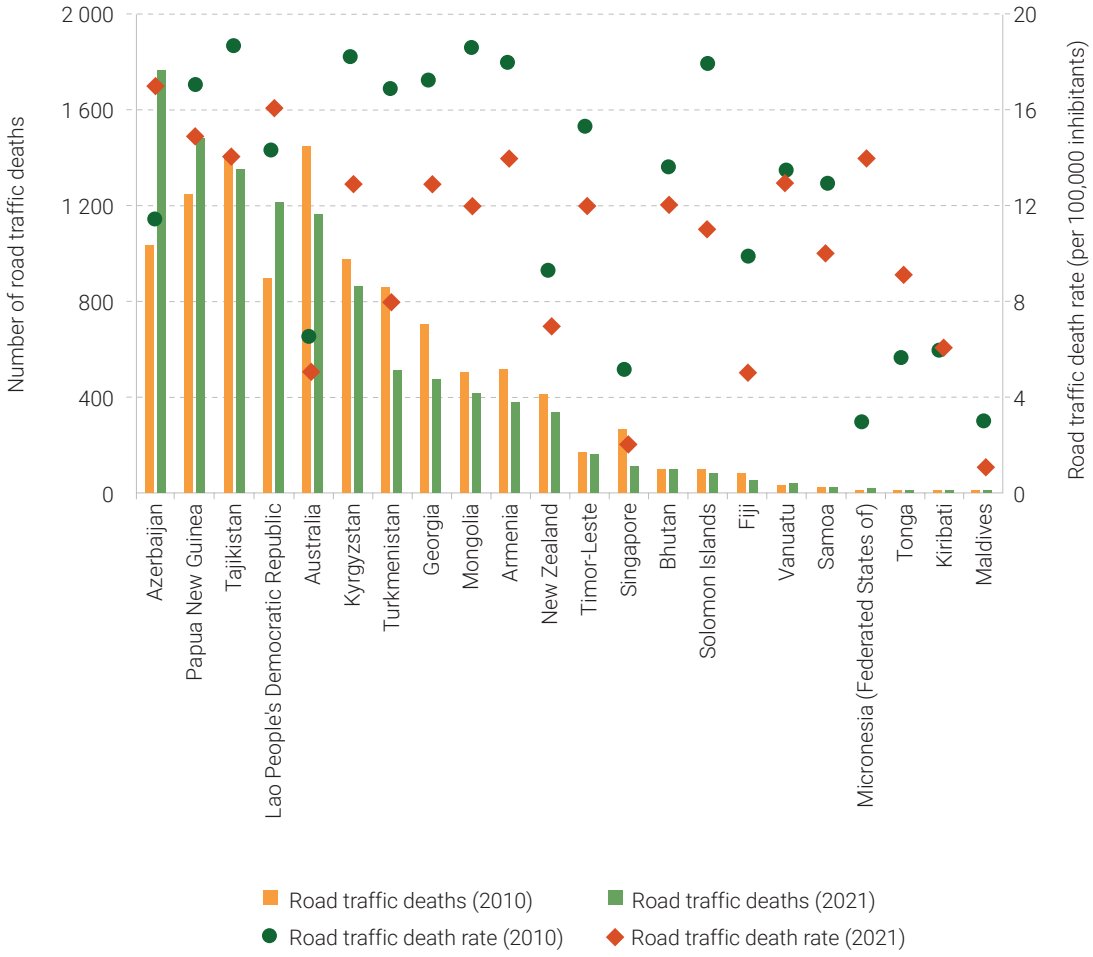
A closer look at individual country data shows more varied trends, with road traffic deaths going down in some countries but increasing in others. Figure 2.41 shows ESCAP member States with more than 2,000 road traffic deaths in 2021, while figure 2.42 shows ESCAP member States that recorded less than 2,000 road traffic deaths in 2021.

Figure 2.41. Road traffic deaths and road traffic death rate per 100,000 inhabitants, 2010 and 2021, in ESCAP member States that recorded more than 2,000 deaths in 2021



Source: WHO (2024).

Figure 2.42. Road traffic deaths and road traffic death rate per 100,000 inhabitants, 2010 and 2021, in ESCAP member States that recorded less than 2,000 road traffic deaths in 2021



Source: WHO (2024).

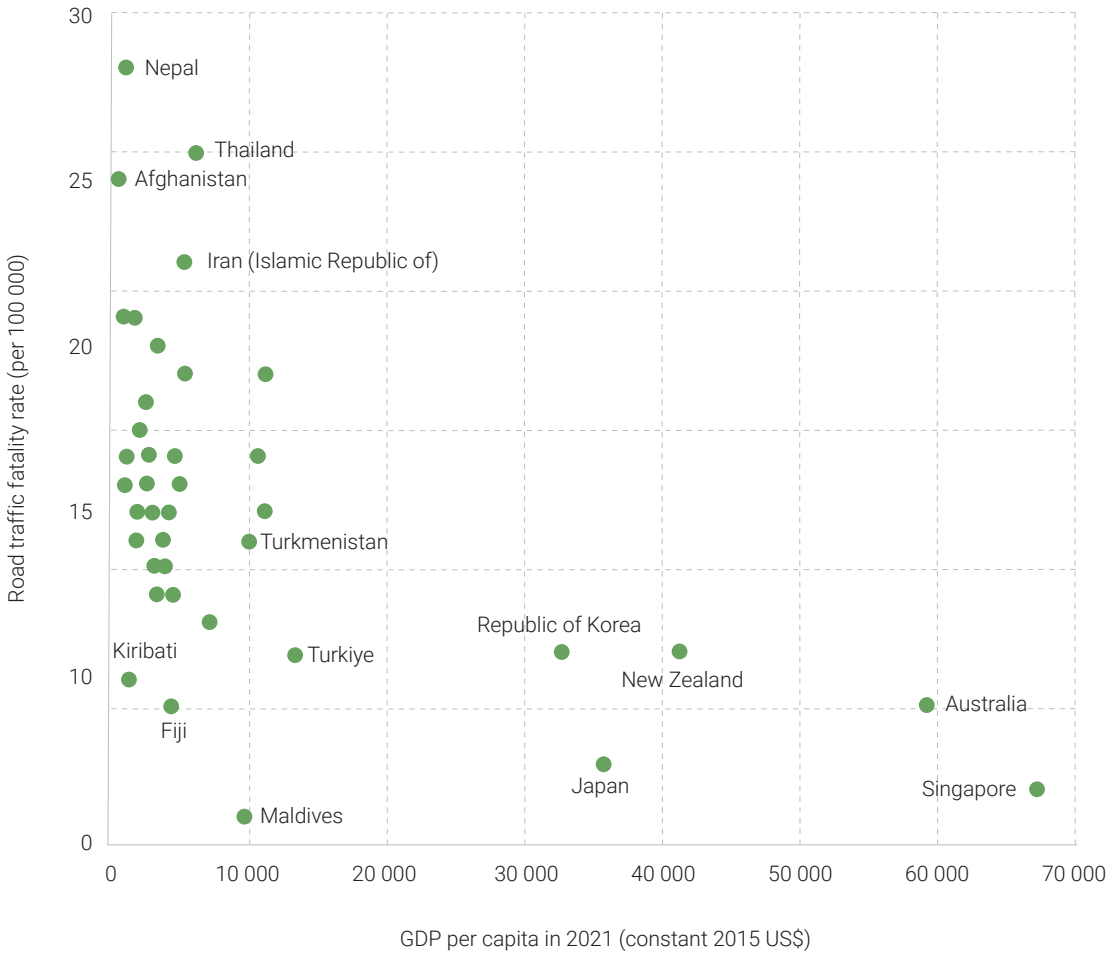
In most countries in the region traffic road deaths (left axis) and the traffic death rate declined between 2010 and 2021 (right axis). Declines in death rates were particularly noticeable in Fiji, the Islamic Republic of Iran, Kazakhstan, Malaysia, Mongolia, the Republic of Korea, the Russian Federation, Solomon Islands, Thailand, Timor-Leste, Turkmenistan and Viet Nam.

2.3.1.2. Emerging issues

A concerning trend across the world, including in the Asia-Pacific region, has been the rising number of road traffic deaths in low- and middle-income countries. However, traffic safety figures

of low- and middle-income countries show a mixed pattern, with some having low death rates (particularly island countries in the Pacific and Maldives) and others reporting very high traffic death rates (figure 2.43). Meanwhile, high-income countries have relatively low road traffic death rates.

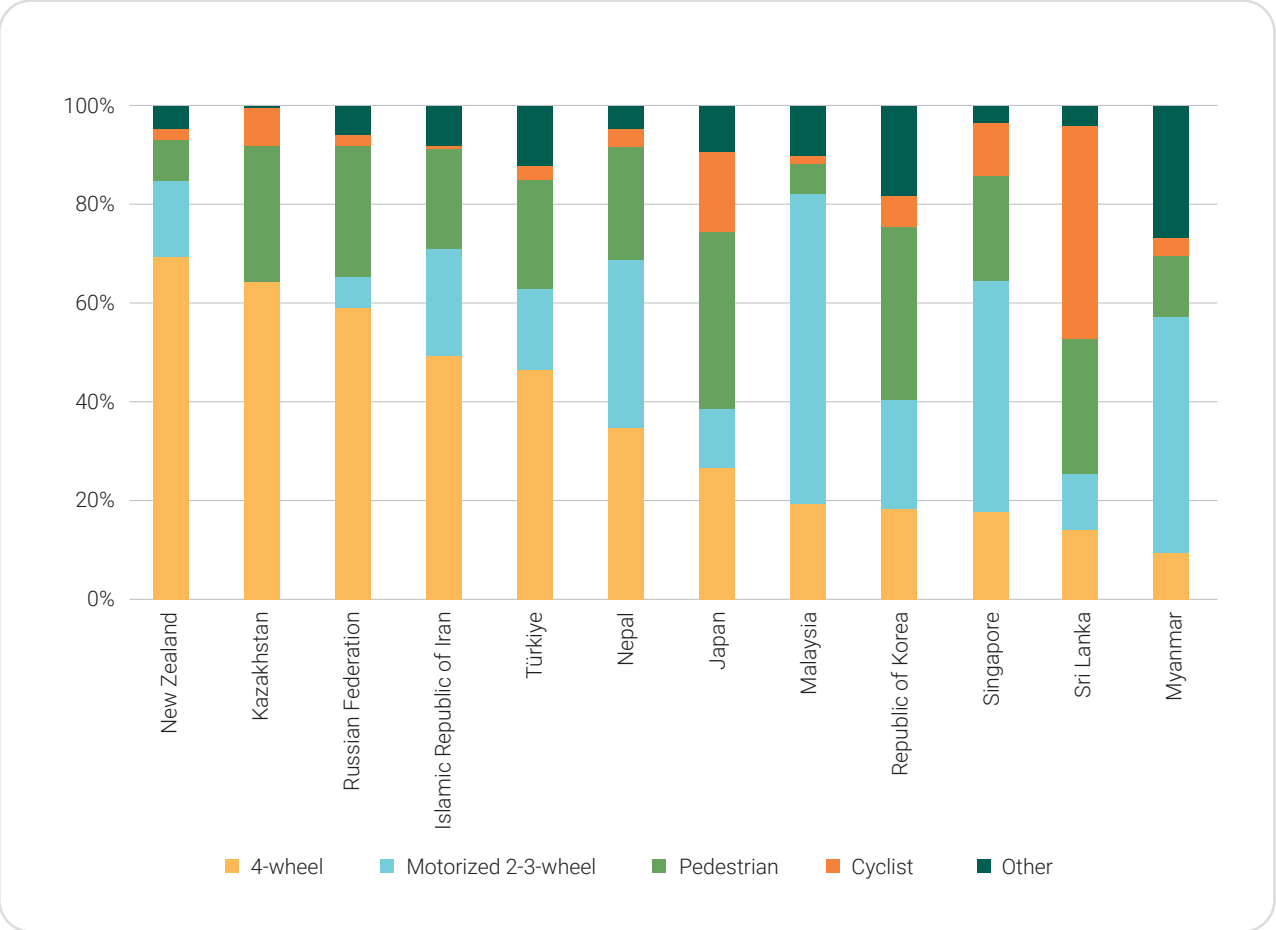
Figure 2.43. Road traffic death rate 2021 (per 100,000) and GDP per capita, 2021 (constant 2015 US dollars)



Sources: WHO (2024); World Bank (2023b).

Meanwhile, more than half of all road traffic deaths globally are among vulnerable road users, including (a) non-motorized road users, such as pedestrians and cyclists, and (b) riders of motorized two- and three-wheelers (WHO, 2023b). Some definitions also include users who are vulnerable due to their degree of mobility, such as young persons, older persons and persons with disabilities or special needs (European Commission, n.d.). Figure 2.44 shows the breakdown of deaths for countries with data on four-wheelers; two-wheelers and three-wheelers: pedestrians; cyclists; and other user groups.

Figure 2.44. Breakdown of traffic road deaths by types of road user in selected countries in Asia and the Pacific



Source: WHO (2021c).

As shown in figure 2.44, two- and three-wheel vehicles account for most road traffic deaths in Malaysia, Myanmar and Singapore, while in Nepal, it accounts for more than one third (34 per cent) of them. Meanwhile, in Thailand, more than 50 per cent of road traffic deaths in 2021 involved two- and three-wheel vehicles.

The spread of new types of technologies in the transport sector is expected to have mixed effects on road safety outcomes. For example, as noted in Section 2.1.2.2 above, the technological advances in "smart mobility" systems can have positive impacts on road safety by removing some of the human errors that contribute to road crashes. This is indeed one of the main drivers for autonomous vehicles. However, the introduction of new technologies is not being matched by amendments to road safety legislation, as noted in section 3.3.1 below regarding changing vehicle safety standards for new types of vehicles.[2]

2 Data for Thailand are not shown in figure 2.48 because official statistics do not give an aggregate number for four-wheel vehicles. Instead, official sources disaggregate data into types of vehicles.

Other major vulnerable road user groups are pedestrians and cyclists. Globally, pedestrian deaths rose 3 per cent and cyclist deaths rose nearly 20 per cent between 2010 and 2021, accounting for almost 25 per cent and 6 per cent of global deaths, respectively (WHO, 2023a). Pedestrians account for close to or more than 50 per cent of traffic-related deaths in Samoa, the Federated States of Micronesia, and Papua New Guinea, and more than 30 per cent of deaths in Fiji, Japan, the Republic of Korea, Mongolia and Armenia. A variety of factors contribute to these trends, such as a lack of segregated pedestrian walkways and population ageing, particularly in high-income countries where the number of traffic incidents involving older persons is on the rise. There have also been more crashes involving distracted pedestrians, giving rise to a new category of "smombies," or smartphone zombie (box 2.2). Focus on equity in road safety will grow as more governments collect disaggregated data and the evidence base on road safety trends for different user groups is strengthened.

Box 2.2. Smartphone-zombies ("smombies") are taking over the world!

While it is already accepted that drivers using mobile phones are more likely to be involved in a crash than drivers not using a mobile phone, pedestrians have become the latest type of distracted road user. Smartphone zombies, or "smombies," is a term used to describe individuals who look at their cell phones while walking in public spaces. This phenomenon has led to a rise in crashes globally, with research finding that pedestrians using mobile phones have reduced situation awareness (Nasar and others, 2008). To stop the spread of "smombies", some cities around the world are taking innovative measures:

1. In June 2020, Yamato became the first municipality in Japan to ban people using their smartphones while walking outside in public places.

2. Authorities in Ilsan, Republic of Korea, installed flickering lights and laser beams at road crossings to alert phone-scrolling pedestrians.

3. Authorities in Chongqing, China, opened a 30m "cellphone lane" on pathways for pedestrians busy on their phones.

4. In Honolulu, Hawaii, a "Distracted Walking Law" was passed under which people caught texting while walking across a crosswalk are fined.

5. Officials in the Dutch town of Bodegraven ran trials of traffic lights that project a red or green lighting strip across the pavements to alert people looking at their mobiles as they crossed the road.

With nearly nine million mobile subscriptions in use worldwide in 2023 (ITU, 2024b), finding innovative solutions to solve the "smombie" challenge is a road safety priority for all countries globally.

Sources: ITU (2024b); Nasar and others (2008).

2.3.2. Gender equality in the transport workforce

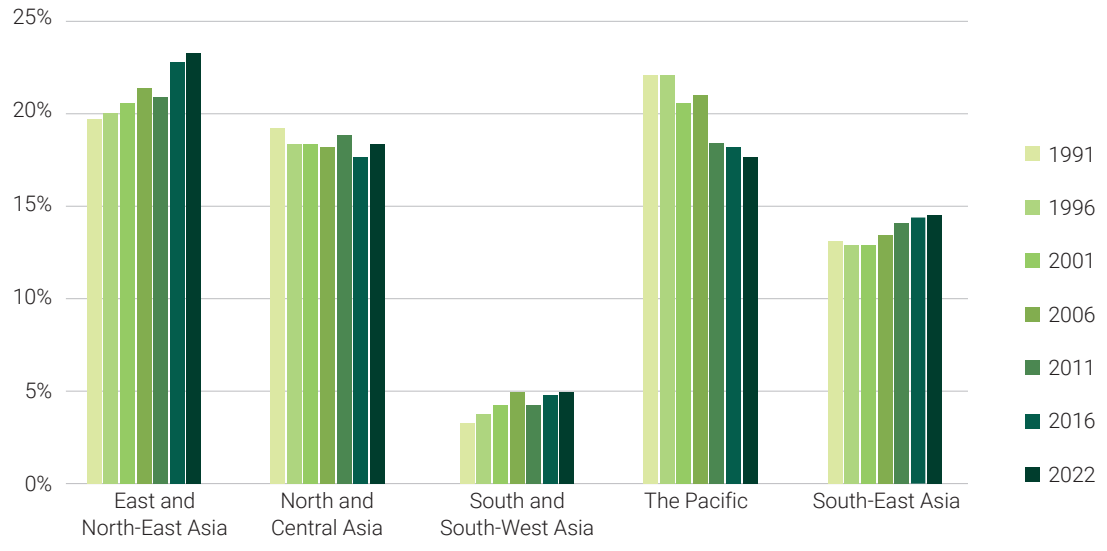
Improvements made in the gender equality of the transport sector will help advance SDG 5 through the inclusion of more women in the transport workforce, which is currently a male-dominated sector. While the sector is working towards achieving a more inclusive workforce, there are still significant barriers for women to enter and remain in the sector. For example, women's rate of labour force participation in both formal and informal transport jobs remains low. Gender occupational segregation is prevalent, and women typically have less income security and job opportunities and work in lower-paid jobs (ILO, 2021).

This section is focused on the development of effective measures that can improve gender equality in the transport workforce.

2.3.2.1. Introduction

Transport is a male-dominated sector with gender gaps at all levels of the workforce; less than 20 per cent of the global transport workforce are women (Ng and Acker, 2020) and an even lower average percentage, 16 per cent in 2022, has been recorded in Asia and the Pacific (figure 2.45).

Figure 2.45. Female share of transport sector employment by subregions in Asia and the Pacific from 1991 to 2022



Source: ILO, 2023.

Countries in South and South-West Asia report the lowest share of women in the transport sector across all five ESCAP subregions (figure 2.45), while East and North-East Asia show the highest share with an increasing trend, unlike the Pacific, where the share of women in the transport workforce is declining.

To achieve greater levels of gender equality in the transport workforce, women need to be encouraged to actively participate in all stages of transport policy design, planning, implementation and construction to make transport more compatible with social inclusion and low carbon transition goals. This can be done through education and training, hiring and retainment of women in the transport workforce, as well as through changes in existing social or cultural perceptions (Ng and Acker, 2018). The vicious circle of under representation and perpetuation of stereotypes encourages even less women to be attracted and apply for jobs in the field (Turnbull, 2013). In addition, women in the sector often find themselves stuck in jobs that are low- or lower-paid or have a low or lower status relative to men, with few if any opportunities for career development (ILO, 2019a).

The sector needs more women at all levels, including in the design of public transport services, the construction of infrastructure and its maintenance and in the evaluation of policies (Wright, 2018). Including more women in the transport workforce will allow a more inclusive approach and thus better accessibility for female users and other social groups. In addition, women are more likely to support changes in transport behaviour and in the adoption of sustainable solutions (Pirra and others, 2021).

As the transport sector transitions to a digital, automated and a low-carbon future, valuable opportunities will open up to mainstream gender by promoting women's employment in new types of jobs, while the shift to electric vehicles will necessitate more researchers, scientists, and technicians in fields, such as battery technology and power electronics (Pek, 2019). As many countries in Asia and the Pacific have a higher proportion of women working or studying in the science, technology, engineering and mathematics (STEM) fields than the global average (UNESCO, 2020), women will likely comprise more of this future workforce. It is also important that State-run transport services reflect the societies they serve (Nolan-Flecha, 2019). In this sense, the Organisation for Economic Co-operation and Development (OECD) states that women employees result in more interventions that are inclusive and responsive to citizen's needs (OECD, 2023). This could result in inclusive transport designs and accessible transport corridors between workplaces and schools, which could increase women's uptake of transport services and enable their participation in economic and social opportunities that support peace and development more broadly (Begzsuren, 2023).

2.3.2.2. Case study: addressing the gender gap in the public transport workforce

Background

A comparative analysis of women in the public transport workforce was conducted for Azerbaijan, the Lao People's Democratic Republic, Mongolia and Nepal to highlight key trends and policy priorities in the region.

In 2017, the Government of Azerbaijan established that the transport workforce was 16 per cent female. For the Lao People's Democratic Republic, generally females occupy the lower strata of the labour market. In Mongolia, women made up 15.5 percent of the transport workforce in 2017 and their wages

were almost identical to those of men (ILO, 2022a). Nepal had made progress in gender equality in the transport sector, as shown by the increasing number of women in the workforce rising from 3.6 per cent in 1999 (Turnbull, 2013) to 11.1 per cent in 2013, when at least one-third of the public transport users in Kathmandu were women (World Bank, 2013).

The four countries all show gender inequality in transport engagement. Nepal had the greatest gender gap, where the number of women participating was as low as 9.31 per cent compared to the total employment in the transport sector, followed by the Lao People's Democratic Republic where women accounted for 16.35 per cent of the transport workforce (ILO, 2022b). There is little difference in the proportion of women in the transport sector in Azerbaijan and Mongolia, at 23.1 per cent and 22.5 per cent, respectively, but Azerbaijan had three times as many women in the labour force as Mongolia.

Nepal is making progress in mainstreaming gender and social inclusion in the rural transport sector. Nepal ratified the Convention on the Elimination of all Forms of Discrimination Against Women in 1991 and the Optional Protocol to the Convention in 2007. The Nepal national strategy also lists gender equality in transport services as one of its objectives (Sharda and Sabu, 2021). In the Lao People's Democratic Republic, the National Commission for the Advancement of Women was established in 2003. The Commission is responsible for implementing the Strategy for the Advancement of Women, which sets out gender-related objectives and targets for each sector. This has led to gender-sensitive planning and the country's first strategy for the advancement of women in the transport sector. The number of women employees has increased, even in decision-making positions (ADB, 2016). In 2012, a workshop funded by ADB held in the Mekong subregion in which the Lao People's Democratic Republic was a participant, promoted action by ministries of transport on gender (ADB and World Bank, 2012). Gender mainstreaming activities in some government-implemented rural transport projects have also transformed the lives of rural women (Wise Nepal, 2018). In another Nepalese project, women working in the road improvement job were also included in the policy evaluation (Sharda and Sabu, 2021).

In Mongolia, the Government has introduced policies in sectors in which women are underrepresented, such as transport (Khan and Aslam, 2013). At least 30 per cent of the jobs generated must be filled by women in bus operating companies where women can be drivers, hold positions at stations or be supervisors (ADB, 2013). In Nepal, an inclusion project has allowed some women to take on important roles in which they have performed as well as men. They were paid the same and delays due to unpaid care work could be justified with their employers. To ensure that their wives could earn more money, some husbands (less than 5 per cent) began to help their wives with household tasks (Sharda and Sabu, 2021), highlighting the significance of unpaid care work as a barrier for women to enter or fully participate in the workforce. Finally, in the Lao People's Democratic Republic, the Ministry of Public Works and Transport Community Road Model Implementation Guidelines (2005) advocated mixed-gender meetings and required villages to include at least one woman in their maintenance committees to ensure that women have a consistent voice in decisions and participate in road maintenance (ADB, 2012).

The first long-term goal is access to education for equal opportunity. In the Lao People's Democratic Republic, policies to reduce disparities in access to professional training are key opportunities for women. In Nepal, some of the women who have received training recognize its value for income

generation (Hada, 2020). The second long-term goal is equal pay. Accordingly, some men encourage women in their households to participate in road work, especially in poorer families. This income improves their status and self-confidence, and they can use their money independently, which allows them to be part of the family's decision-making on everyday purchases. Women are also attracted by the flexibility that driving for ride-hailing services can offer (Wright, 2018), which serves as an economic opportunity.

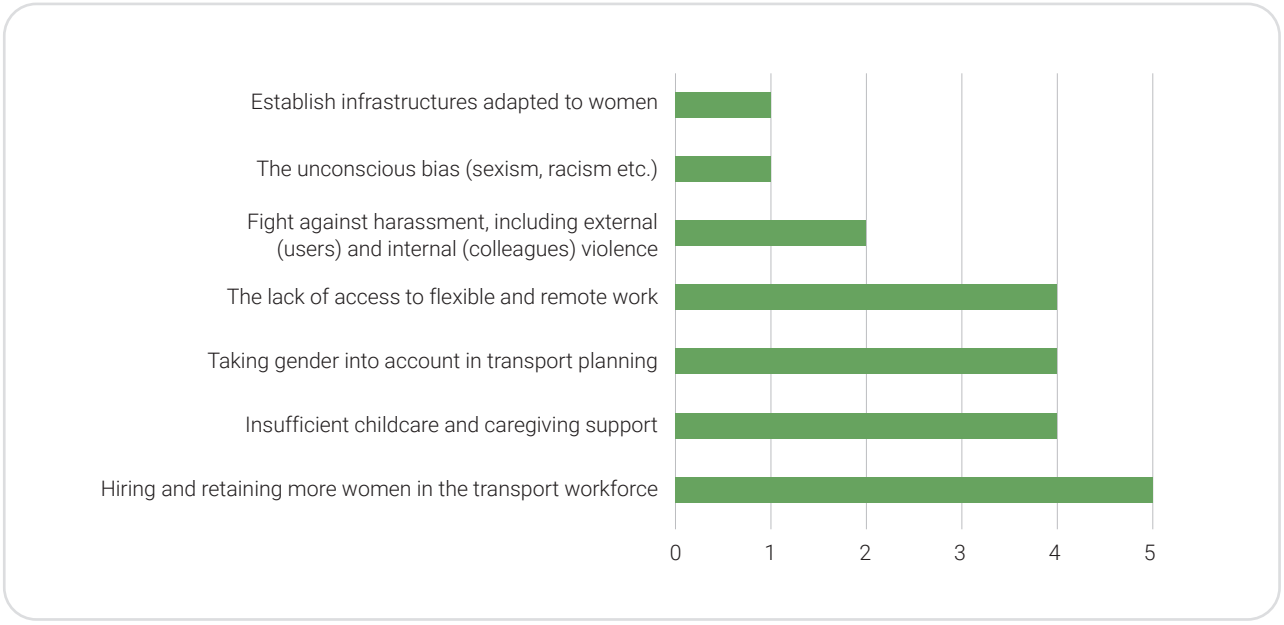
Survey analysis

A survey was conducted among transport ministries of Azerbaijan, the Lao People's Democratic Republic, Mongolia and Nepal to better understand the challenges and relevant policies that have been implemented to improve gender equality in the transport workforce, specifically public transport. The questionnaire was divided into three sections, namely transport and gender policies, transport data, and challenges and actions on gender equality.

The survey results show that while safety and security are a common priority, along with tackling local air pollution and congestion, inclusive transport is less so. Only Nepal stated that it was putting in place policies to improve employees' welfare in the public transport workforce, giving examples of relevant ones, such as implementing mandatory insurance of the employees (the Vehicle and Transport Management Act) and guaranteeing a minimum wage (the Labour Act).

Azerbaijan, the Lao People's Democratic Republic, Mongolia and Nepal also identified main challenges as barriers to realizing SDG 5 to achieve gender equality and empower all women and girls, as shown in figure 2.46.

Figure 2.46. Main challenges identified as barriers to achieving Sustainable Development Goal 5 by Azerbaijan, the Lao People's Democratic Republic, Mongolia, and Nepal



The greatest challenge for the respondents is to hire and retain more women in the transport workforce, reflecting the current gender inequality in the sector. Nevertheless, some gender equality policies have been implemented. For example, the Ministry of Road and Transport Development of Mongolia has established a subsidiary council on gender equality, in accordance with the Law on Women's Representation, which requires that the ratio of 40:60 for all employees to be met. Azerbaijan has also made progress in transport workforce gender equality through a series of beneficial policies, including the provision of a 50 per cent grant for graduate school tuition to women workers, policy-mandated flexibility for women with children under the age of three or on maternity leave, and exemption from public transport duty schedule in the weekends and on holidays.

Box 2.3. Labour shortage in maritime transport

Recently, seafarer shortages have been increasing at the global level, which presents an opportunity to close the gender gap in the maritime transport workforce by making full use of the labour force available and recruiting and retaining more women, while providing equal training and career advancement opportunities for women (ILO, 2019b). The shortage of officers in the shipping industry is worsening. According to the Drewry's manning annual review and forecast 2023/2024 (2023), as of 2023, the demand for officers in the global shipping market is 705,000, but the actual supply is 648,000, and the supply-to-demand ratio of officer is approximately 91 per cent, down 4 percentage points from the computation made in the previous year. The officer shortage rate was balanced in 2019, but it began to increase after the COVID-19 pandemic, reaching 9 per cent in 2023. This is because even though demand for seafarers has increased, especially for container ships, the supply of seafarers has not reached this level.

The reason behind the worsening of this seafarer shortage is not only because crew training has been disrupted due to the pandemic, but also because the isolation from society caused by boarding has reduced the attractiveness of this job. Welfare is being emphasized in the seafarer labour market rather than wages, which had been one of the key factors in the attractiveness of seafarers' jobs, and communication facilities and convenience facilities that enable smooth contact with family, as well as a cooperative work environment, have become important.

The shortage of high-quality seafarers at the officer level, who are typically licensed individuals with specific responsibilities and authority, is more severe than those of ratings, who are skilled but non-officer crew members supporting a ship's operations under the direction of the officers, because not only do the education and training of these officers take a relatively longer period, but these personnel have more opportunities to transfer to a land operation. In addition to the shortage of seafarers, the ageing of seafarers, limited female workforce participation, lack of training and education to operate high-tech ships, and disconnection from the family and society are also continuing challenges to the shipping industry and the seafarer labour market.

Box 2.3. Labour shortage in maritime transport (cont.)

While the automation of ships may reduce some of the demand for traditional seafarer roles, future demand for skilled and certified seafarers is likely to remain strong due to a number of interrelated factors, including the need for expertise in advanced technology systems, compliance with evolving maritime regulations for alternatives fuels and continued growth in the global shipping industry.

The Asia-Pacific region occupies an important position in terms of both supply and demand in a situation which crew shortages are expected to continue. Major seafarer supply countries, such as China, India, Indonesia, Myanmar, Philippines and the Russian Federation, have unique seafarer education and training systems that can meet diverse global demands, and the demand for seafarers in the Asia-Pacific region is steadily increasing due to growing demand for fleets resulting from global economic growth and increased international trade. In some countries, seafarers are a source of foreign currency that contributes towards the national economy and a human resource pool that supplies specialized manpower to the entire logistics sector.

The eco-friendly and digitalization of ships will accelerate, and ultra-large ships fueled by liquefied natural gas, methanol, ammonia and hydrogen are becoming more commonplace in the market. Ships are no longer just mechanical devices, they are high-tech facilities armed with digital equipment, and it is of utmost importance to train and supply professional personnel, both women and men, who can manage these ships at the right time.

Ships have now become a place where seafarers of various nationalities gather and work, and various stakeholders are working together to maintain the education, training and professionalism of seafarers. This involves not only international organizations, such as the International Maritime Organization (IMO) and the International Labour Organization (ILO), but also governments, shipowners' organizations, seafarers' organizations, universities, and education and training institutions. Collaboration among stakeholders is urgently needed to respond to changes in the operating environment and supply of STCW certified seafarers.

CHAPTER 3

POLICY SOLUTIONS AND THE WAY FORWARD

Transport is a sector that is rapidly growing in Asia and the Pacific compared to the rest of the world in terms of scale and speed. However, transport trends within the region are often changing because of the diverse opportunities and constraints. Current policies will have a varying range of impacts on future levels of connectivity, travel behaviour, energy use, road safety, carbon emissions and local air pollution in cities based on existing transport infrastructures, systems and services, as well as land-use planning and pricing structures.

Based on the major trends presented in chapter 1 and current challenges described in chapter 2, a broad range of policies need to be implemented to keep the transport sector on a sustainable path moving forward in Asia and the Pacific. This is especially critical as passenger and global freight transport demand are projected to continue to grow significantly between 2019 and 2050, increasing by 79 per cent and almost 100 per cent, respectively (ITF, 2023a). Most of this growth will emerge from Asia and the Pacific where passenger demand is expected to more than double in South-East Asia, surge by 92 per cent in South and South-West Asia, and increase in East and North-East Asia and Europe, by 44 per cent (ITF, 2023a).

Freight transport demand will be affected by changes in trade and commodities being transported and is projected to surge by more than 300 per cent between 2019 and 2050 in South-East Asia. It is also expected to increase by an even greater factor of 4.9 in South and South-West Asia, and more than double in East and North-East Asia (ITF, 2023a). Similar projections to 2030 conducted by the Asian Transport Outlook (ADB, 2022) have also illustrated that the increase in freight transport demand will outpace passenger demand. Although passenger demand will continue to grow, freight transport will be dominating the increase in Asia and the Pacific by 2030, with East Asia, accounting for an estimated two-thirds of domestic regional freight activity (ADB, 2022).

3.1. ECONOMIC SUSTAINABLE TRANSPORT SOLUTIONS

3.1.1. Regional transport infrastructure connectivity

The role of the regional transport network, including the Asian Highway Network and the Trans-Asian Railway Network, can enhance freight connectivity by aggregating disparate infrastructure systems into a cohesive regional network (Banomyong, 2024). Increased economic sustainability through infrastructure requires taking a holistic approach across transport modes and country borders.

Despite regional progress in freight connectivity, continued development of land infrastructure to support international trade is required. While the bulk of the regional land transport network has been constructed, new highways, railways and dry port facilities still need to be built, as illustrated by the current number of potential Asian Highways, Trans-Asian Railways missing links and potential dry ports.

The continued development of the regional transport network must go hand in hand with heightened attention to its efficient operationalization. While road transport facilitation remains a concern, scaling up the construction of the missing links along the Trans-Asian Railway Network would only have a tangible impact if accompanied by greater regional cooperation on the cross-border rail operations.

Multimodal transport operations require not only facilitating international regulatory frameworks, but also taking a holistic approach to transport infrastructure development. More concretely, supporting the dynamic dry port development also requires linking this trend to the planning and operationalization of the international transport corridors, with the goal of advancing multimodality.

Dynamic port development in the region is not sufficient to address the growing maritime connectivity divide. Innovative maritime and port policies, regional cooperation and active involvement of the shipping industry remains essential for advancing sustainable maritime connectivity in Asia and the Pacific and addressing the needs of small island developing States.

Prioritizing transport infrastructure resilience in the planning, operationalization and maintenance of the regional transport network. Faced with the variety of risks and external shocks that cause significant economic losses, infrastructure resilience must be embedded in the national and regional infrastructure development processes. At the same time, resiliency benefits from traditional transport policy priorities, such as promoting the use of rail and/or multimodal transport or ensuring proper infrastructure maintenance and regular quality upgrades, should not be overlooked.

3.1.2. Transport technology, innovation and digitalization

Understanding the potential of smart transport systems for economic sustainability can further unlock greater efficiency. Smart transport systems integrate a range of technologies, which can interact across transport systems. They have the potential to make transport safer, more efficient and more sustainable, while providing users with increased convenience and choices. Enhancing the transport sector in this regard correlates directly with increased economic potential of cities and countries by increasing economic productivity and efficiency due to a decrease in traffic congestion and travel time. Specifically, after examining how smart transport systems enhance the efficiency of transport systems in the Asia-Pacific region, it is evident that they play a significant role in promoting economic sustainability (ESCAP, 2020a), and that they align with SDGs 9 and 11. Throughout the region there is a strong drive to embrace new technologies, where countries are leading the development and utilization of smart transport technologies regionally and globally.

Strengthening collaborative efforts can help realize the full potential of smart transport systems. Collaborative efforts of stakeholders across the public and private sectors and continued investment in research, development and the deployment of innovative transport solutions will support the development of transport innovation. Addressing challenges through regional cooperative policy interventions is also essential for realizing the full potential of smart transport in driving economic sustainability in transport systems across the region. According to the survey conducted by ESCAP in 2022, these challenges include limited funding, policy support, regulatory foundation, technical capacity and knowledge, and collaboration among stakeholders, as many activities related to smart transport systems are still being designed and pursued locally without the consideration of regional harmonization. This has resulted in unbalanced development among countries. In contrast to regional cooperation, bilateral or limited-country cooperation may be simpler to coordinate, but it may not harness the same level of resources and expertise. This can also lead to a variety of limitations, such as limited harmonized and balanced policies, fragmentation of standards, regulations and technologies, and limited connectivity, integration, and interoperability between neighbouring countries, which can hinder the potential benefits of smart transport systems (ESCAP, 2023e).

Pursuing a harmonized policy goal can lead to the implementation of smart transport systems. Smart transport systems need to be shaped by technology and well-directed policy to successfully achieve regional and global agendas. New technologies have been introduced, and they need to be integrated into existing systems smoothly. Limited communication and cooperation among countries (and among stakeholders) inhibit the ability for countries to leapfrog developmental stages, and decrease the potential for sharing of best practices, lessons learned and pitfalls to avoid. The absence of a harmonized policy direction at a regional level will result in the benefits of transport digitalization being underutilized and ineffective in addressing transport-related issues. Smart transport systems are still evolving, and the levels of understanding and stages of utilization vary within countries. Accordingly, regional collaboration and cooperation with strong policy support are necessary to advance smart transport systems under an inclusive future policy direction in Asia and the Pacific. In summary, regional collaboration and cooperation with a harmonized policy direction is emerging as the more favourable choice, as it allows for a holistic and coordinated approach to enhancing transport systems across a broader geographical area. A regional policy direction is required to bring smart transport systems to the regional agenda for policymakers in Asia-Pacific countries; to establish a harmonized guidance to provide clear direction for the future development of sustainable smart transport systems, and to strengthen capacity for regional cooperation by bridging the imbalance and eliminating barriers to a broader deployment of sustainable smart transport systems in Asia and the Pacific. These efforts will eventually facilitate an integrated pursuit of necessary actions that take place locally, subregionally and regionally to address roadblocks hampering the wider utilization of smart transport systems.

Leveraging advances in big data collection, processing and analysis for more reliable, efficient and evidence-based decision-making in transport policies and strategies is required. For example, data analytics can be used to better understand the travel behaviour of different user groups to support efforts to design smart transport solutions that will meet their needs. There are still data gaps on smart transport policies and strategies in the Asia-Pacific region and even if data are available in some developed countries, many governments still lack access to available data in the transport sector. More importantly, transport planners and policymakers do not have enough knowledge and capacity to utilize available data with smart transport systems when developing sustainable transport policies and strategies. To achieve sustainable development supported by data-driven policies and strategies with smart transport systems, a broad range of actions, including increasing knowledge and the capacity of countries, is required. Furthermore, regional policy guidelines for data utilization with smart transport systems need to be provided, which also include data security and privacy issues for the better use of smart transport systems.

Improving a regulatory framework helps countries to better prepare for the governance of emerging transport innovation and technology. Freight transport innovation and digitalization are crucial to improving the efficiency, safety and sustainability of the movement of goods. To facilitate the deployment of innovative solutions, it is important to engage with policymakers and regulatory bodies and advocate supportive policies. Moreover, demonstrating new technologies' safety, efficiency, and environmental benefits can help gain regulatory approvals.

Cooperation through intergovernmental platforms should be prioritized. Strengthened regional cooperation and coordination among countries and stakeholders in the transport sector can be achieved through existing intergovernmental platforms to facilitate the exchange of information and best practices, foster trust and collaboration, and implement joint actions and solutions in response to disruptions, such as pandemics. Doing this makes it possible to create a more efficient and effective freight transport system that benefits all stakeholders.

Challenges and risks can be mitigated through greater collaboration. The implementation of new technologies can involve significant expenses and risks. To overcome these obstacles, it is crucial to collaborate effectively with relevant stakeholders, such as governments, civil society, development institutions and the private sector, to secure funding, grants or subsidies for innovation projects. One option is to explore PPPs that can share costs and mitigate risks among stakeholders.

Interoperability and standardization can promote the development and adoption of advanced digital technologies in the freight transport industry. The interoperability and standardization of data and systems across various modes, regions and stakeholders need to be further strengthened to enable a seamless exchange of data and services among different modes, regions and stakeholders. This can then significantly reduce costs, enhance safety and improve operational connectivity by optimizing routes and schedules, reducing manual data processing, enhancing security and traceability, and facilitating the transfer of cargo between different modes of transport.

Safe and responsible application of new technologies needs to be promoted. Addressing various concerns, including safety, security, privacy and liability, can be done through effective regulation and policy frameworks, which is important to enable the safe and responsible deployment of new technologies. To ensure safe and secure freight transport operations, robust cybersecurity measures, risk assessments, and prioritized safety protocols are required.

The increase in stakeholders' capacity forms an underlying foundation for future innovation in the transport sector. It is essential to build the capacities of local governments and transport operators and monitoring and research capabilities in the Asia-Pacific region to enable the effective planning, implementation and evaluation of innovative and digital solutions for freight transport. By doing this a more sustainable and resilient freight transport system can be created to adapt to changing conditions and the needs of countries.

3.2. ENVIRONMENTALLY SUSTAINABLE TRANSPORT SOLUTIONS

3.2.1. Low-carbon transport pathways

To achieve low-carbon transport, countries should prioritize setting targets for passenger and freight transport, including greater support for public transport and active mobility, higher levels of fuel efficiency and vehicle advancement, better management of demand, and modal shifts from road to rail or waterways. Additionally, to effectively transition towards a more sustainable transport system, it is imperative to adopt a comprehensive and integrated approach that encompasses passenger and freight transport.

Develop ambitious targets for CO_2 emissions reduction in nationally determined contributions and transport policies. Transport carbon emission reduction targets and timelines not only need to be included in nationally determined contributions, but more ambitious targets also need to be developed. The transport sector plays a critical role in reducing regional and global CO_2 emissions, yet it is often overlooked in key climate change policy processes. Transport ministries need to determine their own emission reduction targets that are aligned with national climate strategies and other sustainable and inclusive transport goals. The transition to low or zero carbon requires more ambitious emission reduction targets along with realistic timelines that can guide the implementation of low-carbon transport strategies, which can transform transport and climate change commitments into action and support the transition in an efficient and inclusive manner.

Adopt modal shift strategies for passenger and freight transport. Governments must set ambitious targets and create robust incentives to encourage a modal shift from road to more sustainable transport modes, such as rail and waterways, for freight transport, while encouraging the shift away from private vehicle use for passenger transport to public transport and active mobility. Rail and waterways offer substantial environmental advantages, including lower greenhouse gas emissions and reduced traffic congestion. By facilitating this shift, policymakers can significantly reduce the carbon footprint of freight transport and promote a low-carbon transport system.

Increase fuel efficiency through advanced technologies and alternative fuels. Enhancing fuel efficiency is a key strategy for reducing emissions across the transport sector. Policymakers should promote the adoption of advanced fuel-efficient technologies and alternative fuels in freight and passenger vehicles, including the use of renewable energy when possible. Incentivizing the use of cleaner fuels and technologies not only lowers emissions, but it also provides operational cost savings for businesses. This dual benefit can drive widespread adoption and contribute towards a cleaner, more sustainable transport system. The implementation of stringent low-carbon transport regulatory measures and standards that will support the increase of fuel efficiency will also promote cleaner and safer transport practices. Governments should establish and enforce emission standards and vehicle efficiency requirements that push the adoption of cleaner technologies.

Invest in low-carbon transport infrastructure for greater sustainability. Strategic investment in sustainable transport infrastructure is essential for enabling efficient and low-carbon freight and passenger movements. For freight transport, governments should prioritize the development of intermodal terminals, modern rail networks and other critical infrastructure that supports seamless transitions between different transport modes. In addition, green freight needs to be prioritised. Despite its growing impact, freight-related measures are often neglected in nationally determined contributions and national transport policies. Addressing this oversight is crucial to mitigating the environmental and economic consequences of freight transport demand growth in Asia. Decarbonizing the freight transport sector requires a multi-faceted approach, including developing green multimodal zero-emission corridors, adopting efficient technologies and promoting green freight practices in the logistics industry. For passenger transport, infrastructure that supports public transport and activity mobility (such as walking and cycling) should be prioritized. Such investments enhance the overall efficiency of the transport system, reduce the environmental impact and support the growth of sustainable transport options.

Strengthen transport adaptation and resilience to prepare for future disruptions. Along with transport mitigation, countries need to enhance the resilience of the transport sector to better prepare for extreme weather conditions and other disruptions. This could be done through the increase of investment in climate adaptation measures for transport infrastructure, including strengthening existing infrastructure and incorporating climate-resilient design standards in new projects. Additionally, risk assessment and planning can be improved using innovative tools and technologies. The enhancement of regional cooperation with a focus on knowledge-sharing and collaborative initiatives will also address the transboundary impacts of climate change or other disruptions on transport networks.

Establish PPPS to develop sustainable financing mechanisms. Effective collaboration involving governments, industry stakeholders and financial institutions can play a pivotal role in advancing low-carbon transport initiatives. PPPs can mobilize resources, share expertise and foster innovation. By leveraging the strengths of the public and private sectors, PPPs can accelerate the development and implementation of low-carbon transport solutions.

Enhance capacity-building and knowledge-sharing through stakeholder engagement and training. To support the widespread adoption of low-carbon practices, capacity-building, knowledge-sharing, and peer-to-peer learning are essential. Policymakers should promote programmes that educate stakeholders about best practices and lessons learned related to low-carbon transport and provide them with the tools and information needed for effective implementation. By fostering a culture of knowledge exchange, stakeholders can better understand and apply low-carbon practices in their operations. In addition, regional cooperation has the potential to achieve more sustainable, resilient and inclusive transport growth, with opportunities emerging from strong regional dynamics that can also achieve the SDGs. Stronger regional cooperation is also required when addressing transboundary challenges, risks, disruptions and climate change impacts, which can lead to more efficient and effective solutions. Accordingly, strong policy coordination through the sharing of knowledge and experience can promote best practices and maximize policy impacts by creating synergies and reducing duplication of efforts.

Promote integrated planning to reduce transport activities and emissions. Promoting integrated land-use and transport planning will minimize the need for long-distance freight movements. By aligning land-use policies with transport planning, cities can reduce the reliance on extensive freight travel and enhance the efficiency of last-mile delivery solutions. The same principle applies to passenger transport. This integrated approach not only supports sustainability, but it also improves urban mobility and the overall quality of life. Establishing dedicated governance structures for low-carbon transport will further optimize planning, legislative frameworks, regulatory processes, financing mechanisms, operational standards, monitoring systems and promotional activities. Such structures enable more effective policymaking and implementation, ensuring that low-carbon practices are embedded in every aspect of transport management.

3.2.2. Sustainable urban transport

Promoting modal shift in urban transport to reduce private vehicle use. Sustainable transport modes imply shifting away from private car use towards alternative modes, such as walking, cycling, micro-mobility or public transport. Modal shifts to these modes are recognized as an effective means to reduce

traffic congestion and greenhouse gas emissions. This can be attributed to the increased occupancy rate per vehicle in public transport leading to higher levels of energy efficiency and the lack of fossil fuel use in the case of walking and cycling or other non-motorized modes. Policies that can encourage modal shifts include pricing instruments for the regulation of private vehicle use, such as tolls, road pricing, parking pricing and fuel and vehicle taxation, while keeping public transport affordable, reliable and efficient, and provide appropriate infrastructure for non-motorized transport modes at the same time.

Developing and expanding efficient, reliable and affordable public transport systems to increase ridership. Further development and improvement of public transport systems, while increasing ridership, can be instrumental in providing convenient alternatives to private car ownership. Long-term transformation of urban transport is required through commitment and holistic approaches to transport and land-use planning to increase the accessibility of all users (ESCAP, 2021a). Effective regulatory policy frameworks and financial support through government subsidies and other means can also encourage public transport ridership.

Encouraging active mobility for greater transport system integration. An integrated transport system can increase its sustainability and inclusiveness. A trip has to be sustainable and inclusive from the starting point to the final destination. Active mobility, namely walking and cycling, complements public transport. Often, public transport stops and stations are not the final destination and walking and/or cycling have the potential to complete the journey. To complement public transport with active mobility, public transport stops must also be appealing. Ensuring accessible and safe first- and last-mile transport routes requires infrastructure designed with cyclists and pedestrians in mind. This entails, for example, sidewalks and bus stops without hazardous crossings or obstacles due to inadequate infrastructure. Public transport stations and bus stops should provide pleasant and socially and physically secure environments. To encourage the use of bicycles to a public transport station or bus stop, adequate and safe parking facilities for all types of bicycles also need to be provided (Ohlund and others, 2021).

Transitioning to electric vehicles especially in public transport. The use of electric vehicles in public transport has a significant impact on urban CO_2 emissions, especially when clean and renewable fuels for urban transport are used, along with the development of charging infrastructure. It is a promising avenue for reducing emissions and enhancing energy efficiency in urban transport. Switching fossil fuels with biofuels or electricity requires policymakers to be mindful of the impacts of those sources and continuous efforts need to be made to enhance the sustainability of electricity sources (ESCAP, 2021a). Efforts to make informal transport modes sustainable can also be achieved by electrifying them or adopting energy-efficient technologies.

A progressive transition to formality should aim to reduce decent work deficits in a way that also encourages decarbonization efforts accompanied by just transition principles. Policies and programmes should be implemented in an integrated manner to ensure comprehensive, adequate and sustainable levels of social protection, while building access to universal social protection systems.

Integrating data collection and analysis into urban transport policymaking processes. Better data collection and analysis measurably improve decision and policymaking capacity that are either inconsistently gathered, not collected at all or collected by different authorities for different

purposes, and as a result, leave authorities with partial or incomplete information. Furthermore, diverse methodologies across countries for various types of data make it difficult to gather reliable time series that are comparable. Accordingly, standardized data collection efforts for urban transport development can help track national and regional progress. Some specific data that can contribute to more sustainable policy development, but are still not commonly collected include data on modal distribution, such as number of lanes for motor vehicles, presence of bike lanes, availability of surface parking for bicycles and motor vehicles, type of street (pedestrian or shared), existence of public transport (mode, frequency and demand) and interaction with other modes of transport, including connectivity with other modes.

3.3. SOCIALLY SUSTAINABLE TRANSPORT SOLUTIONS

3.3.1. Road Safety

Drawing on the Global Plan for the Decade of Action for Road Safety, 2021-2030, the *Regional Plan of Action for Asia and the Pacific for the Second Decade of Action for Road Safety 2021–2030* was developed and welcomed by the ESCAP Committee on Transport in 2022 (ESCAP, 2022e).

Safe road infrastructure for greater levels of road safety. One reason behind the growing proportion of road traffic deaths in low- and medium-income countries is that the quality of their road infrastructure is much lower than that of other countries. As it will take time to redress this, road safety agencies are starting to shift to the "Safe System" approach, which argues that as human beings are prone to making errors, "those who design and maintain the roads, manufacture vehicles, and administer safety programs … share responsibility for safety with road users, so that when a crash occurs, remedies are sought throughout the system" (Trafikverket, Swedish Transport Administration, 2019). In other words, a more targeted approach is being adopted, which aims to make roads safer and reduce the severity of crashes (namely, building "forgiving roads"). Implementing road designs that minimize the risk of crashes, such as incorporation of roundabouts, can reduce collision points and separated bike lanes will protect cyclists. In particular, infrastructure improvements on roads with a high frequency of crashes or where highly severe crashes take place, such as speed bumps or rumble strips, could be incorporated to ensure safe travel speed and greatly reduce deaths and serious injuries. In this regard, organizations such as the International Road Assessment Programme play a critical role in training engineers and road safety officers in auditing and rating high-risk roads.

Safe vehicle standards need to be adopted across the Asia-Pacific region. Vehicle safety standards are one of the first areas of cooperation involving governments and vehicle manufacturers. Unfortunately, the adoption of the main United Nations vehicle safety standards among countries in Asia and the Pacific is still very limited. Examples of safe vehicle standards include seat belts and seat belt anchorages, pedestrian protection features, two-wheel anti-lock brakes, frontal impact, and side impact protection, and Electronic Stability Control (ESC), a technology that improves a vehicle's stability by detecting and reducing loss of traction, preventing skids or slides during oversteering or understeering (WHO, 2023a).

New types of vehicles, such as electric bicycles and electric scooters (e-scooters), also need to be monitored carefully as their usage increases. A study in Guangzhou, China, for example, found that between 2011 and 2021, the number of ordinary bicycle accidents trended lower, but the number of e-bike collisions increased significantly, particularly after 2018 (Zhou and others, 2024). However, categorizing new types of vehicles and applying relevant laws are major challenges. For example, while some countries treat electric bicycles as motorized vehicles, in others, the classification of them is linked to the power of the motor (wattage). In the future, specific safety standards will be required for emerging technologies, such as autonomous vehicles.

Promote safe road use to reduce risk factors. Asia-Pacific Governments have continued to strengthen legislation on risky behaviours, which contribute to road crashes, such as negligence and rule violation by drivers. WHO best practices in legislation focuses on five risk factors, speeding, drink-driving, use of motorcycle helmets, seat belts and child restraints, which all require necessary laws and enforcement. With the increasing use of mobile phones around the world, the risk of distracted driving continues to rise. In the region, 35 countries have passed legislation on mobile phone use, but only seven countries have banned hands-free usage.

Implement post-crash care policies as part of road safety strategies. In line with the Safe System approach, post-crash care policies make up an important part of road safety strategies. Out of 43 countries surveyed in the Asia-Pacific region, 37 have a national emergency care access number, while 23 have introduced universal access to emergency care, which ensures that all crash victims receive needed medical services regardless of their ability to pay. Kazakhstan, for example, has 40 highway medical and rescue stations across the country, each serving an area within a radius of 50 km (Kazakhstan, 2023). However, only five countries have a national Good Samaritan law, which is designed to offer legal protection to bystanders who provide aid in emergency situations and thereby encourage more people to assist without fear of legal repercussions. Meanwhile, seven countries offer psychological services, and ten countries offer rehabilitative care.

Promote safe speed in Asia and the Pacific. Speeding contributes to one-third of road traffic deaths and is an aggravating factor in all crashes (European Conference of Ministers of Transport, 2006). All Asia-Pacific countries, apart from one, have legal speed limits. However, only a few countries have implemented the WHO best practice of 50 km/h for urban roads, despite research showing that the death risk of a pedestrian hit by a motor vehicle increases 4.5 times between one travelling at 50 km/h and one travelling at 65 km/h. In the Republic of Korea, the success of the "SAFE SPEED 5030" pilot project led the Government to set the speed limit to 50 km/h for general roads in urban areas and 30 km/h for residential streets for the whole country in 2021 (ITF, 2023b). Lowering speed limits and enforcement of safe speed in more countries in Asia and the Pacific will, therefore, be necessary to improve road safety across the region.

The integration of modal shift, land-use planning and reduced road use exposure will support the achievement of road safety goals. Land-use and mobility planning are increasingly recognized as important components for road safety strategies based on the assumption that fewer road traffic crashes would occur if more people travelled by public transport. Furthermore, governments can enact policies that would increase access but reduce the need for mobility, for example by extending

Internet connectivity, which increases accessibility to remote work, online education, telehealth services, e-commerce, online banking and social interactions without the need for physical travel. For example, the Malaysia Road Safety Plan 2022–2030, contains a subarea on "Improving the public transport chain infrastructure" and notes that infrastructure development to expand the accessibility and connectivity of the public transport system is also part of the country's road safety strategy (Malaysia, Ministry of Transport 2022). Notably, however, only a few countries have effectively combined their land use, transport and information technology connectivity strategies, suggesting that there is potential for integrating road safety concerns into these planning strategies in the region.

Increase road safety management and leadership to enhance capacity and data collection processes. In Asia and the Pacific, 34 countries have in place a national road safety strategy, but only 24 have clear funding (5 fully funded, 19 partially funded), and only 24 have dedicated national lead agencies to implement their country's national road safety strategies. To design effective policies, governments also need to identify the leading causes of traffic crashes using effective systems for capturing, consolidating and analysing traffic safety data. With the help of private sector companies and academic institutions, big data and Global Positioning Systems (GPS) data can be captured. More efforts are, therefore, needed to improve data collection processes, build local capacities to analyse these data and communicate the results to policymakers. In this regard, governments can work more closely with international organizations, such as ESCAP, and the Asia Pacific Road Safety Observatory (APRSO), established in 2020. In particular, APRSO works with governments to improve the quality of data being collected and ensure that it is made available to all agencies. The Global Alliance of NGOs for Road Safety is also leading a movement to collect local data, challenge how streets are designed and promote a Safe System approach in road designs (Global Alliance of NGOs for Road Safety, 2022). The Regional Plan of Action for Asia and the Pacific for the Second Decade of Action for Road Safety 2021–2030 is intended to inspire the governments of the Asia-Pacific region at all levels and stakeholders who can influence road safety (including non-governmental organizations, academia, the private sector, donors, the broader community and the media) as they develop national and local action plans and targets for this vital Second Decade.

As reported road traffic death figures often differ from the WHO estimates due to several factors, including, among them, underreporting in official data, varying definitions of road traffic deaths, and differences in data collection methods. Many countries, especially low- and middle-income ones, lack reliable data systems, leading to underreporting, while WHO uses standardized definitions and multiple data sources (such as health records and surveys) to provide more accurate estimates. WHO also adjusts for delays and inconsistencies and uses modelling techniques to better approximate fatalities. As a result, the WHO figures tend to be higher and more reflective of the real burden of road traffic crashes than official reports. As effective monitoring and evaluation of progress on road safety are contingent upon accurate data systems to measure and monitor road safety performance, it is critical to address data discrepancies in the region to improve road safety.

3.3.2. Gender equality

Mainstream gender equality in transport policies for more inclusive transport. Gender mainstreaming can be defined as "the process of assessing the implications for women and men of any planned

action, including legislation, policies or programmes, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated" (United Nations, 1997). Gender mainstreaming has been proven to be an effective approach to ensure that all policies consider their impact on different genders. It is often listed as an ultimate goal in policymaking in order to achieve gender equality (OECD, 2019) and is a strategy that has to be implemented with specific actions and not just a collection of methods (United Nations, 1997). The establishment of evaluation, monitoring and reporting systems for countries and companies serves as a first step to mainstream gender in transport. Proper evaluations can confirm whether gender mainstreaming has been a success. Evaluation, monitoring and reporting systems can include mandating household travel surveys with gender indicators so that trends can be monitored over time; requiring in transport procurement contracts that data on gender and emissions are recorded and reported; requiring reporting on gender balance and gender pay gaps in the workforce and from educational institutes in subjects relevant to transport; publishing results of gender-based analysis of transport policies; ensuring transport policies seeking to increase uptake of sustainable modes are included in the nationally determined contributions, and requiring ex-post evaluation of transport policies, with particular attention to the gender dimension (Ng and Bassan, 2022).

Eliminate gender stereotypes and increase women's representation to improve gender equality in the transport workforce. The hiring and retainment of women in the transport workforce is critical to the gender equality of the transport workforce in the long term. To actively strengthen women's employment in the sector, measures and actions can be promoted to alleviate gender-specific obstacles to enter the transport workforce, including addressing root causes, combating occupational segregation and ensuring equal pay for work of equal value, and promote career progression, including by introducing technology that enhances gender equality (ILO, 2021), In addition, diverse teams need to be promoted in a culture where it is safe for women to speak about their experiences and not be dismissed, as their voices are too often neglected (ILO, 2019c). For every project or team, this may not be immediately possible. In these instances, it is even more important to ensure that the views of women stakeholders have been gathered and considered in initial problem definition and option design. Women's participation and leadership in the transport workforce also need to be enhanced. Employers need to ensure that they have the structures in place to attract diverse employees. These can include parental leave policies with considerate return to work planning, ongoing support to work flexible hours around caring responsibilities, and appropriate workplace facilities (including adequate and equitable sanitation, hygiene, and welfare facilities) and uniforms (ILO, 2019b). Some organizations adopt publicly reported quotas for women representation and report on their gender pay gaps. While applicable to many sectors, these actions are particularly important for the male-dominated transport sector in which a more gender balanced workforce can lead to more sustainable decisions for all (Ng and Bassan, 2022).

Improve data availability and collection processes to support gender balance policies. Disaggregated data by sex or gender are essential to assess the current situation and challenges to close the gender gap in the transport workforce. Data collected at a national level can help guide the improvement or development of equitable policy design and implementation. The impacts of various policies also influence different genders and social groups differently, due to varying behaviour, attitudes, preferences and constraints. Accordingly, the collection and analysis of relevant data are critical for understanding

existing gender differences and supporting gender mainstreaming processes. In addition, funding for gender-based analysis, which requires data collection and analysis, also must be prioritized.

3.4. CONCLUSIONS

The scale, scope and complexity of sustainable transport development across all seven thematic areas requires cross-sectoral collaboration that can break the silos of the transport sector, as the economic and social transformation that will come with it is simply not for any one country or stakeholder group to address alone. Multiple stakeholder engagement among different levels of government, regional and international organizations, non-governmental organizations, academia, civil society and the private sector is necessary. Such engagements can prepare the transport sector for greater sustainability and resilience in response to potential disruptions, including pandemics, emerging (such as digitalization, extreme weather conditions and climate change) or temporary (such as congestion) disruptions. Cross-sectoral collaboration is also necessary when developing solutions to manage the social impact of transport, including working conditions and gender equality in the transport workforce, as these domains tend to fall beyond the authorities of transport ministries.

In the case of the digitalization of transport, harnessing their benefits in the region requires combined and sustained efforts by multiple stakeholders, as collaboration, continuous learning and adaptability are essential for overcoming challenges and driving innovation in the transport sector. Much of this work should be done at the national level, but related efforts must be coordinated and aligned with the subregional- and regional partners and supported and supplemented by the development community. It requires engaging in policy advocacy, creating synergies through partnerships, ensuring high-level political support and developing capacity-building programmes for transport sector players to manage the transition to sustainable transport in Asia and the Pacific.

In addition, synergizing policies between sectors require cross-sectoral and multi-level governance, which will support and accelerate the transformation to sustainable transport development. This involves more than transport stakeholders' engagement. Relevant line ministries, in addition to transport, that play a significant role in this transformation include trade for sustainable connectivity (SDG 9); social development, education and labour for gender equality (SDG 5); energy, environment, climate change, urban development and land use for sustainable and low carbon transport (SDGs 11 and 13); and public health and police (interior ministry) for road safety (SDG 3), for example. Accordingly, for the transport sector to achieve set sustainable targets, it is imperative to strengthen cross-sectoral collaboration between line ministries while aligning sectoral goals and initiatives.

Existing mechanisms that can promote cross-sectoral collaboration applied in countries in Asia and the Pacific include the creation of task force teams focusing on specific cross-sectoral topics, such as climate change, regular meetings with relevant ministries, virtual platforms to share information and data, and exchange of best practice knowledge and lessons learned. Partnerships can also be created by identifying common goals and joint initiatives.

The acceleration and scaling up of sustainable transport solutions need to occur across the Asia-Pacific region for greater regional progress in closing the sustainable development gaps. As indicated in chapters 1 and 2, progress has been made in the transport sector in Asia and the Pacific across

different thematic areas, and positive trends appear to be moving towards the achievement of specific SDG targets, such as those concerning road safety. However, some countries and subregions are closer to their sustainable transport targets than others. In other words, countries are growing differently across the Asia Pacific region and the sustainable transport challenges each country or subregion faces tend to be unique. Accordingly, in the implementation of sustainable transport action, relevant national or subregional characteristics, especially in the context of accelerating and scaling up successful pilot projects and case studies, need to be considered.

The transformation and acceleration of sustainable transport action needs to be further enhanced for the Asia-Pacific region to achieve the SDGs. However, the current pace of transformation towards sustainable transport is too slow, and barriers, including a lack of coordinated investment and technology transfer, need to be addressed. Financial barriers include the lack of long-term and scalable financial options, procurement practices for new technologies, such as electric vehicles, and the elevated price of alternative transport technologies. Large-scale investments can support the acceleration of the transformation required in the transport sector, specifically for the achievement of low-carbon transport (World Economic Forum, 2021). In addition, technological barriers, including the lack of awareness, capacity and knowledge, relevant strategies and data, and technical limitations for the adoption of sustainable and low-carbon technologies also need to be overcome.

Environmental and social transformation in Asia and the Pacific will ultimately occur if countries continue to engage in constructive dialogue, share best practices, foster a culture of sustainable transport and make strategic investments in all aspects of sustainable transport as part of their broader goals of sustainable development. This also entails the need to develop, implement and enforce appropriate policies.

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United Nations Publication

Sales no: E.24.II.F.13

PRINT ISBN: 9789210032810
PDF ISBN: 9789211067927
Print ISSN: 2411-8079
Online ISSN: 2411-8087
Bar code: ean-13_9789210032810

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The *Review of Developments in Transport in Asia and the Pacific 2024: Transition Towards Sustainable Transport Solutions* includes an overview of progress made across seven transport thematic areas included in the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) Regional Action Programme for Sustainable Transport Development in Asia and the Pacific (2022–2026), which are (a) regional land transport connectivity and logistics; (b) maritime and interregional transport connectivity; (c) digitalization of transport; (d) low carbon mobility and logistics; (e) urban transport; (f) road safety, and (g) inclusive transport and mobility. These transport thematic areas are also directly linked to the advancement of five specific Sustainable Development Goals (SDGs), as they can enhance accessibility to essential services and facilities, such as education, health care, employment, and public services, and thus reduce inequalities (Goal 5, Goal 11). Sustainable and resilient transport infrastructure development can further support industry, innovation and connectivity, including associated supply chain networks and cross-border freight transport, which will also lead to higher levels of efficiency in the system, especially with the deployment of information and communications technology (ICT) and real-time data sharing across a supply chain in the long term, as well as increases in competitiveness in the region (Goal 9). By reducing greenhouse gas emissions and air pollution through low-carbon technologies, mode shifts, alternative fuels and route optimization, sustainable passenger and freight transport can mitigate the climate change impact (Goal 13), while improving public health (Goal 3) at the same time. Additionally, improved public transport systems serve as a core function of sustainable cities (Goal 11), while minimizing resource use and the environmental impact in the transport sector. Common sustainable transport solutions include the need to enhance capacity, match sustainable transport infrastructure needs with appropriate financing mechanisms, strengthen data collection and analysis, build greater regional collaboration and cross-sectoral cooperation, and develop, implement and enforce sustainable transport policies.

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