

# REVIEW OF DEVELOPMENTS IN TRANSPORT IN ASIA AND THE PACIFIC 2021

Towards Sustainable,  
Inclusive and Resilient  
Urban Passenger  
Transport in  
Asian Cities





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## ***Towards Sustainable, Inclusive and Resilient Urban Passenger Transport in Asian Cities***

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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 Turkey.

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.

Values are in United States dollars unless specified otherwise.

The term “billion” signifies a thousand million.

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# EXECUTIVE SUMMARY

Since the last *Review* was published in 2019, the ways in which human mobilities are viewed have undergone profound changes. Many government measures to contain the COVID-19 pandemic were designed to discourage and even stop people from travelling. This led to unprecedented falls in passenger levels, particularly for aviation, long distance rail travel, and public transport, while more people started walking, cycling, and driving. The pandemic also accelerated the shift towards online shopping, schooling, and work, further dampening travel demand. Meanwhile, the Asia-Pacific region has also witnessed an extraordinary rise in climate-related disasters, ranging from severe flooding, wildfires and haze, intense rainfall and landslides, and typhoons. It is now widely accepted that climate change is driven by greenhouse gas emissions, and that urban transport is a major contributor. The question of how to make urban passenger transport more sustainable has therefore moved centre stage on the climate change agenda. The *Review of Developments in Transport in Asia and the Pacific 2021* argues that to achieve more sustainable urban transport systems, policymakers should ensure that transport policies and plans are based on environmental sustainability, social inclusiveness, and resilience, and then elaborates measures to achieve this.

**Chapter 2** presents a broad overview of the current state of the urban passenger transport sector in Asian cities, including traditional modes and new mobility services. A noteworthy trend is the expansion of mass transit systems in the region, particularly bus rapid transit, light rail and metro systems. At the same time, the COVID-19 pandemic reignited interest in non-motorized travel, which is particularly important for low-income groups and people who do not have access to cars. Over the past few years, new types of transport services, such as ride-hailing motorcycles and taxis, shared bicycles, and other types of micromobility have flourished in some Asian cities, expanding travel options for users.

**Chapter 3** notes, however, that the development of sustainable urban passenger transport faces several major challenges. The most urgent of these is the continuing demand for fossil fuels, exacerbated by rising motorization rates, as well as fossil fuel subsidies in some countries. A related challenge is dependence on automobiles and other private transport modes, which brings problems such as urban sprawl, pollution, greenhouse gas emissions, congestion and road traffic accidents. The Asia-Pacific region also accounts for some 60 per cent of the global total of traffic fatalities, with the number of accidents expected to increase as motorization continues. Another major issue is the lack of focus on the mobility needs of low-income groups, women, children, persons with disabilities, and the elderly, even though they make up the majority of the population.

**Chapter 4** highlights selected policies for environmentally sustainable transport which are particularly relevant for the Asia and Pacific region. These include making land-use planning processes more effective; internalizing the social and environmental costs of transport into planning processes; expanding smart transport systems and associated technologies; and promoting energy efficient vehicles. It then describes a transport energy modelling exercise using the Avoid-Shift-Improve (ASI) framework to estimate the impact of five representative low-carbon policy scenarios on energy use and emission profiles for 2030 and 2050. The results suggest that policies associated with “Improve” scenarios, particularly energy efficiency and electric vehicle scenarios, had the most significant effect on reducing emissions.

**Chapter 5** assesses the short and longer-term impacts of COVID-19 on mobility, as well as some of the implications for other dimensions of sustainability. The most immediate impacts were a fall in ridership

levels and a shift from public transport to private cars and motorcycles. In some cities, there was also a rise in walking and cycling. It is too soon to say whether these short-term effects will translate into longer-term structural changes in transport demand. The pandemic also exposed the vulnerability of urban transport systems, particularly for public transport operators who depend entirely on farebox revenues for operational expenses. However, the pandemic also triggered a wave of innovative applications of digital technologies, from ticketing to crowd management. As they reflect on the experiences of the pandemic to 'build back better', countries and cities need to take a more creative approach to policy-making which looks holistically at transport systems, not only at individual problems.

**Chapter 6** concludes with selected policy recommendations, as follows:


1. *Make urban transport more environmentally sustainable* by reducing fossil-fuel based private transport modes, removing fossil fuel subsidies, and promoting electric mobility, public transport and active transport modes;
2. *Design inclusive urban transport systems which meet everyone's needs*, ensuring that different groups can access transport to fulfil their daily activities, and that safety issues are also taken into account;
3. *Integrate resilience into urban and transport planning*, including ensuring that public transport services recover from the drop in trip demand during the pandemic, as well as taking actions to "climate proof" transportation infrastructure in the face of changing climates and increasing natural disasters;
4. *Harness the power of new technologies* to make transport more sustainable, such as through smart technologies, more energy efficient vehicles, new energy sources and engines, including electric mobility, and intelligent transport systems;
5. *Build the capacities of local governments and transport operators*, including informal service providers, to plan and deliver more sustainable services and to better coordinate with each other in times of external shocks such as disasters and infectious disease outbreaks;
6. *Direct more financing to sustainable transport modes* through innovative financing models so that operators do not depend on farebox revenues and can also improve the quality of services;
7. *Strengthen monitoring and research capacities* in the region, ensuring that the large volume of research being conducted by academia and the private sector can be used by governments to design better policies; and lastly,
8. *Utilize regional fora and cooperative mechanisms* to share experiences and knowledge about effective policies for sustainable urban passenger transport.


Policy decisions taken now will directly influence the ability of the region to deliver the 2030 Agenda for Sustainable Development and achieve the Paris Agreement on Climate Change. Crises such as COVID-19 and climate change can be catalytic for meaningful, transformative actions to overcome previous barriers. They also underscore the need to think beyond the transport sector and to strengthen linkages to other sectors, including health, social welfare, energy, environmental protection, and security. Ultimately, sustainable transport policies need to integrate elements of environmental sustainability, social inclusiveness and resilience. City and national governments should visualize urban transport systems that best meet the needs of the planet and their people, not only for this generation but also future ones.







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Photo credit: Madan B. Regmi



# Chapter 1

## Introduction

## 1.1 Urban passenger transport: a changing paradigm

Since the last ESCAP *Review of Sustainable Transport Connectivity in Asia and the Pacific* was published in 2019, the way in which human mobility is viewed has undergone profound changes. Many government measures to contain the COVID-19 pandemic, from lockdowns, restrictions on mass gatherings, quarantines and even border closures were designed to discourage and even stop people from travelling. This led to unprecedented falls in passenger levels, particularly for aviation, long distance rail travel, and public transport. On the other hand, more people started walking, cycling, or using personal vehicles, such as cars and two-wheelers. Restrictions on people's mobilities, coupled with fear of catching the virus, also appear to have accelerated the shift towards "virtual" activities, such as online shopping, schooling, and work, which further dampened travel demand - at least in the short term. No other event in recent history has had such a significant impact on urban passenger transport as the COVID-19 pandemic.

Meanwhile, the past two years have also witnessed an extraordinary rise in the number and intensity of climate-related disasters. Asia has been one of the worst affected continents. Severe flooding in Nepal, China, and India, wildfires and haze in the Russian Federation, intense rainfall and landslides in Japan, and typhoons in the Philippines are just some of the many examples. The first part of the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, *Climate Change 2021: The Physical Science Basis*, reaffirms that the impact of human activities is leading the earth's climate system on an irreversible path of disruption.<sup>1</sup> Urban agglomerations are both victims and perpetrators of climate change. Economic development and population growth have led to rapid motorization and increasing sprawl, which in turn have resulted in rising greenhouse gas emissions, air pollution and congestion.<sup>2</sup> An estimated 40 per cent of global passenger transport emissions are generated by urban travel,<sup>3</sup> and in the coming decades, energy demand and emissions from the transport sector are expected to rise as urbanization continues. Between 2010-2019, overall CO<sub>2</sub> emissions from transport in Asia grew by an estimated 41 per cent.<sup>4</sup> As Figure 1.1 shows, most countries registered very high growth, with only a few reporting a reduction. In this regard, the question of how to make urban passenger transport more sustainable has moved centre stage in the ongoing discussions on climate change mitigation.

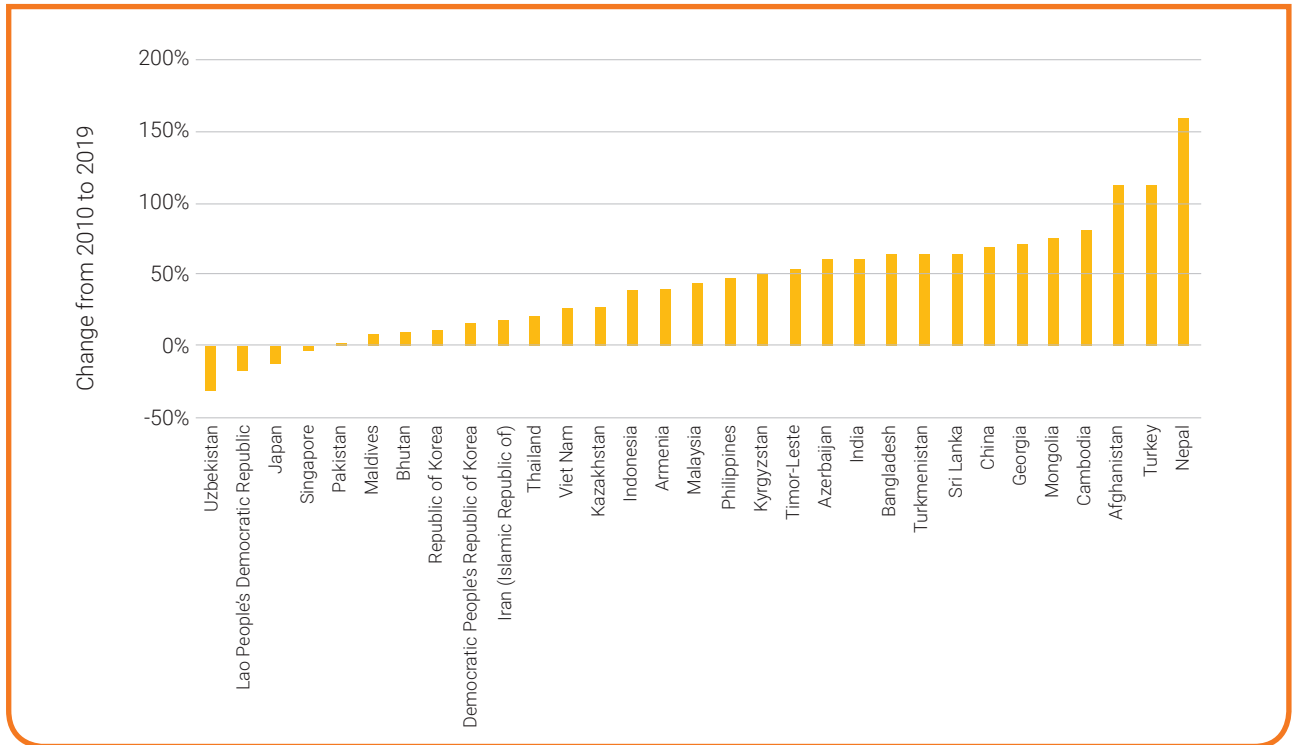
Against this backdrop, there has never been a more urgent need to rethink the way people move – and are moved – in Asian cities. Sustainable transport should drive sustainable development, which is "meeting the needs of the present without compromising the ability of future generations to meet their own needs,"<sup>5</sup> by enabling trade, tourism, and economic growth, and allowing people to access jobs, services, education, and the in-person social contacts that help create fulfilled lives. Towards this end, the international community adopted the Millennium Development Goals in 2000, and then further elaborated the global development priorities in the Sustainable Development Goals (SDGs) in 2015. Sustainable transport should therefore advance the people-centred goals at the heart of the 2030 Agenda for Sustainable Development, while protecting and preserving the planet and its resources for generations to come (Box 1.1).

Although definitions of sustainable transport vary between different researchers and organisations, the Canadian Centre for Sustainable Transport's 1997 definition covers many of the key elements. This defines sustainable transport as a system which:

- "Allows the basic access needs of individuals and society to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations.
- Is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy.



**Figure 1.1** Change in CO<sub>2</sub> emissions from transport in Asian countries, 2010-2019



Source: SLOCAT, 2021

**Box 1.1** Linkages between urban transport systems and the SDGs

**2 ZERO HUNGER**  
Target 2.3 on logistics that increase agricultural productivity

**3 GOOD HEALTH AND WELL-BEING**  
Improved transport networks save energy, time and costs, enhancing market accessibility and farmers' incomes.

## Box 1.1 Linkages between urban transport systems and the SDGs (cont.)

**3** GOOD HEALTH AND WELL-BEING



**Target 3.6** on the number of global deaths and injuries from road traffic accidents

Improving and maintaining adequate road infrastructure, monitoring traffic, reducing traffic through good public transport and pricing could lead to reduced deaths and injuries from road accidents.

**Target 3.9** on reducing deaths and illnesses by air pollution

Transport sector emissions of NO<sub>x</sub> and SO<sub>x</sub> are major air pollutants in some Asian cities. Enforcing inspection and maintenance regimes and improving vehicles will help reduce air pollution in cities.

**5** GENDER EQUALITY



**Target 5.1** on ending all forms of discrimination against all women and girls everywhere

Public transport systems need to address the needs of women and girls, differently abled and ageing populations.

**7** AFFORDABLE AND CLEAN ENERGY



**Target 7.3** on doubling the rate of energy efficiency

Over time, research and development have increased the energy efficiency of engines and brought new technologies to the forefront. New transport technologies and ICT monitoring can improve energy efficiency and reduce transport energy demand.

**9** INDUSTRY, INNOVATION AND INFRASTRUCTURE



**Target 9.1** on sustainable infrastructure that promotes economic development and human well-being

Roads and highways are large infrastructure systems with wide-reaching impacts. Proper planning and design can lead to more sustainable transport networks.

**11** SUSTAINABLE CITIES AND COMMUNITIES



**Target 11.2** on equitable and affordable transport network access to the urban population living in cities

With more than half the Asia Pacific population living in cities, urban transport networks and systems need to be made accessible and affordable for city dwellers to use them.

**Target 11.6** on sustainable cities that reduce the adverse impacts of cities, with special attention to air quality

By strengthening inspection and maintenance regimes and raising emission standards, the adverse environmental impact of cities can be improved.

**12** RESPONSIBLE CONSUMPTION AND PRODUCTION



**Target 12.c** on removing fossil fuel subsidies that disturb the price of fossil fuel

Regulating fossil fuel prices through removal of subsidies will reduce their demand, particularly in the transport sector where they are the main source of energy.

**13** CLIMATE ACTION



**Target 13.1 and 13.2** on climate change adaptation and mitigation

The reduction of emissions from the transport sector can contribute to climate change mitigation while climate proofing infrastructure (road, rail etc) can reduce the adverse effects on climate change on the transport sector.

Image credit: macrovector@ref123.com

- Limits emissions and waste within the planet’s ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise.”<sup>6</sup>

The key to sustainability is to develop a transport system which balances these various, sometimes competing, dimensions. In this regard, some observers have noted that governments have the chance to “build back better” in the wake of the COVID-19 pandemic. But what exactly does this entail? The *Review of Developments in Transport in Asia and the Pacific 2021* argues that transport policies and plans should be based on three fundamental principles of sustainability: environmental sustainability, social inclusiveness, and resilience. These three principles often go hand in hand.

## 1.2 Principles for designing sustainable transport systems

### 1.2.1 Environmentally sustainable transport systems

The concept of environmentally sustainable transport is gaining recognition in the region because of the rapid growth of energy use and emissions from the transport sector. As noted above, a sustainable transport system “Limits emissions and waste within the planet’s ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise.”<sup>7</sup> Of these, the most urgent challenge is to limit greenhouse gas emissions and decarbonize the transport sector. In the Asia-Pacific region, the transport sector was responsible for approximately 13 per cent of carbon dioxide emissions in 2018 (see figure 3.2 in Chapter 3), with road transport accounting for more than 75 per cent of the sector’s emissions.<sup>8</sup> Road transport also gives rise to negative externalities such as air and noise pollution, road traffic crashes, and congestion in cities. To capture the various aspects of environmentally sustainable transport, ESCAP developed the Sustainable Urban Transport Index (SUTI), which tries to measure ten key indicators (Box 1.2). As the SUTI project found, many cities are starting to monitor the impact of their policies using tools like SUTI. Some of the information gathered under this project has been used to inform this Review.

### 1.2.2 Inclusive, accessible, and safe transport systems

Inclusive transport is a key requirement for an equitable city. Inclusiveness is “the quality of including many different types of people and treating them all fairly and equally.”<sup>9</sup> According to the definition given above, a sustainable transport system “Allows the basic access needs of individuals and society to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations”, and “Is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy.”<sup>10</sup> Some key concepts of inclusive transport are access (both to the transport service itself, as well as to socially desirable destinations); affordability; safety; personal security; and fairness, including transport justice. People who are potentially at risk of being excluded from transport services include the elderly, women, people with disabilities, and low-income groups. The Asia-Pacific population is ageing rapidly, and the region has an estimated 690 million persons with disabilities. Difficulties in accessing transport services may cause people living with disability to skip doctor’s appointments, job interviews, or social visits.<sup>11</sup> Furthermore, some countries in the Asia and Pacific region continue to have the worst traffic safety records in the world. Fear of traffic accidents may discourage people from travelling, thereby preventing them from fulfilling livelihood needs. These issues led the international community to adopt SDG target 11.2, which is “By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all”.

### 1.2.3 Resilient transport systems

One way to think about urban passenger transport is as a ‘system of systems’ that are configured around particular modes of transport. They are configurations of different elements – technology, infrastructure, policy and regulation, cultural values and meanings, user practices, and knowledge – that change due to internal dynamics and external pressures and shocks.<sup>12</sup> With its multiple waves of infection and government-mandated containment measures, the COVID-19 pandemic has led to a series of interconnected shocks to transport systems, forcing city governments to intervene in transport operations to ensure the health and wellbeing of commuters and operations. Through this process, both governments and operators have had to re-examine how urban passenger transport systems were designed in the past, and how they can be made more resilient in the future.

#### Box 1.2 Sustainable Urban Transport Index (SUTI)

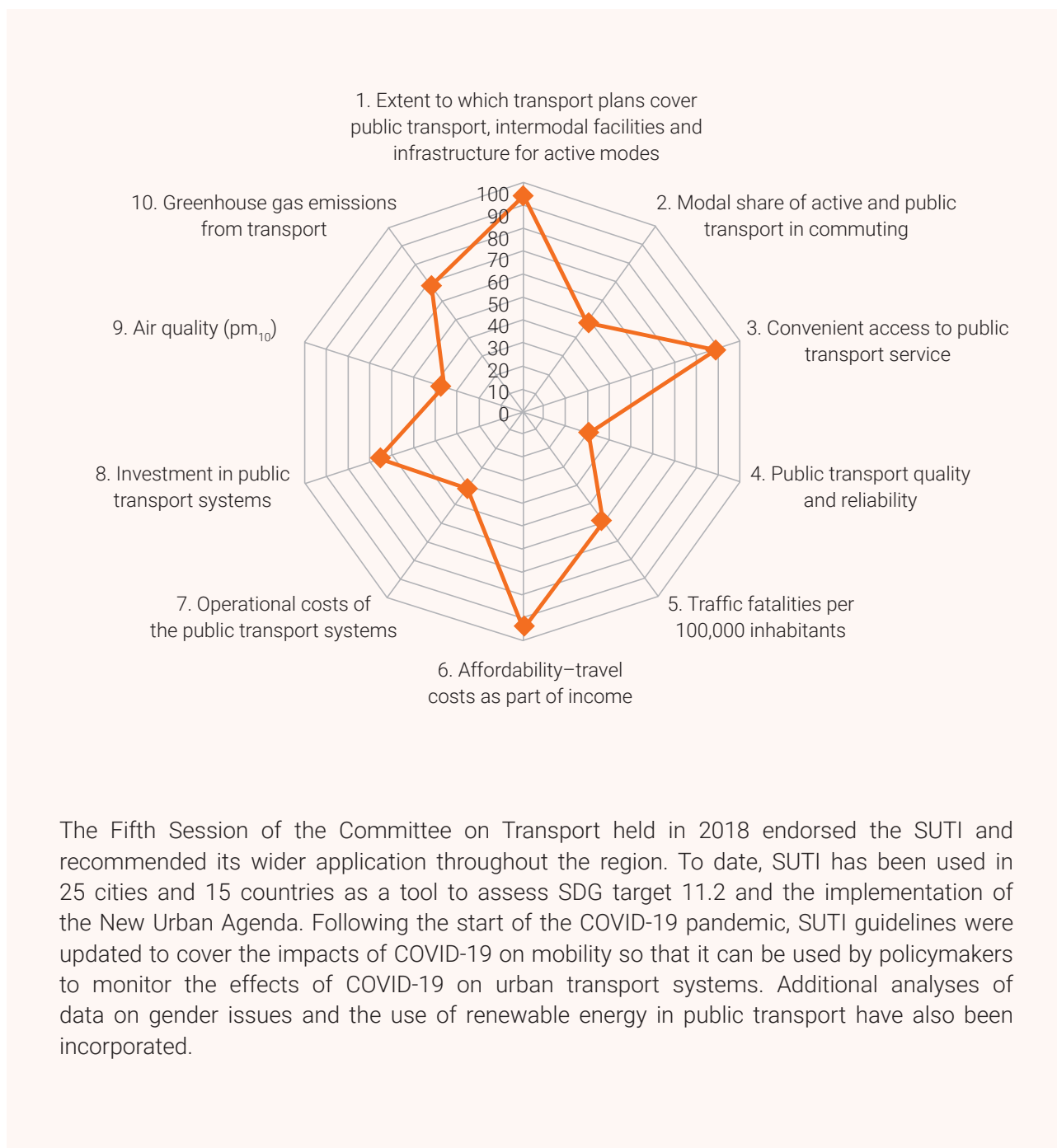
The Sustainable Urban Transport Index (SUTI) is a framework of indicators for the assessment of urban transport systems and services. The 10 indicators which currently make up SUTI and their measurement units and normalization ranges are shown in the table below. These indicators can help summarize, track and compare the transport performance of a city.

**Indicators for SUTI**

No	Indicators	Measurement	Weights	Range	
				Min	Max
1	Extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	0-16 scale	0.1	0	16
2	Modal share of active and public transport in commuting	Trips/mode share	0.1	10	90
3	Convenient access to public transport service	0% of population	0.1	20	100
4	Public transport quality and reliability	% satisfied	0.1	30	95
5	Traffic fatalities per 100,000 inhabitants	No of fatalities	0.1	10	0
6	Affordability–travel costs as part of income	% of income	0.1	35	3.5
7	Operational costs of the public transport systems	Cost recovery ratio	0.1	22	100
8	Investment in public transport systems	% of total investment	0.1	0	50
9	Air quality (pm <sub>10</sub> )	ug/m <sup>3</sup>	0.1	150	10
10	Greenhouse gas emissions from transport	CO <sub>2</sub> Eq. Tons	0.1	2.75	0
<b>SUM</b>			1.00		

Indicators on different scales are normalized and the performance of each indicator is compared on a scale of 1-100. The overall SUTI is derived through the geometric aggregation of the 10 indicators. Entering the data for all ten indicators in the SUTI Excel tool will calculate the SUTI and generate a spider diagram, as shown here.

## Box 1.2 Sustainable Urban Transport Index (SUTI) (cont.)



The Fifth Session of the Committee on Transport held in 2018 endorsed the SUTI and recommended its wider application throughout the region. To date, SUTI has been used in 25 cities and 15 countries as a tool to assess SDG target 11.2 and the implementation of the New Urban Agenda. Following the start of the COVID-19 pandemic, SUTI guidelines were updated to cover the impacts of COVID-19 on mobility so that it can be used by policymakers to monitor the effects of COVID-19 on urban transport systems. Additional analyses of data on gender issues and the use of renewable energy in public transport have also been incorporated.

Source: ESCAP, 2017a

Furthermore, working from home became a viable work style for some jobs, which has game-changing potential in terms of reducing commuter traffic and congestion. Transport operators also used digital technologies in creative and innovative ways to respond to the challenges posed by the pandemic. While earlier discussions about resilience in transport systems focused on recovery after natural disasters and emphasized 'engineering resilience', the experience of COVID-19 suggests that 'socio-ecological resilience' is also important. Rather than aiming only for robustness, the ability to adapt to changing circumstances is critical.

### 1.3 Transport policies for sustainable transport: on the right track?

Recognizing the importance of urban passenger transport as a driver of development, many governments are striving to improve their transport systems through policy efforts and public expenditures, both at the national and municipal levels.<sup>13</sup> These efforts are evident in the Nationally Determined Contributions (NDCs) and Voluntary National Reviews (VNR) relating to the Paris Agreement and SDGs. Most of the 47 VNRs submitted in 2020 referred to sustainable transport policies and measures to realise the SDGs.<sup>14</sup> Figure 1.2 shows the transport emissions mitigation measures in the NDCs of selected countries in the Asia-Pacific region.<sup>15</sup> The top three strategies are the improvement of public bus transport, cleaner energy sources such as LPG, CNG and biofuels, and electric mobility, while some countries also included walking and cycling. Only a few countries mentioned fuel subsidy removals, land use and parking policies, which are all important in promoting sustainable transport. However, it is notable that governments agreed to phase out inefficient fossil fuel subsidies at the COP26 (Conference of the Parties) to the UN Framework Convention on Climate Change (UNFCCC).<sup>16</sup>

The NDCs suggest that most governments are moving towards more environmentally sustainable urban transport. However, the number and range of policies do not seem ambitious enough. Furthermore, many governments still actively promote private vehicle use, despite the fact that the number of private cars is the main influencing factor of passenger transport carbon dioxide emissions. Moreover, policies are often implemented in an ad-hoc manner, without clear linkages to other sectors and without taking into account how transport systems may negatively affect the lives and livelihoods of some people. Furthermore, the experiences during COVID-19 outbreaks underlined the role of urban passenger transport in sustaining not only economic activities, but also critical social services such as health and education. To put it bluntly, the pandemic showed that without urban transport, health systems can collapse and people can potentially die. Transport planners and policymakers therefore need to embrace the concept of resilience in order to ensure that transport services can be maintained during crises or disasters.

### 1.4 Structure of this study

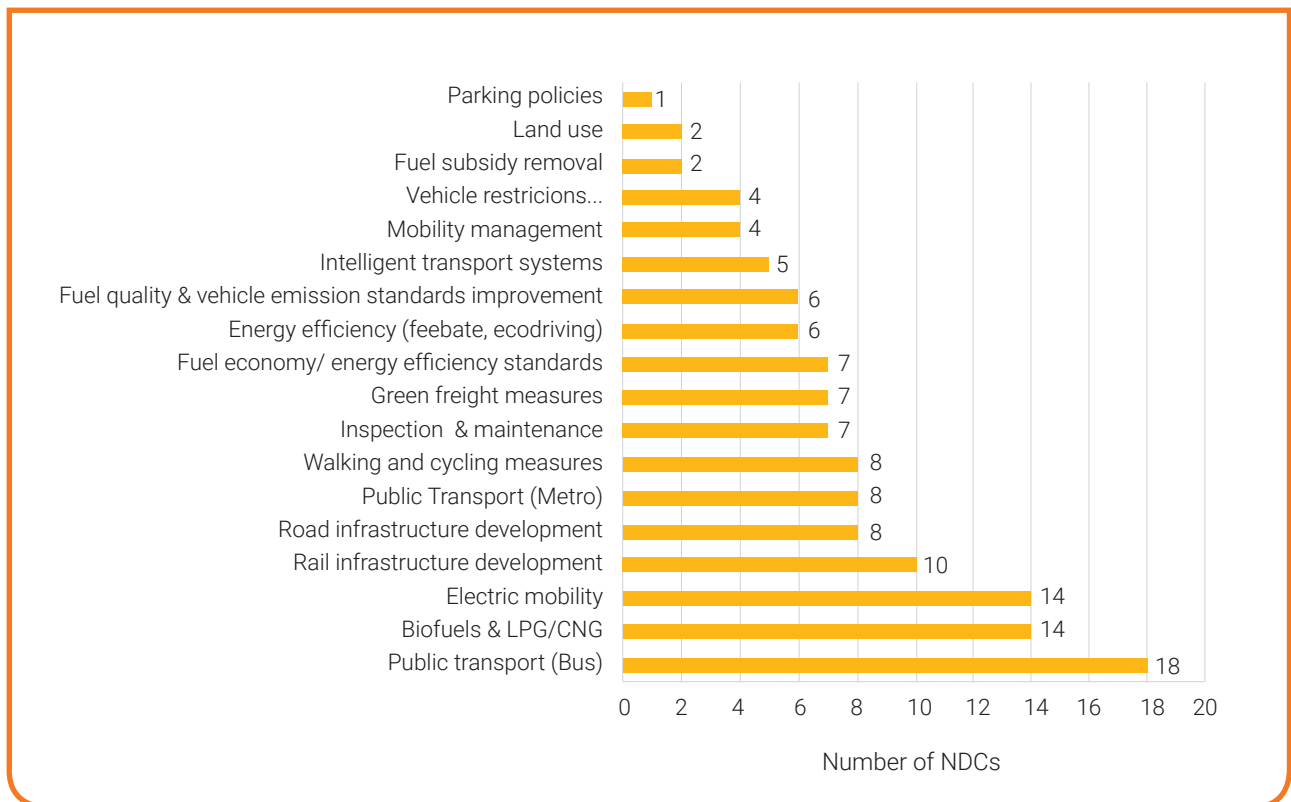
Against this background, the *The Review of Developments in Transport in Asia and the Pacific 2021* is structured as follows:

**Chapter 2. The State of Urban Passenger Transport Systems in Asia** provides a broad overview of the current state of the urban passenger transport sector in Asian cities, including traditional modes and recent mobility services.

**Chapter 3. Issues and Challenges to Sustainable Urban Passenger Transport Development** outlines the major challenges for developing sustainable urban passenger transport in Asian cities. These include the negative environmental and social externalities of current systems, as well as governance and financing issues.

**Chapter 4. Selected Policies for Moving towards Sustainable Urban Passenger Transport** describes selected policy options for making urban passenger transport more environmentally sustainable. Based on a modelling exercise using demographic, energy, and transport data from select countries in Asia, it then presents hypothetical scenarios for different policies under the Avoid-Shift-Improve framework.

**Figure 1.2** Transport sector mitigation policies in NDCs of Asia-Pacific countries



Source: ESCAP, 2019b.

**Chapter 5. Impacts of COVID-19 on Urban Passenger Transport** assesses the impacts of COVID-19 on mobility in Asian cities and other dimensions of sustainability. It also discusses a broader approach to the concept of resilience, which will help governments plan more resilient transport systems in the future.

**Chapter 6. Conclusions** offers policy recommendations for accelerating progress towards more sustainable transport systems. This includes environmental sustainability, social inclusiveness, “building back better” in terms of resilience, harnessing emerging technologies, and regional cooperation. It also describes practical ways to strengthen the capacities of various stakeholders to design and implement sustainable transport policies.

Policy decisions taken now will directly influence the ability of the region to deliver the 2030 Agenda for Sustainable Development and achieve the Paris Agreement on Climate Change. Crises such as COVID-19 and climate change can be catalytic for meaningful, transformative actions to overcome previous barriers to sustainability. Ultimately, the idea of sustainability should be viewed integrally through the lens of environmental sustainability, social inclusiveness and resilience. City and national governments should use this moment to visualize what kind of urban transport systems will best meet the needs of the planet and their people, not only for this generation but also future ones.

## Endnote

- 1 IPCC, 2021
- 2 ESCAP, 2018a
- 3 ITF, 2021
- 4 SLOCAT, 2021
- 5 WCED, 1987
- 6 Gilbert *et al.*, 2002
- 7 Gilbert *et al.*, 2002
- 8 ESCAP calculations based on IEA (no date), <https://www.iea.org/data-and-statistics/data-product/co2-emissions-from-fuel-combustion-highlights>
- 9 Cambridge Dictionary, accessed at <https://dictionary.cambridge.org/ja/dictionary/english/inclusiveness>
- 10 Gilbert *et al.*, 2002
- 11 Hine and Mitchell, 2001, p. 319
- 12 Geels, 2012; Geels *et al.*, 2017
- 13 Parikesit and Susantono, 2013
- 14 SLOCAT, 2020
- 15 UNFCCC, NDC Registry, <https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>, Accessed, 5 August 2021.
- 16 UNFCCC, 2021

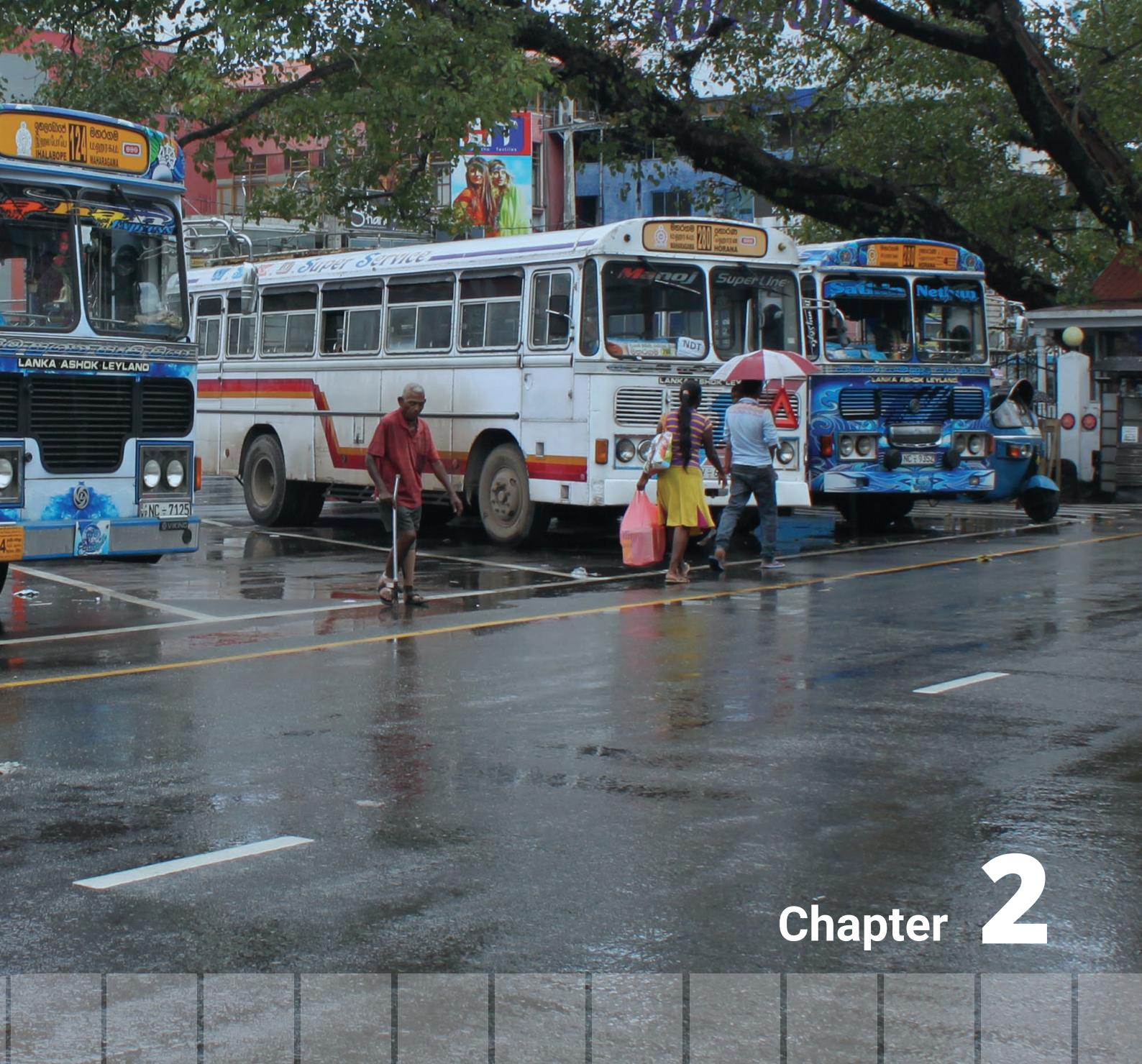




Photo credit: Madan B. Regmi



Photo credit: Madan B. Regmi



## Chapter 2

# The State of Urban Passenger Transport Systems in Asia

Over the past twenty years, Asian cities have become some of the most vibrant and dynamic in the world. This is reflected in the rise in people’s mobilities and activity participation. Table 2.1 shows passenger transport activities in 2019 for some of the most populous countries in Asia and compares them to 2010 levels. Unsurprisingly, the passenger kilometres travelled are high in these countries because of their population size, but the rate of growth is also notable: India’s passenger transport activity grew by 122 per cent between 2010 and 2019, while Indonesia’s passenger activity grew by 43 per cent.<sup>1</sup>

To accommodate the growing mobility of people, a diverse range of transport modes co-exist within urban environments (Figure 2.1). Most notably, private vehicle ownership, including automobiles, motorcycles, bicycles, and e-bikes, has continued to grow across the region, but many cities have also launched an ambitious range of public transport projects. Following the examples of China; Hong Kong, China; Japan; the Republic of Korea; and Singapore, where the majority of commuters use public transport to commute to work and school, other countries have started to invest in mass transit modes such as Bus Rapid Transit, elevated monorail, and Light Rail Transit (LRT). Many people also rely on paratransit modes such as multi-passenger vans, three-wheel tuk-tuks, two-wheel motorcycles and scooters, and non-motorized rickshaws, particularly as first/last mile services to access mass transit systems.

**Table 2.1 Passenger transport activity of selected countries, 2019**

<b>Countries</b>	<b>Passenger transport activity, million Pkm*</b>	<b>Increase in passenger transport activity compared to 2010 (per cent)</b>
China	3,534,920	27%
India	20,879,333	122%
Indonesia	114,202	43%
Japan	611,250	11%
Russian Federation	635,000	32%

Source: SLOCAT 2021. \* Passenger transport data of India is for 2017, Indonesia and Japan are for 2018

In South and South-East Asia, much travel is done by non-motorized transport (NMT), either walking, bicycles, or non-motorized paratransit.<sup>2</sup> In some countries, NMT is the only affordable form of travel for the low-income population, but more recently various forms of public bicycle sharing schemes, which target a more affluent section of the populace, have emerged in China, Japan, India, the Philippines, the Republic of Korea, Singapore, and Thailand, especially in the wake of the COVID-19 pandemic. Another exciting trend which has proliferated in many Asian cities are the “new mobility services”. Several companies such as Didi, Grab, Go-Jek, Uber, and Ola have pioneered ride-hailing services using integrated digital platforms, accessed by the customer via smartphones and apps. The current chapter provides an overview of both traditional and emerging modes of transport in Asian cities.

**Figure 2.1 Mixed traffic in Dhaka city**



Photo credit: Madan B. Regmi

## 2.1 Mass transit systems

Over the past few decades, there has been a dramatic shift in transit advocacy and public policies in support of mass transit systems, with almost every country making substantial efforts to develop conventional bus services, Bus Rapid Transit, and rail transit in order to reduce automobile travel. China has led the way by investing enormous sums in extending mass transit,<sup>3</sup> while other countries, such as India, Pakistan, Thailand and Viet Nam are also developing new systems. It is estimated that Ho Chi Minh City, Viet Nam, has invested more than 5 per cent of its annual GDP to this purpose in the last decade.<sup>4</sup> In India, the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), established in 2005, was catalytic in promoting Bus Rapid Transit in Indian cities.<sup>5</sup> Meanwhile, in 2009, Indonesia adopted a Transportation Act which requires that all cities with a population over half a million develop mass transit systems, including large-capacity buses, segregated lanes, specific routes that do not overlap with existing routes, and feeder services.<sup>6</sup> Many studies have been conducted on how these modes can capture a greater share of urban travel, and point to comfort, speed, reliability, and especially safety as being the most critical factors.<sup>7</sup> Technology is also playing an increasingly important role in upgrading the quality and efficiency of mass transit services.

### 2.1.1 Conventional buses

While conventional bus systems are the main transit providers in most cities, not many studies focus on issues related to their operation and use. Typically, bus services are provided by private companies with exclusive rights to routes based on tendering. However, caught between the objective of keeping fares affordable to low-income users and inadequate subsidies from the government, the quality of bus systems in many cities are deteriorating, pushing travellers to motorcycles and automobile travel. Common criticisms of traditional public bus systems are: 1) poor enforcement and lack of capacity to exercise legal authority; 2) incomplete networks necessitating multiple transfers; 3) lack of dedicated bus lanes; 4) delayed modernization and old vehicles; 5) inefficient fare collection systems; and 6) inflexibility in bus size vis-à-vis varying needs.<sup>8</sup>

To reform bus operations, some cities are using service quality licensing when tendering or franchising routes. In Greater Jakarta, the introduction of air-conditioned buses and an increase in the fleet size triggered a steady growth in public transport use. This was achieved by deregulating the tariffs of private operators.<sup>9</sup> But in other countries such as India, the unregulated operation of private buses, particularly with regard to the allocation of routes and schedules, has spawned excessive competition. As a result, the financial performance of public transport and the quality of service have deteriorated.<sup>10</sup>

Despite these issues, buses remain a critical part of public transport systems in most cities, particularly for people without private vehicles (Figure 2.2). They also serve as links between suburban areas, rural areas, and urban centres. Some municipal authorities are upgrading bus services by investing in better bus terminals and intermodal facilities, such as the Parañaque Integrated Terminal Exchange (PITX) in Metro Manila (Box 2.1). It is also notable that local governments in some high-income countries, such as Australia and Japan, continue to subsidize bus transport operators to help keep fares down and services running. More creative financing options for bus services in middle- and low-income countries should be explored.

### 2.1.2 Bus Rapid Transit (BRT)

Bus Rapid Transit (BRT) was first introduced in Asia in 2004 and has now spread to over 40 cities, with new ones being added each year (Table 2.2). Currently, Asian cities operate approximately 1,600 km of BRT carrying about 9.3 million passengers per day, which is still a small portion of the total travel in larger cities.<sup>11</sup> The Tehran BRT has the highest capacity at 2 million passengers per day,<sup>12</sup> whereas the Jakarta BRT system is the longest in the world at 207 km. In ten Chinese cities, the daily passenger load is over 200,000 riders, with daily passenger totals of over 600,000 in two cities. Most BRT systems operate in segregated busways which allows rapid boarding and alighting. They tend to be more efficient than traditional buses also because many use ITS technologies and prepaid fare collection. But perhaps the most attractive feature of BRT systems is their cost-effectiveness: they are four to twenty times less expensive than an LRT system, and ten to a hundred times cheaper than a metro system.<sup>13</sup> Lower investment and operational costs also mean lower ticket prices, which makes BRT systems attractive to consumers.<sup>14</sup> As a result, multilateral development banks and international organizations have actively promoted this mode.

Apart from design and financing issues, successful development of BRT systems depends on political factors. BRT systems are an attractive alternative for elected officials as they can be built relatively quickly, within a single term of office. A BRT system can be incrementally expanded, as it makes use of the existing

## Box 2.1 The PITX, a fully integrated bus terminal in Metro Manila

In November 2018, the Parañaque Integrated Terminal Exchange (PITX) opened in Metro Manila. It is the first integrated and multi-modal terminal in the city and serves as termini for up to 100,000 passengers travelling to and from the nearby provinces of Cavite, Batangas, and others from the south west side of Metro Manila. It was funded through a PPP project by the Department of Transportation and MWM Terminals under the Build, Build, Build program.

The PITX has departure and arrival bays for buses, jeepneys and taxis, facilitating the smooth transfer of passengers coming in and out of the city and thereby reducing congestion in the city centre. It also implements a bus reservation and online booking system. Moreover, the PITX has a wide array of amenities, such as comfortable waiting areas, drinking water stations, free Wi-Fi access, workstation areas, lockers, telephone booths, shopping centre, baby care rooms, breastfeeding stations, clinic, prayer room, and clean restrooms. Trolleys and wheelchairs are also available for senior citizens and persons with disabilities (PWDs).



Photo credit: MWM Terminals, Inc.

**Figure 2.2** Public bus at a bus stop in Ulaanbaatar



Photo credit: Madan B. Regmi

road infrastructure with only minor adaptations.<sup>15</sup> The mayors of Jakarta and Seoul were vigorous advocates for the introduction of BRT systems in their cities, winning global recognition (Box 2.2).<sup>16</sup> On the other hand, the BRT line in Bangkok was undermined by the discontinued political leadership, the failure to attract more passengers, challenges in connecting to other modes as well as in extending the network.<sup>17</sup> Furthermore, the introduction of a BRT system has been stiffly opposed by paratransit operators in some cities, pointing to the need to develop a mechanism where small-scale operators have opportunities to negotiate projects that affect their livelihoods.

As well as successes, some BRT projects have also suffered from inadequate design and failures.<sup>18</sup> Studies emphasize that the land-use development around BRT stations is of critical importance, requiring careful planning of access, coordination with other modes of transit, and consideration of various design issues. In order to overcome political obstacles, BRT stations have often been sited on publicly owned land in highway medians, with inadequate attention to public access. In Istanbul, the popularity of the Metrobus system led to overcrowded stations and buses, with some arguing that the capacity of the BRT was inadequate and needed to be upgraded to an LRT system.<sup>19</sup> Furthermore, while some BRT systems in Asia have succeeded in reducing travel times and increasing passenger comfort, they have not necessarily reduced private car travel. For example, an evaluation of the TransJakarta system in 2012 found that



**Table 2.2 BRT systems in Asia**

Countries	Passengers per day	Number of cities	Length (km)
China	4,375,250	20	672
India	497,411	9	228
Indonesia	46,467	1	251
Islamic Republic of Iran	2,135,000	3	165
Japan	9,100	2	29
Malaysia	N. A.	1	5
Pakistan	305,000	2	50
Republic of Korea	400,000	1	115
Thailand	15,000	1	15
Turkey	100,000	1	52
Viet Nam	8,000	1	15

Source: <https://brtdata.org>

most passengers had shifted from conventional buses, and there was no significant modal shift by private car drivers and motorcycle riders.<sup>20</sup> Nonetheless, BRT systems remain a cost-effective and relatively efficient mode of transport.

### 2.1.3 Metro and Light Rail Transit (LRT)

There are more than sixty metro and subway systems in Asia. Cities such as Beijing, Guangzhou, Moscow, Tokyo, Seoul, and Shanghai have more than 300 km of rail-based urban transport networks.<sup>21</sup> In China alone, the number of cities with a metro system grew from three to over forty between 1990 and 2020. There is a general aspiration to establish metro systems in most cities, with metro lines under construction in Bangkok, Hanoi, Ho Chi Minh City, Jakarta, selected cities in South Asia such as Dhaka and Lahore, and some Iranian cities (Ahvaz, Karai, Kermanshah, and Qom). Figure 2.3 shows a new metro line in Lucknow, India.

Rail transit contends with the competing facets of high costs on the one hand, and high benefits in terms of travel time and speed on the other. High-capacity transit is a viable option, particularly along corridors with high-density settlements. In some cities, the ratio of daily ridership on heavy rail is already substantial relative to the population. For example, in Beijing daily ridership is 9 million out of a population of 22 million; in Shanghai it is nearly 7 million out of a population of 26.5 million.<sup>22</sup> While ideally rail networks should be developed before urbanization, such investments are typically delayed in the framework of rapid urbanization, leading to increased costs and difficulties in land acquisition.<sup>23</sup>

## Box 2.2 Jakarta's award-winning BRT system

TransJakarta, the very first BRT in Southeast Asia, is notable for its progressive policies. It came into being partly thanks to the strong political support it received from the government. It is affordable at a fixed rate of Rp. 3,500 (around 24 US cents), with free facilities for special groups including students, 60+ senior citizens, disabled commuters, low-income people, and people in certain occupations such as religious figures and the police. The seats are arranged front-facing to prevent sexual harassment, and the network has women-only areas at the front of the buses and women-only buses. It also uses a modern ticketing system, with e-tickets/prepaid cards and Tap-On-Bus payment through bank cards on feeder routes. However, TransJakarta's performance has also been hindered by mixed-traffic incursion on some sections of the BRT lanes, inadequate supply of CNG fuel for the buses, delays at key intersections, and overcrowding. These issues show that even well-designed systems require constant monitoring and incremental improvements.

One of the next challenges for the operator will be modal integration. TransJakarta is expected to play a central role in the city's "Jak Lingko" scheme, which represents a move away from car-oriented planning. Beginning with fare integration, it will eventually allow passengers to travel seamlessly between different modes. TransJakarta has also started to allow cyclists to bring their bicycles into stations and carriages, thereby supporting active mobility in the city.



BRT in Jakarta, Photo credit: Madan B. Regmi

Sources: Ernst, 2005; Kogdenko, 2011; Sayeg, 2015; Buragohain, Regmi and Joshi, 2020; and the ITDP Sustainable Transport Award website.

Apart from costs, other major barriers to the successful implementation of metro and LRT systems include insufficient institutional capacities and lack of inter-agency collaboration. Large cost overruns are common, partly because rail transit requires a long implementation time. Many projects also overestimate passenger numbers, leading governments to fear that railway fares will not cover operating

**Figure 2.3** New metro line in Lucknow, India.



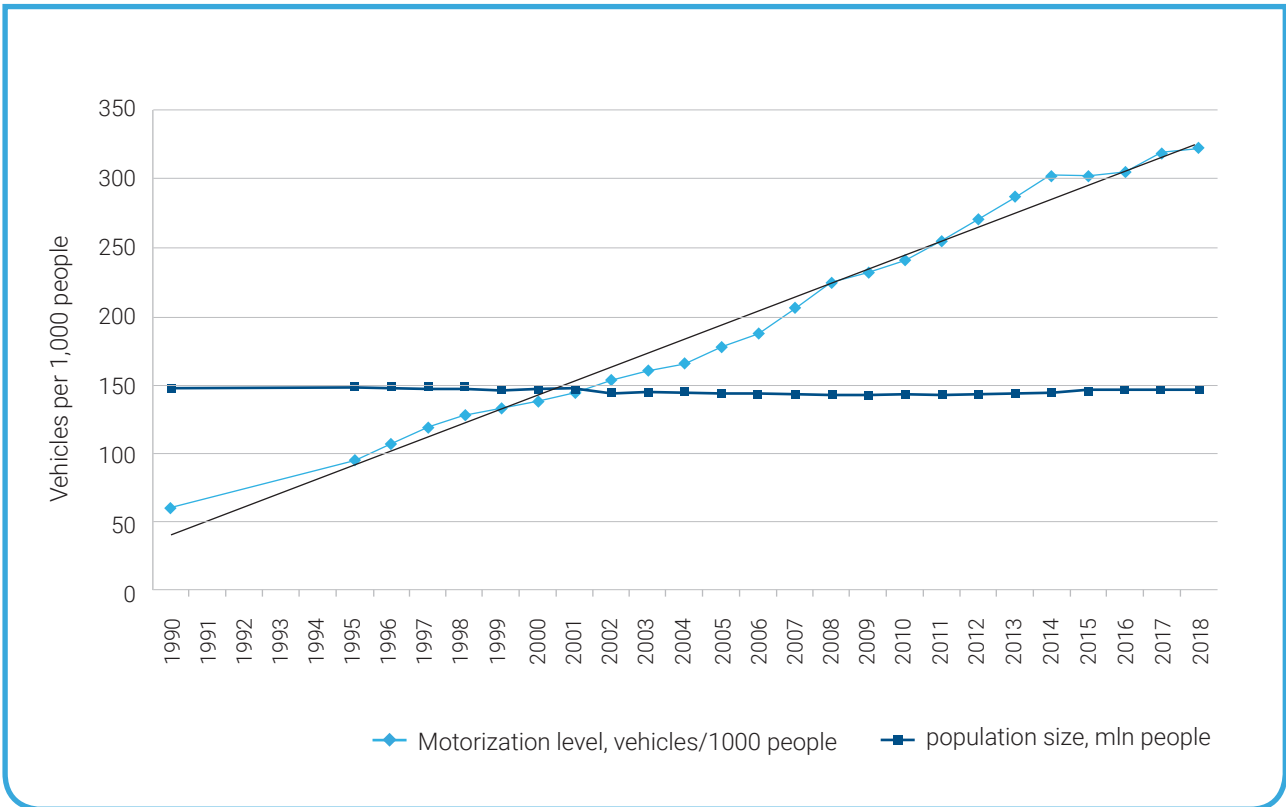
Photo credit: Madan B. Regmi

costs. This is based on the experiences of European cities; in reality, Asian systems have been self-supporting and even profitable – as the examples of Tokyo, Bangkok, Hong Kong, China, and Singapore show.<sup>24</sup> With regard to setting fares, the fare-setting strategy in successful systems such as Shanghai and Tokyo has now shifted from affordability to service quality, with evidence suggesting that users are willing to accept higher fares for better service.<sup>25</sup> To assist in the achievement of equity, rail networks must also provide accessibility to the maximum number of urban residents. Singapore plans to double its rail network by 2030, so that eight in ten homes will be within a ten-minute walk of a metro station.

## 2.2 Privately-owned automobiles

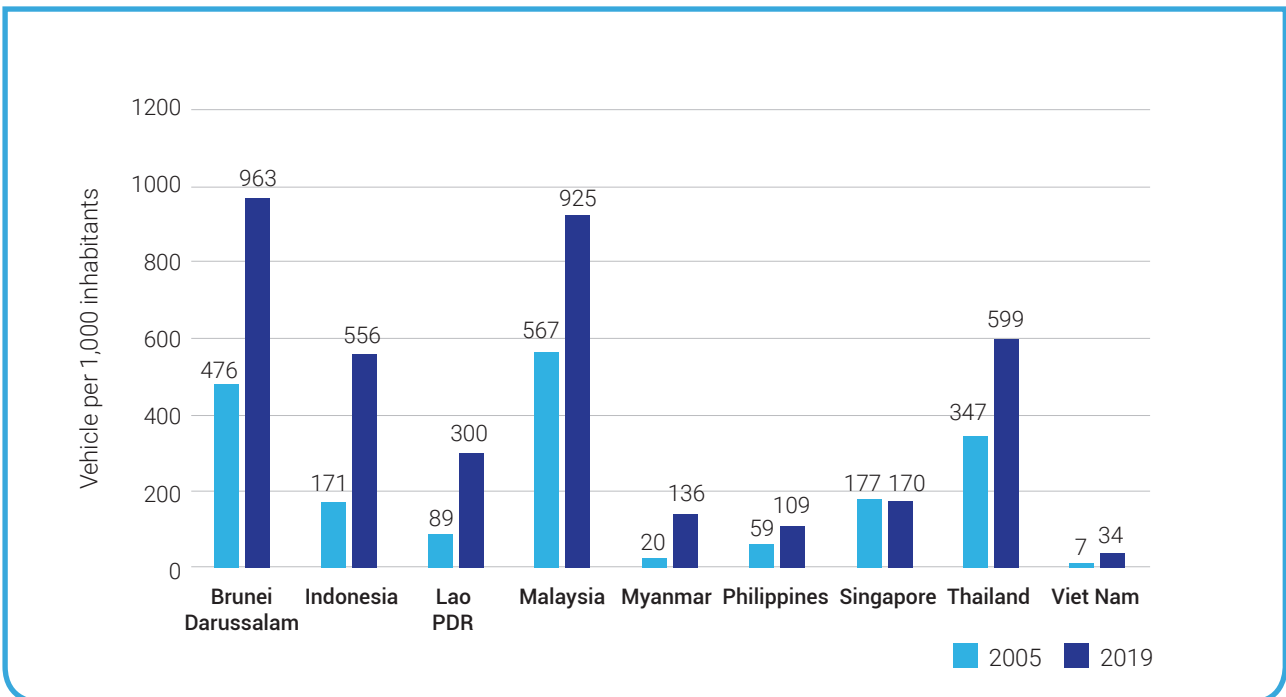
Most governments in the Asia and Pacific region have actively promoted personal vehicle ownership in the past. Motorization rates have grown faster than what many cities have been able to comfortably absorb. Figure 2.4 shows the pattern of motorization in the Russian Federation. Like other countries, it continues to rise rapidly, doubling between 2000 and 2015. Meanwhile, Figure 2.5 shows the number of registered vehicles per 1,000 population in South East Asian countries during 2005 to 2019.<sup>26</sup> High growth is observed in Brunei Darussalam, Malaysia, and Thailand; only Singapore has managed to reduce the number. In China, private car ownership per capita nearly doubled in the five years from 2014 to 2019, from 76.8 vehicles per thousand people to 147.9 vehicles per thousand people. In 2019, car ownership exceeded one million in 66 cities, and two million in 30 cities, of which Beijing ranked top with 5.934 million cars. By 2035, it is estimated that China alone will have approximately 350 million private cars, which is 10 times the number for 2008. The motorization rate in less developed countries, such as India, Pakistan, the Philippines, and Viet Nam is slower: it increased from 20-36 in 2014 to 22-38 in 2015.<sup>27</sup> However, by 2035 India's private vehicles are expected to increase threefold.

**Figure 2.4 Motorization in the Russian Federation in 1990-2018 (vehicles/1000 people)**



Source: State Committee of the Russian Federation on Statistics (Goscomstat) 2018

**Figure 2.5 Registered vehicles per 1,000 people in South-East Asia.**



Source: ASEAN, 2020

At the same time, faced with increasing travel distances and inadequate transit, non-car owners in some cities have taken control of their transport options with inexpensive individualized motorized transit such as motorcycles, scooters, and more recently, e-bikes. Studies of transport behaviour have shown that attachments to personal mobility vehicles can undermine the propensity to shift to mass transit. The paradox is that in Asian cities, the path to the wealth enabled by the emergence of motorized transport has in many cases exacerbated the “transport poverty” of the lower economic classes.

To counter these trends, some cities have undertaken strategies to reduce car travel and better manage car parking.<sup>28</sup> For example, Singapore adopted a multipronged strategy to reduce automobile use, in addition to constructing an extensive mass transit system. The strategy includes quotas on the number of new cars that can be purchased, substantial taxes on the purchase and annual license of cars, congestion pricing, and cheap mass transit tickets (compared to local incomes and other Asian nations).<sup>29</sup> Meanwhile, since 1994, Shanghai has restricted the number of cars by instituting a local vehicle-license auction. Suburban cars are forbidden from entering the core, and cars with nonlocal licenses are forbidden from driving on the elevated expressway network in the central urban area during peak hours. Sometimes outcomes of transport policies differ greatly from intuitive expectations. For example, Jakarta provided priority on its roads for high occupancy vehicles (HOV) in order to reduce car traffic. This led to the widespread emergence of “jockey” services for a fee, which even included children. When the city suspended the program there was no change in car usage; instead, there was a sudden surge in the volume of bus passengers who were no longer sought by car drivers.<sup>30</sup>

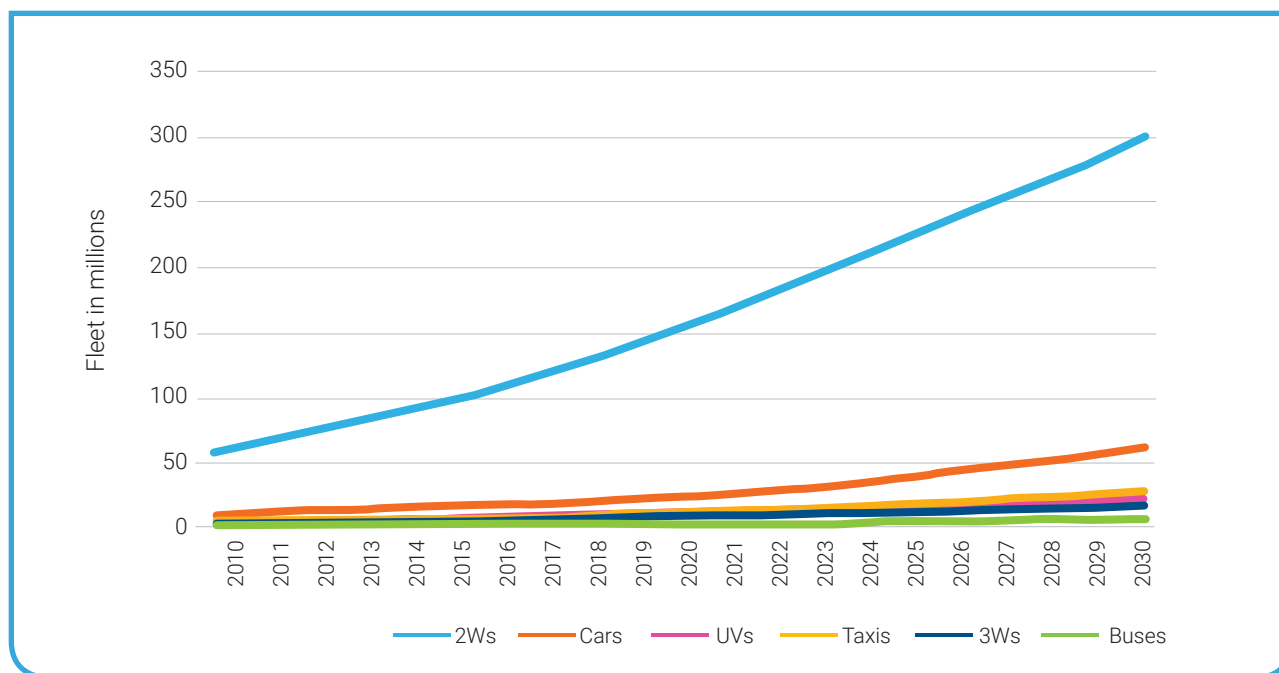
### 2.3 Motorcycles, scooters, and other two-wheeled private vehicles

Powered two- and three-wheelers play an important role in passenger mobility, particularly in South-East and South Asia. Two-wheelers, including mopeds, scooters, and motorcycles, are used mostly for personal transport. More than half of the motor vehicle fleet in China, Thailand, and Malaysia consists of two-wheelers. In Indonesia and Viet Nam, the figure exceeds two-thirds of the fleet; it is estimated that in Viet Nam, virtually every adult owns a motorcycle.<sup>31</sup> In India, more than 70 per cent of motorized vehicles are two-wheelers (Figure 2.6).<sup>32</sup> Delhi has around 6.6 million registered motorcycles; Bengaluru, a much smaller city, has around 5 million.<sup>33</sup> Karachi has around 2.7 million registered motorcycles.<sup>34</sup> In 2011, the share of travel by private motorcycles in Phnom Penh was 64 per cent, with an additional 8 per cent traveling in motorcycle taxis.<sup>35</sup> In Jakarta, more than half of the trips within the capital region were on motorcycles in 2012, compared to only 14 per cent in 2000.<sup>36</sup>

Not only are motorcycles cheaper, but they are often faster than other modes. For a 5-7 km trip - the most common travel distance in the two cities - a motorcycle typically takes 15-20 min, whereas a private car takes 25-30 min; buses take longer.<sup>37</sup> In South-East Asian cities, motorcycles can, almost magically, navigate streets swarming with cars, buses, pedestrians, and vendors.<sup>38</sup> On the other hand, motorcycle use in Bangladesh has been much lower, as it has been hampered by a lack of domestic production, high costs for imported motorcycles, high taxes and registration costs, and lower income levels.<sup>39</sup>

While two- and three-wheelers are seen as a solution by much of the population, they are also seen as a source of transport problems. Apart from their poor safety record, critics point to the high levels of pollution that they cause. Another criticism is that they are usually parked on sidewalks, and even drive on sidewalks during rush hour, to the detriment of pedestrians and cyclists.<sup>40</sup> On the other hand, two- and three-wheeler users like these modes because they are cheap and fast.<sup>41</sup> To encourage people to buy motorcycles with smaller engines and thereby reduce emissions, some governments have made motorcycles with small engines exempt from special permit and license requirements.

**Figure 2.6 Vehicle stock in India**



Source: Soman *et al.*, 2020. Note: 2018 onwards are the projections based on prevailing BAU CAGR trends.

While two- and three-wheelers have dominated travel in much of urban Asia, explosive growth in car use is anticipated as incomes levels increase. Given that a car needs at least four times as much road space as a two- or three-wheeler, a huge amount of extra road network would be needed if a significant proportion of the population switched from motorcycles to private cars. In some cities, such as Hanoi and Ho Chi Minh City, the street networks are dominated by narrow alleys which are hard to serve with public transport. In this context, two- and three-wheelers are more efficient than cars and therefore should be prioritized over cars in the allocation of road space.<sup>42</sup>

## 2.4 Paratransit and informal transport

Paratransit includes both motorized and non-motorized transport modes. Motorized modes include taxis, shared taxis, minibuses, jeepneys, angkots, and three-wheelers such as auto-rickshaws in India and Sri Lanka, baby taxis in Bangladesh, and tuk-tuks in Thailand, as well as larger vehicles such as tempos in Bangladesh, Nepal, and parts of India, which carry as many as a dozen passengers.<sup>43</sup> In many South-East and South Asian cities, motorcycles are also used for paratransit (Figure 2.7). Bottom-up, demand driven informal minibus (marshrutka) mobility services operated by the private sector have emerged in Central Asian cities such as Bishkek and Tbilisi.<sup>44</sup> Examples of non-motorized vehicles include rickshaws, pedicabs, thela or push carts, buggy/tonga or animal-drawn carts, inland boats, and ferries. The term “paratransit” is often used interchangeably with informal transport, but some forms of paratransit are regulated by transport authorities. Figure 2.8 shows the share of informal transport in selected Asian cities.

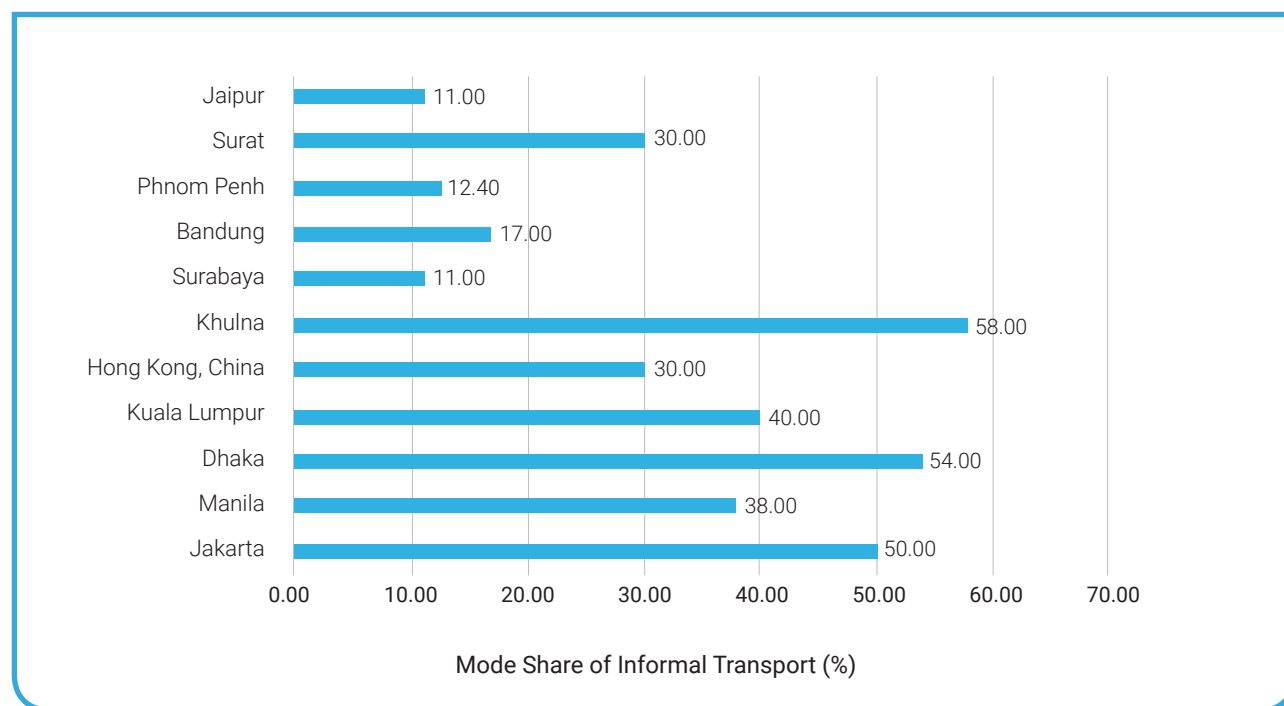
For decades, support for paratransit use has been undercut by the political influence of the automobile and road lobbies, as well as affluent drivers who like to sustain a car-oriented lifestyle. These groups often push for curbs on paratransit use. Rickshaws are often blamed for causing traffic congestion because

**Figure 2.7** A motorcycle taxi stand (wyn) in Bangkok



Photo credit: Madan B. Regmi

**Figure 2.8** Share of informal transport in selected Asian cities.



Source: ESCAP SUTI Mobility Assessment Reports

they are slow moving.<sup>45</sup> In addition, the motorized paratransit sector is often blamed for high levels of air-polluting emissions in Asian developing cities. This is a valid claim because vehicles tend to be ill-equipped, second-hand imports in poor condition.

However, these vehicles also serve as a flexible public transport mode, highly responsive to passenger demand, especially in poorer Asian countries. In some cities, they provide services between points that are not served or are inefficiently served by public transit. Paratransit operators, who are well-familiar with the local context, are often in a better position to quickly respond to market demand than slow planning bureaucracies.<sup>46</sup> They can navigate narrow alleys and dead-end streets or walkways, which are impenetrable by formal transport. Paratransit services also offer a convenient transport option for vulnerable groups such as women, children, and the elderly, and address the first mile/last mile access issue, which is key to the success of mass transit systems such as metros and BRT systems. Finally, paratransit provides a significant source of employment for the poor. It has been estimated that there are 10 million rickshaw drivers in India, while Bangladesh has 2 million rickshaw drivers with 280,000-400,000 operating in Dhaka alone.<sup>47</sup>

Recent studies have focused on the sustainability of paratransit and its integration into the overall public transport system.<sup>48</sup> In some cities, the paratransit fleet is gradually electrifying – although this necessitates the construction of supporting infrastructure (e.g., charging facilities), provision of maintenance services, and financing schemes to cover the initial costs of e-vehicles. In Nepal, for example, the government has mandated and supported the electrification of paratransit in the Kathmandu valley. In the Philippines, the Asian Development Bank is working with the government to promote the adoption of e-trikes in cities. The operation of e-jeepneys in Manila has also recently been considered by a group of utility vehicle operators in the Philippines.<sup>49</sup> A study in Jakarta, however, found that paratransit drivers were reluctant to switch to new technologies without government support due to cost implications.<sup>50</sup>

## 2.5 Active transport modes

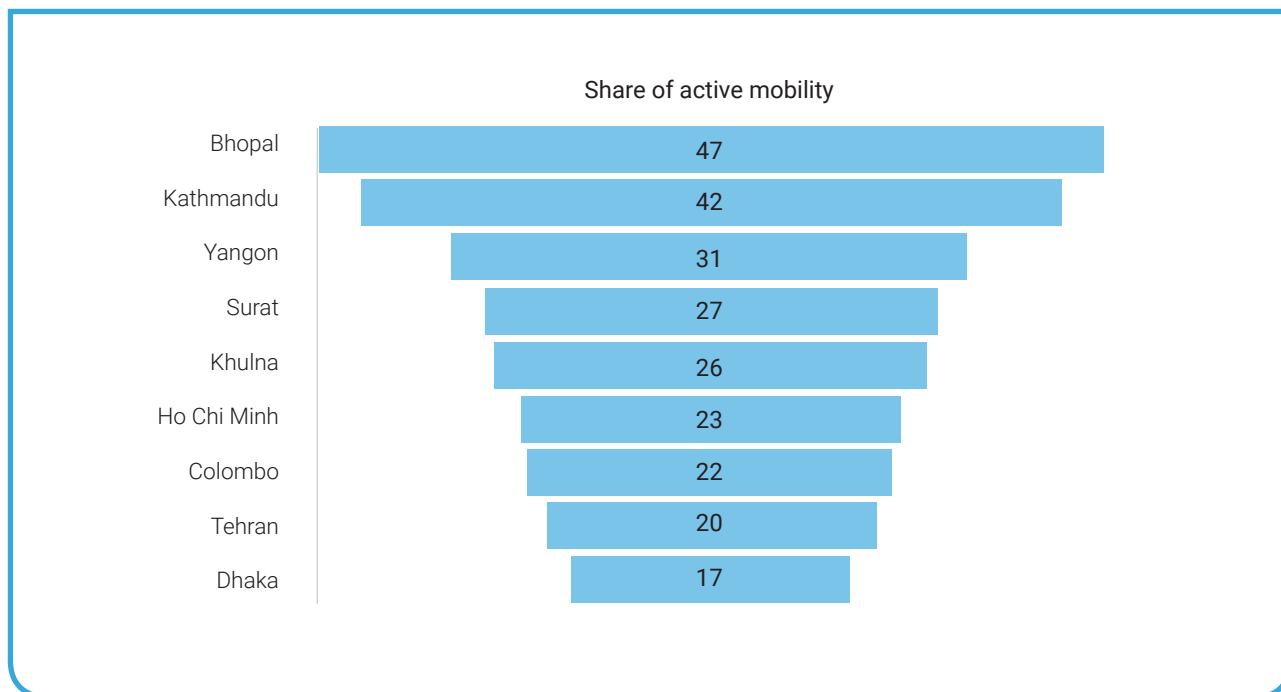
### 2.5.1 Pedestrians

The share of walking and cycling is quite high in many Asian cities, highlighting the importance of these modes in meeting the needs of urban residents. Figure 2.9 shows that the mode share of active mobility in commuting trips is higher than 20 per cent in many cities; the high share in Bhopal, Kathmandu and Yangon highlights the importance of active mobility in meeting the needs of urban residents. In Indian megacities, the share of NMT ranges between 40 and 50 per cent.<sup>51</sup> Many countries have prioritized active mobility as they have the potential to reduce emissions,<sup>52</sup> while some have also noted its importance in the context of the COVID-19 pandemic, when other forms of public transport were suspended.

Transport planners have repeatedly noted and have been highly critical of the loss and degradation of the most basic form of travel in Asia, walking, which is free and therefore affordable for all (Figure 2.10). The creation of space for motorized transit has often led to the disappearance or reduction of passable space for pedestrians – such as basic sidewalks.<sup>53</sup> This has forced the population to use paratransit or cars, even for short trips that could be easily accommodated on foot.<sup>54</sup> Another common critique has been a failure to take into account pedestrian access to mass transit.<sup>55</sup> Infrastructure for pedestrians is essential to reduce the negative externalities of automobility. Improving urban design, creating interconnected parks, lining all streets with sidewalks, and designating car-free zones and days can induce more walking trips.



**Figure 2.9** Modal share of active mobility in selected cities (percentage)



Source: ESCAP calculations based on data from SUTI mobility assessment reports,

**Figure 2.10** Heavy pedestrian traffic in Manila



Photo credit: Dorina Pojani

## 2.5.2 Bicycles and other forms of micromobility

Throughout Asia, there has been a steep drop in bicycle use as motorized traffic has overwhelmed road space and created a dangerous environment for bicycle travel. However, this trend may be reversed in the near future by new forms of personal mobility, or “micromobility”. The term “micromobility” is used to describe small-scale modes of transport such as bicycles, which remain the most common form found in Asia. However, more often it refers to electric-powered modes of transport which are lightweight and designed for short distances.<sup>56</sup> An increasing variety of micromobility vehicles have come onto the market, including electric bicycles (e-bikes), electric kick pedal scooters (e-scooters), e-skateboards and Segways. In Chinese cities, the decline in conventional bicycles has been offset by a growing demand for e-bikes, with sales in the range of 30 million per year.<sup>57</sup> Already by the mid-2010s, China accounted for more than 90% of the global e-bike market, and there are 700 registered e-bike producers in the country.<sup>58</sup>

In other countries, take-up of electric vehicles such as e-bikes and e-scooters has been much slower, for a variety of reasons. One is that these modes are more expensive than their original versions, discouraging people from buying them. Furthermore, e-bike usage is feasible in China due to extensive bicycling infrastructure (Figure 2.11), with growth accompanied by the spread of docked and dockless bike sharing. Another barrier to their adoption is the ambiguity of their classification: are electric bicycles motorized or non-motorized vehicles? This has a bearing on how they can be used. For example, if they are classified as a kind of bicycle, then some cities would allow them to be used on pavements, but if they fall into the category of motorized vehicles, they would be restricted to roads, making them much more dangerous to the user. Another related issue lies in their safety, especially as their batteries allow them to reach speeds equivalent to ordinary motorcycles.

The challenge for government regulators is to allow people to benefit from these modes, which are convenient, relatively cheap and flexible, but also ensure the safety of the users as well as people riding other modes. In Japan, for example, e-scooters are still classified as motorcycles with small engine displacement. This means that riders must have a driver’s license, compulsory automobile liability insurance, and a registration plate; helmets are optional but very strongly recommended. Another issue related to bike and scooter rideshare services has been the haphazard way in which these vehicles are parked around cities, becoming a safety hazard for pedestrians, especially persons with disabilities, as well as an additional expense for municipalities.

Some studies suggest that the majority of e-bike users are former bus or bicycle riders, rather than former car drivers,<sup>59</sup> which suggests that their contribution to sustainable goals is limited. However, advocates maintain that they are an affordable, efficient, and environmentally friendly form of transport. They are particularly useful for access to transit stations, and they provide a route for the entry of the poor into the economic life of cities. Uneducated and marginalized male migrants find work by making deliveries on e-bikes or providing ‘last mile’ passenger services to rail commuters.<sup>60</sup> Under these circumstances, the creation of dedicated e-bike infrastructure could be useful. Low-speed and low-conflict rights-of-way should be complemented by secure parking and feed high-capacity public transport systems.<sup>61</sup>

## 2.6 New mobility services

New mobility services refer to the many emerging transport services linked to digital technologies. The word “mobility” shifts the focus from the movement of vehicles (transport) to the movement of people (mobility), while “services” suggests that trips can be “bought”, like other services, using

**Figure 2.11** A cycle path in Shanghai, China



Photo credit: Yijia Cheng

digital interfaces. Examples of new mobility services include shared mobility services (car, bicycle and scooter sharing); ridesharing services such as carpools, whereby drivers allow other people to share their journeys and split the costs, as well as ridesourcing platforms whereby users can request road transport services using apps or online platforms; and even new forms of delivery services which link independent couriers to freight or packages for delivery.

New mobility services are underpinned by several different technologies. One is global positioning system (GPS) based navigation systems, which allow drivers to reach the person requesting rides, and passengers to recognize drivers, based on their respective geographical coordinates. Another is cashless payment systems, usually involving the registration of bank details with a service provider so that no cash transaction takes place between drivers and passengers. Another is the development of algorithms to allow service providers to operate with dynamic pricing, whereby the fares vary depending on the level of demand in that area at that time. But the gateway to all of these services is the smartphone, which contains the necessary apps with which to request and access the service. Transport authorities therefore need to ensure that transport providers also offer alternative methods to engage passengers who don't own smartphones, thereby reducing the risk of excluding them from these new services.

Technologies are also redesigning traditional transport services such as buses and paratransit operations. For example, in India a large number of bus booking apps have emerged in the past twenty years, including RedBus, AbhiBus, Yatra, Paytm Bus booking app, Make My Trip, and Goibibo to name just a few, many of which were developed by Indian entrepreneurs and tech companies, while in Pakistan bus companies such as Daewoo Express and Faisal Movers have developed their own booking apps for their

customers. Meanwhile, in some Japanese cities, population decline has led to a fall in bus passengers, making it financially unviable for bus operators to provide services. To avoid losing services altogether, municipalities request bus companies to adopt demand responsive transport systems (DRT), whereby users can book buses (or sometimes minivans) as and when they need them using an app or telephone. As they operate without a schedule or routes, they are more flexible than traditional bus or rail services. In some cases, they can also provide door-to-door services, which is a big advantage for the rapidly ageing population.

New mobility services are perceived as being 'disruptive' in the sense that they often introduce new business models or functions, sometimes threatening the incumbent transport service providers. Many pose governance challenges because they are so new that existing regulations cannot regulate them. Such governance challenges suggest that both the public authorities and private transport operators, as well as the IT firms behind service aggregators, must cooperate to avoid further confusion and congestion brought about by these services; the UITP argues that cities with an established Public Transport Agency (PTA) are likely to deal better with changes brought on by new mobility services.<sup>62</sup>

On the other hand, some new mobility service companies employ existing taxi or motorcycle taxi drivers, thereby improving the matching of demand and supply, and boosting their incomes in the process. Many of the most successful new transport companies have emerged from Asia: Didi in China, GoJek in Indonesia, Grab in Singapore, Ola and Jio in India, to name just a few. These companies are now operating across Asia; Grab, for example, lists services in cities in Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand and Viet Nam.<sup>63</sup> Now some of these companies also provide food delivery, hotel reservations, cleaning services, and financial services, making them so-called "superapps".<sup>64</sup> A study of online taxi services in three cities in Indonesia revealed the preference to use a ride-hailing car taxi service compared to motorcycle taxi services.<sup>65</sup>

Furthermore, an increasing number of cities have created or are currently planning integrated ticketing systems. Such systems are examples of Mobility as a Service (MaaS)-type systems, whereby users can 'order' transport from a single integrated platform. The MaaS Alliance (Europe) suggests that MaaS adds value for users by "using a single application to provide access to mobility with a single payment channel instead of multiple ticketing and payment operations."<sup>66</sup> Such a high degree of integration is difficult to achieve in most cities because of different regulations governing different modes as well as different technological platforms already in use, but passengers in Australia; Taipei and Kaohsiung in Taiwan, Province of China; Shanghai; and Singapore can all access MaaS-like integrated ticketing services using just one app.<sup>67</sup>

## 2.7 Transport diversity: strength or hindrance?

As this chapter has shown, transport systems in Asian cities are characterized by a tremendous diversity of modes. This diversity is partly a reflection of the varying needs which people have, as well as different levels of urban development. Having a wide variety of transport options can contribute to more resilient urban transport systems because they offer redundancy and alternatives under different conditions. Despite significant progress in expanding mass transit systems, however, transport authorities in many cities are still struggling to deliver sustainable, accessible, and inclusive services. Mass transit projects are disruptive and take time from conception, design to realization, while debates abound over the allocation of scarce funds among various modes of transport. The notion of limiting automobile use

has also moved up the policy agenda, but governments seem unwilling to enact policies in the face of pressure from both people as well as the automotive businesses. Meanwhile, the COVID-19 pandemic has placed additional burdens on transport planners and operators, with uncertainty about how the impacts of the pandemic will play out. The next chapter takes up some of the major issues and challenges to developing sustainable urban passenger transport systems.

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Photo credit: Martin Jude Suarez





## Chapter 3

# Issues and Challenges to Sustainable Urban Passenger Transport Development

As noted in the previous chapter, passenger transport demand is on the rise. This rise is partly due to the changing distribution of social and economic activities within geographic spaces, but also to the scale of population growth. About 2.3 billion people live in urban areas, with projections showing that this number will grow to reach 3.5 billion by 2050. Beijing, Jakarta, Manila, Mumbai, Seoul, and Shanghai have over 20 million inhabitants, while Delhi and Tokyo have over 30 million inhabitants. Not only the number, but also the proportion of the urban population is increasing; in 2019, the number of people living in urban areas surpassed the number living in rural areas. In Malaysia, for example, 75 per cent of the population lives in urban areas. Even smaller countries are growing rapidly: Lao PDR and Cambodia experienced 7.3 per cent and 4.3 per cent annual growth in population, respectively.<sup>1</sup> Furthermore, it is anticipated that exponential rates of growth will continue: in 2015, India was projected to have an increase of 250 million urban dwellers by 2030,<sup>2</sup> while Indonesia's urban population is predicted to reach 60 per cent by 2025.

However, the number of people is not the only, or even the main, cause of the various transport problems which persist in Asian cities. A major factor is simply that urban passenger transport policies continue to put the movement of vehicles before the movement of people. Widespread congestion and perpetual traffic jams are now common, and other externalities include air pollution, noise, severe health hazards, lack of public and green space, and environmental degradation.<sup>3</sup> In this regard, some observers point to weaknesses in governance and policy implementation. The need for policies to reduce overreliance on individually owned vehicles is particularly acute in cities that are already large and dense, as is typical in Asia, since dense cities are particularly vulnerable to the negative impacts of traffic. However, it is equally vital for smaller secondary cities, where a large proportion of the region's population lives, to invest in sustainable transport systems now, taking advantage of the lessons learned from previous patterns of urban development. This chapter discusses some of the key issues and barriers to sustainable urban passenger transport systems in Asian cities.

## 3.1 Energy use in the urban transport sector

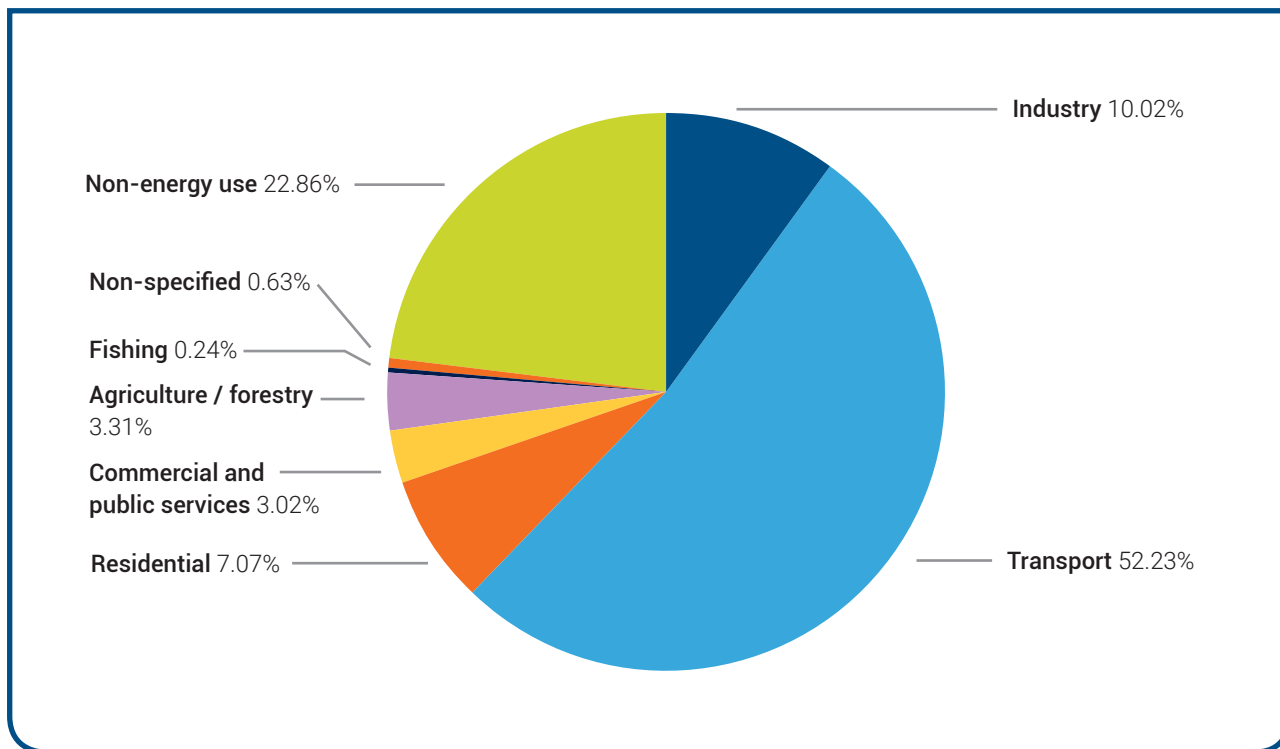
### 3.1.1 Dependence on fossil fuels

The Asia Pacific region has witnessed sustained economic growth, leading to rising demand for both freight and passenger transport and a corresponding increase in energy demand. With economic growth, the disposable incomes of some sections of society have also risen. Most studies have shown that the number of private cars is the main influencing factor of passenger transport carbon dioxide emissions, but individual and household characteristics such as people's awareness of energy conservation, household structure, residential and working locations, also affect travel behaviours such as travel frequency, travel mode, travel distance. For example, environmentalists may be more willing to take public transport with less energy consumption, although it may cost more in terms of time or even money.<sup>4</sup> Families with young children may be more inclined to use private cars to pick up their children considering their safety and security.<sup>5</sup> On the other hand, the spatial differentiation of living and working places can also cause people to drive instead of choosing 'greener' modes such as walking or bicycling.<sup>6</sup> Furthermore, people's lifestyles also affect the energy consumption of travel. For example, people who like to work overtime or who like to drive will rely more on cars.

In 2015, the global transport sector accounted for 64.7 per cent of crude oil consumption; this resulted in 7.75 Gt of CO<sub>2</sub> emissions.<sup>7</sup> The region's transport sector, which is primarily powered by fossil fuels, was responsible for 52 per cent of total oil consumption in 2018, up from around 40 per cent in 1990 (Figure 3.1). Globally, the amount of crude oil consumed in the urban transport sector alone accounts for about

40 per cent of the total crude oil consumption of the whole transport sector.<sup>8</sup> Vehicle fuel is oil dependent, with traditional petroleum buses making up more than 73 per cent of buses and traditional gasoline vehicles making up 99 per cent of private cars.<sup>9</sup>

**Figure 3.1 Final consumption of oil products by sector, 2018**



Source: ESCAP calculations based on International Energy Agency, "World energy balances 2020", online data and statistical database.

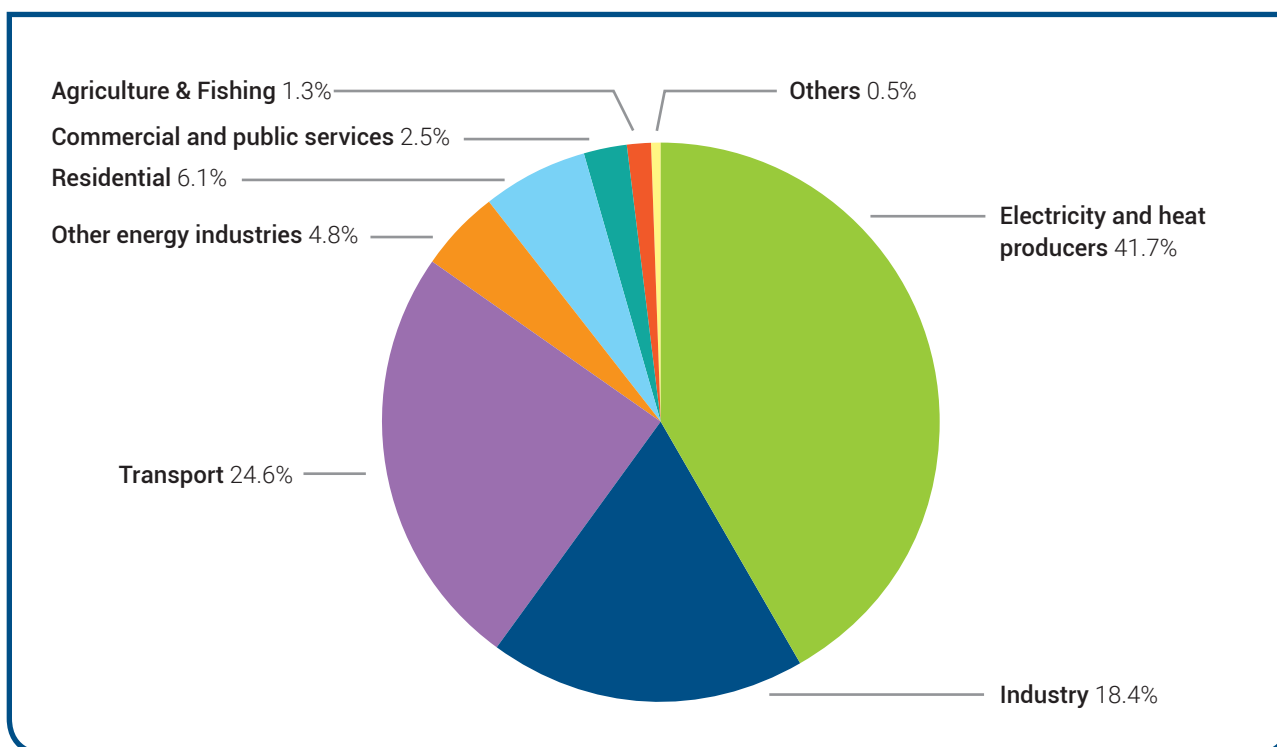
Consequently, the transport system accounted for 24 per cent of total CO<sub>2</sub> emissions in 2018 (Figure 3.2).<sup>10</sup> Due to the high dependence of transport on crude oil, as well as continuously increasing human activities and transport demand, CO<sub>2</sub> emissions from transport have surged.

With increasingly sophisticated and inexpensive tools available to estimate sector-specific energy and emission calculations, it is possible for governments to forecast scenarios based on different policy options. Such analyses are useful to help governments base their policy decisions. Chapter 4 will discuss the results of a modelling exercise based on an integrated transport and energy model which projects regional passenger transport demand for different modes and technologies, and estimates transport-related energy use and CO<sub>2</sub> emissions.

### 3.1.2 Fossil fuel subsidies

Globally, the IEA estimates that governments spent about US\$ 320 billion on fuel subsidies in 2019.<sup>11</sup> Oil accounts for almost US\$ 150 billion or about 47 per cent of total fossil fuel subsidies, of which transport oil subsidies make up an estimated US\$ 78 billion. Countries with the highest transport oil subsidies are Indonesia (US\$ 17 billion) and the Islamic Republic of Iran (US\$ 13 billion), followed by countries such as Malaysia, Kazakhstan, Azerbaijan, Turkmenistan, Uzbekistan, Sri Lanka, and Brunei Darussalam (Figure 3.3, 3.4).

**Figure 3.2 Proportion of CO<sub>2</sub> emissions from fuel combustion by sector in 2018**



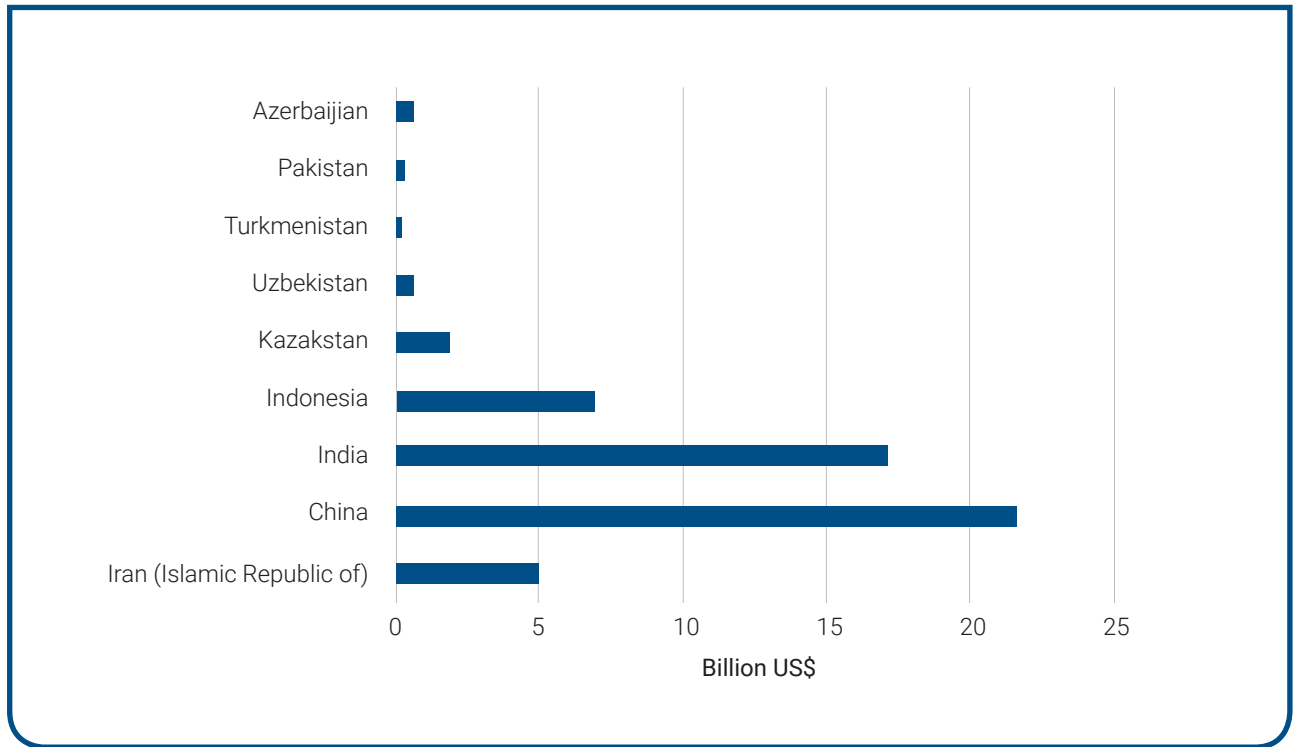
Source: IEA, <https://www.iea.org/data-and-statistics/data-product/co2-emissions-from-fuel-combustion-highlights>

In 2012, it was estimated that developing Asian countries accounted for about 30 per cent of the world's fossil subsidies,<sup>12</sup> and in 2019, ten out of the top 25 countries in the world that subsidized transport oil were in Asia. Currently, the highest subsidies are for oil, followed by gas and coal. For fossil fuels, subsidies can either be for generation of electricity or for their direct use. Subsidies for electricity generation can encourage different infrastructure for power plants, which will in turn contribute to the difference in energy mix of the electricity generation system. Coal subsidies are prevalent in India and Indonesia, a reflection of their high dependence on coal for their energy mix. Petroleum products, subsidized diesel and petrol for direct use, which are mainly consumed by the transport sector, were estimated at US\$ 280 billion in 2011.<sup>13</sup>

While the global trend is a decrease in fossil fuel subsidies over time, they are still very common in some Asian countries. Their intentions are to increase the affordability of energy for poorer sections of the population, as well as support energy producers to recoup the costs of production and distribution, but worldwide experience shows the economic and environmental costs of these subsidies outweigh any social benefits. Very often, they support wasteful and excessive consumption of energy which has adverse economic, social, and environmental effects.<sup>14</sup> For example, subsidized petrol and diesel prices encourage people to use their cars rather than public transport. Furthermore, the targeting of subsidies is very often inefficient, and they do not necessarily reach people who need them most.<sup>15</sup> Additionally, savings made by governments by removing subsidies can be used in other sectors that need investment. Transport oil subsidies in Asia and the Pacific can create perverse incentives and thus hinder the decarbonization of the transport sector, especially in the private passenger transport segment.

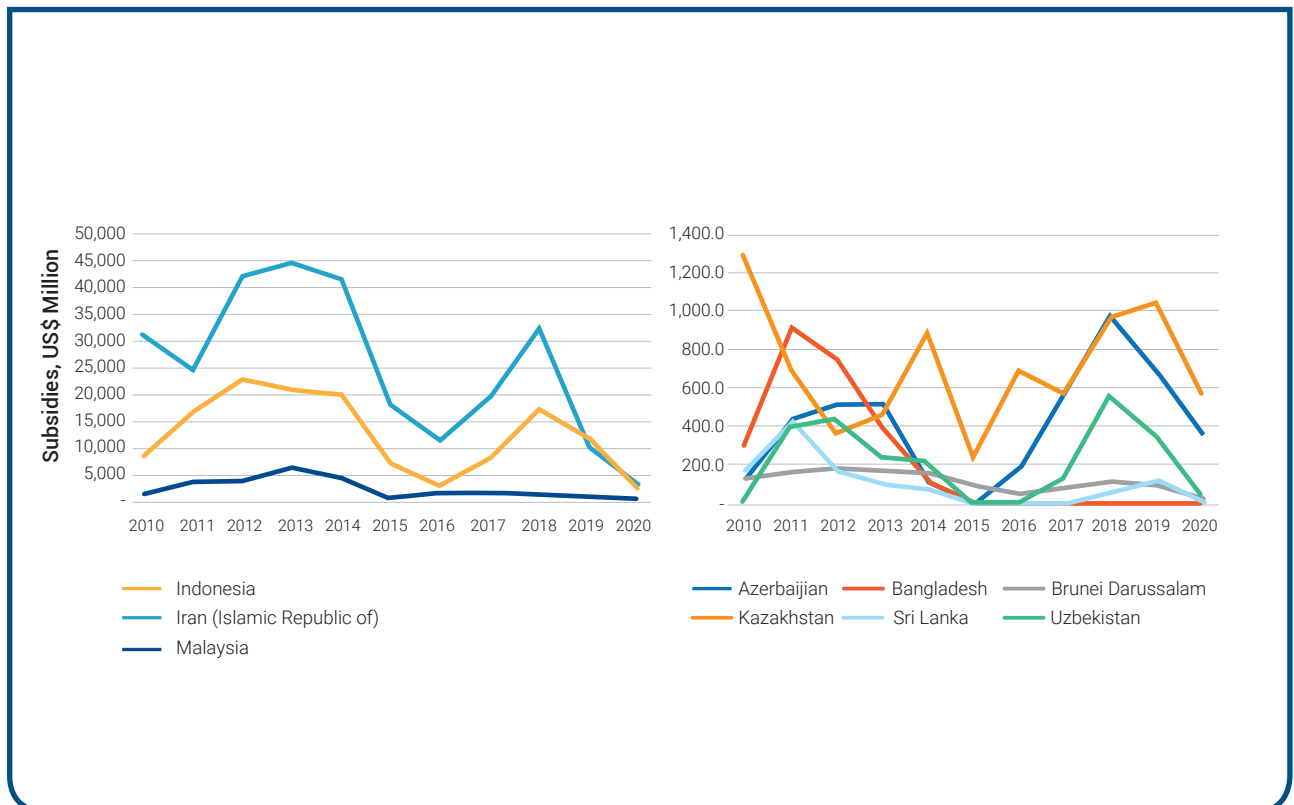
There is therefore a strong economic and environmental case for fossil fuel subsidy reform, but the social impact is less clear. The removal of subsidies will impact all sectors that use fossil fuels, but the transport

**Figure 3.3 Global oil subsidies, Asian countries, 2020**



Source: IEA Fossil fuel subsidies database

**Figure 3.4 Transport oil subsidies in Asian countries**



Source: IEA, 2020

sector will be severely affected because of its dependence on oil. Transport expenses represent a large share of households' monthly expenditure: between 5 and 17 per cent, depending on the region.<sup>16</sup> For drivers, removing subsidies and increasing prices will make private transport more expensive, thereby encouraging some to shift to public transport and non-motorised modes. It may also encourage people to electrify their transport vehicles. However, the impact of removing subsidies may affect low-income groups the most, particularly if transport operators pass the rise in energy costs to passengers. While governments agreed to phase out inefficient fossil fuels subsidies at the recent UNFCCC COP26 negotiations in 2021,<sup>17</sup> the focus now shifts to the implementation process, which must be handled in a sensitive and transparent manner.

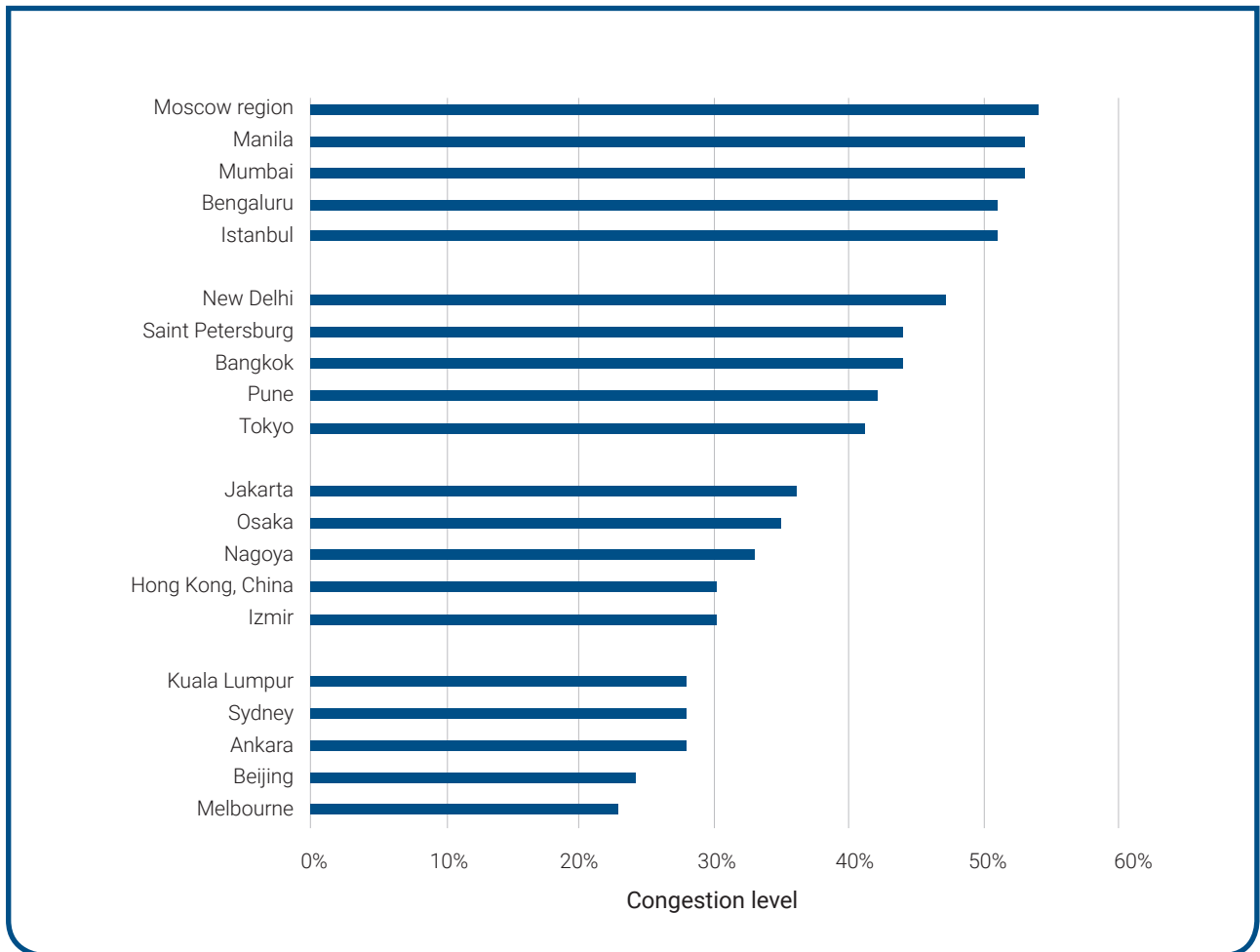
### 3.2 Traffic congestion, urban sprawl and travel times

In the past decades, the pace of urbanization has outrun the ability of many cities to resolve the transport issues that accompany such growth. Asian patterns of urban growth may be contrasted with the experiences of West European cities, which grew at a slower rate in a period which preceded automobiles, leaving them with enough time and sufficient resources to support the introduction of mass transit systems. In contrast, motor vehicle fleets are doubling every five to seven years in some Asian countries. Rapid motorization, coupled with growing mobility demand, have led to severe congestion. In 2019, large Asian cities experienced severe traffic jams, which is defined as the increase in overall travel time compared to a free flow situation. Figures range from 20 to more than 50 per cent (Figure 3.5), with Moscow, Manila, and Istanbul experiencing more than 50 per cent congestion, New Delhi, Bangkok, and Tokyo with more than 40 per cent congestion, and Jakarta, Osaka and Izmir with more than 30 per cent congestion. Road traffic congestion is also a tremendous economic burden, accounting for 2 to 5 per cent of GDP in Asia and the Pacific.<sup>18</sup>

But the other side of the story has been the massive geographic expansion of cities, which, together with an imbalance between jobs and homes, has increased average travel distances<sup>19</sup> and fostered the growth of individualized motorized travel. Suburbanization has taken various forms: it has been a route for burgeoning middle classes to escape crowded central areas and obtain more living space, and it has also been a source of cheap land for the corporate sector to build massive housing developments.<sup>20</sup> At the same time, large peri-urban areas with illegal settlements have been created by poor households who cannot afford inner-city rents. Such settlements often lack infrastructure, public facilities, and basic services, including public transport and adequate roads, because this housing pattern is not easily served by public transport.<sup>21</sup> In some countries, sprawl has been exacerbated by land use restrictions and/or public land development programs, as well as massive road construction. These trends often reflect weaknesses in urban planning policy design, or the poor implementation of good policies. At the same time, more investments in jobs and services in rural areas may also help stem the flow of migrant workers to the cities.

The increase in average travel distance and congestion described above adds to the time to reach employment and complete other daily tasks. Inadequate public transit has driven private car use to levels that saturate the space available for travel, which is small compared to what is needed. Consequently, travel speeds are reduced to a snail-like pace. For examples, in Dhaka the average speed of traffic dropped from 21 km/h to 7 km/h within ten years,<sup>22</sup> while in Jakarta average travel speeds gradually decreased from 25 km/h in 1985 to 9.5 km/h in 2011; travel from south Jakarta to central Jakarta during the morning peak, which took 38 min in 1985, took 100 min in 2011.<sup>23</sup> On a more positive note, travel times in Hanoi and Ho Chi Minh City have remained short, despite the fact that distances are similar to cities of comparable size.

**Figure 3.5 Congestion in Asian Cities, 2019**



Source: TomTom Index

The average trip length is 5-6 km while the average travel time is less than 20 min. Fewer than 10 per cent of trips take more than a half hour. The modal share of car use has remained low while motorcycle use has become nearly universal; buses serve less than 10 per cent of the trips. Most trips by motorcycle and bus are relatively short. However, the situation may be changing since major traffic jams are increasingly common. As more people embrace automobility, the two Vietnamese megacities may be reaching a tipping point, beyond which congestion becomes extremely severe.<sup>24</sup>

### 3.3 Air pollution and other emissions

Emissions from cars, buses, and motorcycles have led to overwhelming levels of pollution and substantial adverse health impacts. In addition to CO<sub>2</sub>, other pollutants of concern are particulate matter (PM), especially PM<sub>10</sub> and PM<sub>2.5</sub>, NO<sub>x</sub> (which contributes to ozone levels), and other hydrocarbons. Emissions are exacerbated by old vehicles, poor vehicle maintenance, and low fuel quality.<sup>25</sup> While many vehicles are gradually becoming cleaner, improvements are offset by the growing number of vehicles as well as congestion. In contexts where more than half of all trips are on foot or by bicycle or motorcycle, many people are exposed to emissions on a daily basis. In addition to staggering human health impacts, air pollution has a steep economic cost in terms of health costs and lost workdays. A series of measures to reduce pollution in Asian cities have been recommended for years, but implementation has been slow.<sup>26</sup>

One of the notable effects of the fall in mobility during the COVID-19 pandemic was the return of blue skies to many Asian cities. Due to the COVID-19 pandemic lockdowns and restrictions in major Asian cities (New Delhi, Bangkok, Colombo, Kathmandu, Dhaka, Jakarta, Hanoi, and Metro Manila) air pollution levels decreased in 2020 compared to 2019.<sup>27</sup> However, the air quality in all cities exceeds the WHO target of 10 µg/m<sup>3</sup> for PM<sub>2.5</sub>.

### 3.4 Social exclusion from urban transport systems

While Asian countries have been experiencing remarkable economic growth, the patterns of transport and housing development have not been favourable to certain groups of people. Historically, pedestrian travel, individualized non-motorized and motorized vehicles, and small paratransit have been the dominant form of travel in Asian cities. Low-income groups are particularly dependent on these modes,<sup>28</sup> but they are also important for non-poor such as some women and children, people with disabilities, and others who do not have access to private modes of transport. Yet planning for these modes of transport has not only been ignored, but sometimes repressed because they are seen as an impediment to car use and bus and rail transit. This has only exacerbated transport problems in poorer Asian cities, accelerating the use of motorized transit, lengthening routes for the same trip, escalating the burden on public transit, and exacerbating social exclusion.<sup>29</sup> Meanwhile, public transport projects have favoured large-scale projects, such as highways, metros, and BRT.<sup>30</sup> While these are welcome from the perspective of environmental sustainability, they have not necessarily improved accessibility. In Jakarta, for example, between 2000 and 2012, the average trip distance doubled to around 15 km, with a longer average for low-income households.<sup>31</sup>

In this regard, it is important to acknowledge the complexity of the exclusionary effects of transport infrastructure and services on different people. A larger proportion of people in Asian cities are excluded from transport services than in industrialized cities, but given the diversity of mobility needs and capabilities, not all people are affected in the same way. However, certain groups are more likely to be excluded than others, as described below.

#### ***Low-income groups***

Low income groups and people who do not have regular employment are sometimes forced to live far from jobs and services, cannot afford to own a car, and have to travel on inadequate public transit systems. In many cities, the physical separation of residential areas from places of employment and services forces urban residents to spend more time and money on transport, with a growing dependency on private motorized transport and other car-centered mobility.<sup>32</sup>

#### ***People with disabilities***

The UN Convention on the Rights of Persons with Disabilities (CRPD) went into force in 2008 and has been ratified by 182 nations to date. However, the implementation of accessibility measures has been surprisingly slow in the Asia Pacific region, even for new mass transit projects. Apart from being deterred by the usual cost issues, efforts to improve access for people with disabilities is plagued by a lack of knowledge about such requirements, failures to enforce existing standards, and failures to obtain input from special-needs groups in the planning process. Public officials are often unaware of how a little



attention to detail in the design of public infrastructure can make a huge impact on the lives of people with limited mobility, vision, hearing, and other impairments. Too often the perception is that making urban transport accessible will be costly, but many examples have shown that there is no appreciable difference in cost between streetscapes that are fully accessible and those that are not.<sup>33</sup> It is therefore within the power of governments to make public facilities and services accessible, with progressive upgrades to their plans, as is stipulated by the CRPD. They can do this by following Seven Principles of Universal Design (Box 3.1). Such measures will also support the accessibility of other groups, such as the elderly and people travelling with small children.

### ***Elderly people***

In recent years, the proportion of the Asian population that is elderly has been growing rapidly thanks to improved living standards and medical care. Since the mobility level of elderly people usually decreases with age due to disability, transport-related social exclusion is becoming more serious in developed Asian countries/regions, with elderly people facing difficulties in participating in social and economic activities because of lack of transport services. One commentary warns that developed Asian countries may need to adjust their social systems in response to changes in the total population and the age structure within a short time period.<sup>34</sup> While support for elderly people's mobilities ranges greatly from city to city, many municipalities can't afford to provide specialized services, and elderly people depend on regular public transport services. Public transport systems will need to be redesigned to accommodate the needs of the ageing population, for example by introducing the Universal Design elements described above.

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### **Box 3.1 The Seven Principles of Universal Design**

Among the various urban planning and design concepts that aim to be inclusive of the needs of the largest range of users (including women, the elderly, and people with disabilities), Universal Design has become the most popular. At its core, Universal Design promotes the idea of usable built environments for all people, not just a minority group. By applying Universal Design to the early design of built environments, barriers can be avoided and people's participation in society maximized.

The Seven Principles of Universal Design which can help guide designers in the application of this concept are (1) Equitable use; (2) Flexibility in use; (3) Simple and intuitive use; (4) Perceptible information; (5) Tolerance for error; (6) Low physical effort; and (7) Size and space for approach. While the United Nations Convention on the Rights of Persons with Disabilities calls for Universal Design principles to be recognized, the application of Universal Design is rarely, if ever, mandated in the cities of the Asia-Pacific region. At most, built environments rely on 'minimum accessibility' standards. Given that many cities are actively developing new transit systems, the time to integrate Universal Design would be now, rather than later.

### Box 3.1 The Seven Principles of Universal Design (cont.)



Photo credit: Mohsen Sadeghi

#### ***Women and children***

Women's travel needs differ from those of men. At the same time, women have limited access to personal vehicles so their travel patterns are governed by dependence on public transport, trip chaining, and off-peak travel. In this regard, a very serious barrier to their mobility is fear of being exposed to crime and sexual harassment. Harassment of women on public transit is a major problem in Asian countries, as well as most of the rest of the world. In 2017, one review noted that in surveys in Asia approximately half to two-thirds of participants report having experienced sexual harassment on public transport,<sup>35</sup> while studies carried out in Delhi found that over 90 per cent of women have faced some sort of sexual harassment – either inside public transport vehicles or waiting at a stop.<sup>36</sup> Due to fear of harassment, women and girls may reduce their use of public transport or move to more private modes of transport. In other words, their participation in activities is affected by their personal safety of available transport modes. This has led to the global phenomenon of women-only transit services. While not all transport experts agree that segregation of men and women is a long-term solution, in the short term it seems to support a greater sense of security (Box 3.2).

In many cities, most transport planning and design processes appear to occur in the context of social and political spheres in which the concept of social exclusion has not had much traction.<sup>37</sup> And yet it is these concerns which led the international community to adopt SDG target 11.2, which is “By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.” But a lack of data makes it difficult to

### Box 3.2 Women only transport

Women-only transit services in order to curtail harassment of women are a growing trend worldwide. In several Asian developing countries, including India, Japan, Indonesia, and Malaysia, mass transit systems include separate coaches for women. A survey of women's views about the pros and cons of women-only cars in the Tokyo metro reported a widespread divergence in views about their benefits. A substantial portion of the interviewees felt that surveillance cameras and increased police presence would be more effective tools in combating harassment.

A 2017 report by ITDP sets out comprehensive strategies to reduce harassment, including: separate ticketing booths for women at all stations, particularly at stations with more congestion, the employment of female guides and staff at ticket booths, upgraded paratransit and walking facilities around stations, well-designed partitions between females and males inside buses, and dedicated seating/waiting areas near the entrances/exits of BRT stations. The study notes that booths should not be provided where women have to divert and travel extra distance to reach bus bays. In the evening/night-time, proper lighting should be provided, and stations should be staffed with security officers.



Source: ITDP, 2017. Above: Women only coach in Delhi Metro. Photo credit: IStock/Elena Odareeva

monitor progress on this target, which is measured as a proportion (percentage) of the population that lives 500 meters or less from a public transport stop with minimum 20-minute service. Furthermore, given the different needs of various groups, the indicator should be measured for the general population and for vulnerable groups: the elderly, women, people with disabilities, and low-income groups.<sup>38</sup> While inclusive transport is a key aspect of any sustainability transport system, further empirical and theoretical work is needed to link this issue to other dimensions of sustainable transport.

### 3.5 Road safety

The Asia-Pacific region accounts for more than 60 per cent of the global total of 1.35 million estimated global fatalities from road crashes.<sup>39</sup> According to the WHO Global Status Report on Road Safety 2018, the fatalities per 100,000 inhabitants for the region in 2016 was 18.35, which is slightly higher than the global average (18.14). There are significant differences between subregions, with the highest (and only increasing region) being South and South-West Asia (20.3 per 100,000 people); South-East Asia (17.8 per 100,000); North and North-East Asia (16.75 per 100,000); North and Central Asia (16.5 per 100,000); and the Pacific (8 per 100,000). On the other hand, between 2013 and 2016, all subregions except the Pacific showed a decrease in the rate of road traffic deaths per 100,000 vehicles from 2013 to 2016. This rate was at least two times higher in the South and South-West Asia subregion than in other subregions. Although the rate of road traffic deaths in the Pacific subregion was lowest, it increased rapidly from 2013 to 2016.

Some of the distinct characteristics of road safety problems in Asia are the high share of powered two- and three-wheelers in their vehicle fleets, more fatalities among Vulnerable Road Users (VRUs), high number of fatalities per crashes in countries with mountainous terrain, high number of crashes involving truck drivers on major trunk routes, high speed and careless driving during festive seasons, and lack of accurate and timely road safety data. In the Asian context, VRUs include pedestrians, cyclists, and riders of motorized two- and three-wheelers. In 2016, pedestrians, cyclists and motorized two- and three-wheelers represented more than half of all global and Asia-Pacific region deaths. In both the South and South-West Asia subregion and the South-East Asia subregion, most deaths were among riders of motorized two- and three-wheelers, who represented 38 per cent and 62 per cent of all deaths, respectively.

Road safety is not only a social issue, but also takes a huge economic toll. Road crashes cost the countries of the Asia-Pacific region as much as 6 per cent of gross domestic product (GDP).<sup>40</sup> Among the 19 countries with available data, Japan had the highest estimated monetary loss due to road traffic crashes at nearly US\$ 64 billion, followed by India at approximately US\$ 58 billion. The economic cost of road crashes in the ESCAP region is estimated to be between US\$ 293 billion and US\$ 527 billion, which is as much as the GDP of Tuvalu, Kiribati, Marshall Islands, and Nauru combined.

As road crashes still represent a leading cause of mortality, the United Nations proclaimed the period 2021-2030 as the Second Decade of Action for Road Safety, with the objective of reducing fatalities and injuries by 50 per cent by 2030.<sup>41</sup> The experiences of some high-income countries such as Japan and the Republic of Korea suggest that it is possible to improve road safety, but it takes time and commitment from the whole of society. In many cases, countries also lack a systematic and holistic approach to tackle these road safety issues.

## 3.6 Governance and financing of urban transport development

### 3.6.1 Institutional weaknesses

The formulation and implementation of transport policies is difficult even under the best of circumstances. In a substantial portion of Asian countries, impractical institutional arrangements undermine efforts to bring about workable and rational approaches for addressing transport issues.<sup>42</sup> The power over the various facets in transport plans is commonly dispersed among numerous agencies, which do not operate in a coordinated fashion. This results in overlapping authorities between a multitude of agencies responsible for transport and the lack of integration between transport and land-use planning at the national and/or local level.

One of the main institutional weaknesses is the gap between national and municipal level transport plans. For example, there may be a lack of national guidance on transport policy or situations in which national transport plans are not binding on local governments and are not even filtered down. Some Ministries of Transport lack an urban transport division within their structure. Even within metropolitan areas, power over transit planning is often widely fragmented.<sup>43</sup> In very centralized countries, decision makers are often disconnected from the cities over which they make decisions. Top-down processes have resulted in conflicts with stakeholders. Public participation is key in ensuring that multiple stakeholders are invested into various transport projects.<sup>44</sup> Many Asian cities lack a vision for urban transport linked to national urban transport policies and supported by implementation strategies, missions, objectives, and targets.

Some commentators have pointed to problems arising out of the culture of collective decision-making which leads to an aversion to making any decisions.<sup>45</sup> Some commentaries highlight the need for strong political leaders to overcome institutional roadblocks. However, when the implementation of a project hinges on the support of a single individual, it faces the risk of being discontinued in case of electoral changes. In Asian countries, it is not uncommon for an entire public administration to be replaced upon the arrival of a new mayor or governor. In some cases, when there is a change of government, earlier mobility plans are usually scrapped, and entirely new plans are drawn.

To address these gaps, some cities have established transport coordinating authorities: Singapore's Land Transport Authority provides one of the best examples of transport and land-use coordination in the region. Other examples are the Dhaka Transport Coordination Authority and Greater Jakarta Transport Authority. But some coordinating agencies have not been given implementation power, thereby limiting the benefits of centralized planning authorities.<sup>46</sup>

### 3.6.2 Financing sustainable transport

Financing issues are at the core of the economic, social, and political viability of urban transport systems. At present, almost 80 per cent of the transport infrastructure funding still comes from the public sector, which is scarce and regulated. Despite the size of investment needed and the risks involved, many governments and donors opt for mega-projects which entail long periods for recouping the investment. Meanwhile at the operational level, major challenges are the operational losses incurred regularly and the need for subsidies from the local, regional, and/or federal governments. For most public transport systems, raising fares in line with operational costs is a sensitive issue.

International financial assistance has played a critical role in transit planning and development in some nations in Asia. Principal sources of aid have been from bilateral donors and multilateral development banks such as the World Bank and the Asian Development Bank. Until recently, their funding has largely been used for highways and roads,<sup>47</sup> but with the growing interest in mass transit systems on the part of developing country governments, more funds are being borrowed for rail and bus rapid transit projects. In many cases, the provision of financial assistance has been interwoven with the provision of technical assistance, such as for the development of urban transport plans, but some observers believe that national governments may be trying to align these projects with the donors' preferences rather than their own.<sup>48</sup> Another criticism is the overemphasis on economic returns to projects, and an undervaluation of the social benefits.

In order to overcome a lack of available funding, innovation in transport finance is required. As will be discussed in the next chapter, one option is to look at the synergistic link between Transit Oriented Development (TOD) and Land Value Capture (LVC). If LVC through property or income taxes is incorporated into the planning stages of metro, LRT, and BRT projects, it can help to offset costs.<sup>49</sup> Good examples of this practice are already available in the region. For example, LVC schemes in China, Hong Kong, China, and Singapore have recovered costs or even achieved profit from rail projects. A common strategy has been to build mass transit systems (typically rail-based) in undeveloped areas and then develop the surrounding area. In some cases, the mass transit agency has acted as a land-use planner or developer too. Often the rail station itself incorporates offices, retail, and even housing. A package of land-use planning strategies has been used in conjunction with rail development. For example, instead of imposing absolute density criteria, some cities have adopted the concept of 'differentiated density' which varies based on the distance from a transit station.<sup>50</sup> In this way, Asian countries and cities may turn the challenges they face into opportunities to upgrade their transit systems.

### **3.7 Significant barriers remain but progress is possible**

The current chapter drew attention to some of the major challenges facing policymakers in their efforts to develop more sustainable transport systems. The rate of population growth and the expansion of urban areas has imposed challenges on local governments to design and build appropriate public transport systems. Too much emphasis was put on road transport development and more specifically, private vehicle use, while paratransit and active transport, which are used by a significant proportion of the population, tended to be ignored. This bias has been deleterious to the welfare of low-income groups, and also constitutes a missed opportunity for supporting mobility with minimal investments. Although there is a greater awareness of the need to make urban transport services more inclusive, many transport planners and authorities still exclude other stakeholders from the procedures. As a result, the mobility needs of groups such as women and children, people with disabilities, the elderly and the poor are left out of formal transport systems.

However, there are also many clear signs of progress in the form of new bus and rail transit systems, as well as greater awareness of both the environmental and safety externalities associated with car and motorcycle usage. It is often observed in the region that there is a high level of enthusiasm in developing transport policies and plans, but that a gap exists between development and effective implementation. There is therefore a need for more evidence-based policymaking, as well as commitment from governments to decarbonize their transport system and ensure that all social groups can access services. The following chapter discusses selected policies which can address the environmental sustainability of urban transport systems.

## Endnote

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- 2 Barbosa *et al.*, 2018
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- 4 Bolderdijk *et al.*, 2013
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- 17 UNFCCC, 2021.
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- 19 Pan and Sung, 2013
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- 21 Barbosa *et al.*, 2018
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- 24 Huynh and Gómez-Ibáñez, 2017
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- 30 Wijaya *et al.*, 2019
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- 32 UN Habitat, 2014; Barbosa *et al.*, 2018
- 33 Babinard *et al.*, 2012
- 34 Chikarashi *et al.*, 2018
- 35 Gekoski *et al.*, 2017
- 36 Bhandare, 2014
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- 39 WHO, 2018
- 40 WHO, 2015
- 41 UN, 2020
- 42 See Stead and Pojani, 2017
- 43 Parikesit and Susantono, 2013; Rathi 2017; Sridhar *et al.*, 2020
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- 45 Huynh and Gómez-Ibáñez, 2017
- 46 Sriraman, 2015
- 47 Wijaya *et al.*, 2019
- 48 Wijaya *et al.*, 2019
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- 50 Zhang and Feng, 2018



Photo credit: Selenia





## Chapter 4

# Selected Policies for Moving Towards Sustainable Urban Passenger Transport

Policymakers have a rich array of policy tools with which to try to influence people's transport behaviours and thereby steer the externalities of the transport sector. As will be described below, the Avoid-Shift-Improve framework has served as a useful planning tool to help policymakers link policies to outcomes. However, it is not always clear what the impact of these policies will be, and furthermore, there will sometimes be trade-offs between policies. A more evidence-based approach to policy-making could help them persuade citizens and influential stakeholders of the different effectiveness of the available options. Increasingly, computing power and methodological developments are being combined to provide sophisticated analyses of transport policies, based on recent trends and patterns.

This chapter presents a selection of policy options which are seen to offer practical ways to address many of the issues raised in the previous chapter. In particular, the application of new technologies is expected to enhance the sustainability of public transport, in all three domains of environmental sustainability, social inclusiveness and resilience. The chapter then presents the results of a modelling exercise which aimed to compare several policy options within the ASI framework. It applies an integrated transport and energy model to project the regional passenger transport demand for different modes and technologies and estimate transport-related energy use and CO<sub>2</sub> emissions.<sup>1</sup> Such models can support policymakers in making important decisions based on available data.

## 4.1 Avoid-Shift-Improve framework

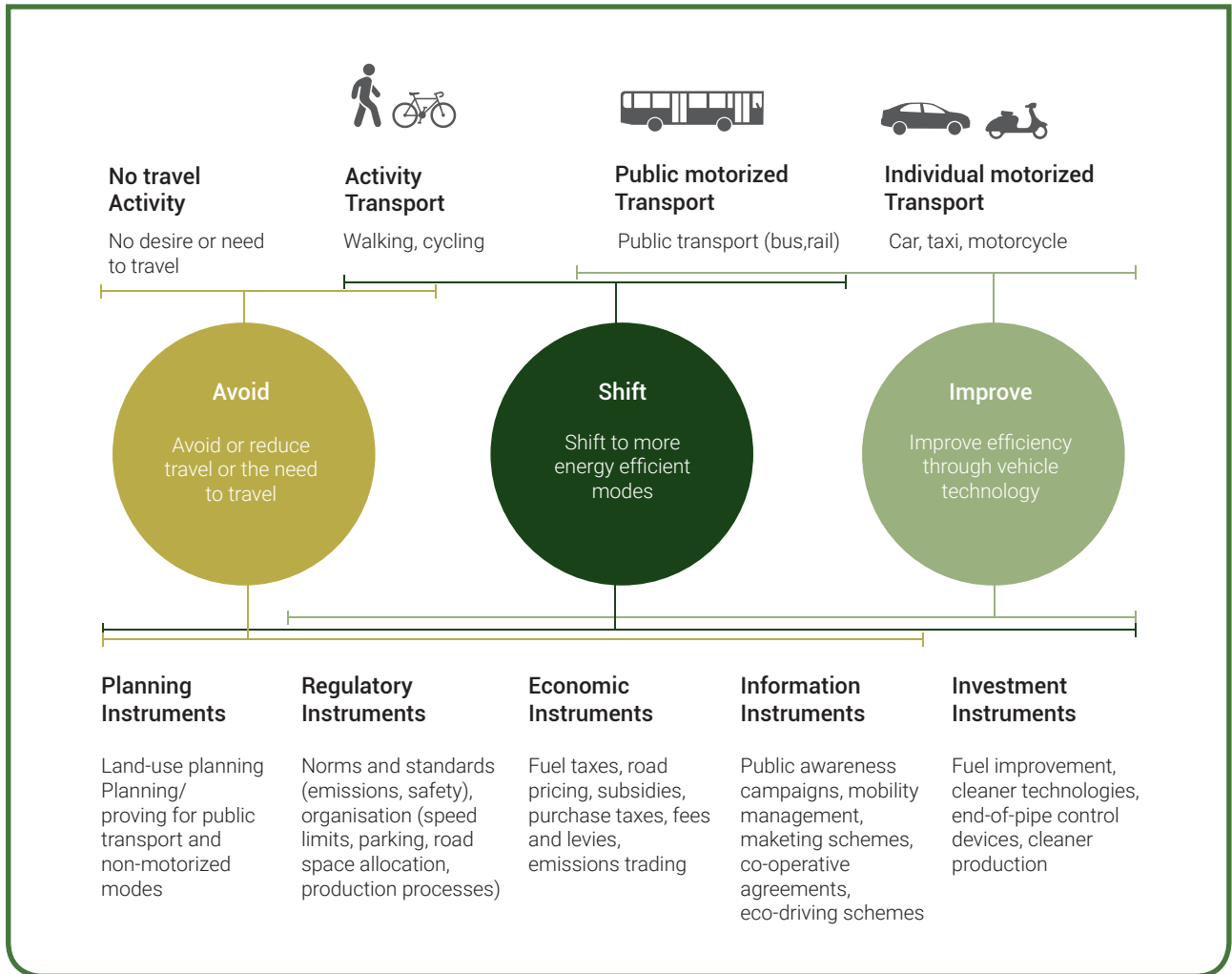
There are multiple mitigation options to reduce emissions from the transport sector. These have been highlighted in the Avoid-Shift-Improve (ASI) framework, as shown in Figure 4.1:<sup>2</sup>

- **Avoid** means to reduce travel demand through planning of city clusters that require less mobility or avoid motorised modes of transport. This requires integrating land use and transport planning to create less need for mobility. As the COVID-19 pandemic demonstrated, avoiding is also possible by using online modes of communication, work, and studies.
- **Shift** means shifting from high energy intensive and polluting modes of transport to less energy intensive and less polluting modes. It means shifting from road to rail transport or shifting from private vehicles to public transport and non-motorized modes (walking/cycling).
- **Improve** means to upgrade the efficiency of urban transport and vehicles through technological improvements, improving vehicle standards, inspection, and enforcement; use of EVs and biofuels for transport; improving transport efficiency using information.

A rich menu of tried and tested policy instruments has also developed over the years. These include:

- **Planning instruments:** Planning instruments include mixed land use patterns. It also supports public transport modes and creates space and infrastructure for walking and cycling routes.
- **Regulatory policies:** For sustainable transport, regulatory policies encompass emissions standards and safety norms. Regulatory policy can also restrict private car use, regulate speed, parking, and space allocation for roads. For Improve strategies, regulatory policies include fuel economy standards, emissions standards, carbon standards for fuels, limits on use of big cars, limits on imports of used vehicles, pricing for charging electric vehicles, guidelines on the use of biofuels, biogas, natural gas and methane, regulations for intelligent transport systems, support for

**Figure 4.1 ASI framework and instruments**



Source: Valiantis, 2014

the transition from internal combustion engines to electric vehicles, guidelines on vehicle inspection and enforcement, standards for quality and reliability of public transport, and fare integration in public transport.

- **Economic instruments** such as fuel taxes, road pricing and subsidies, purchase taxes and emission trading can act to encourage or discourage ownership and/or use of a particular mode of transport.
- **Information instruments:** Increasing public awareness and information through campaigns and marketing schemes can act as information instruments.
- **Investment instruments:** These include fuel improvement and cleaner technologies, investment in public transit and rails, vehicle charging infrastructure, and so forth.

Some of the most effective policies are elaborated below.

## 4.2 Selected policy options for greening urban passenger transport

### 4.2.1 Land-use planning (Avoid / Shift)

While large-scale mass transit projects can help resolve several of the issues raised in Chapter 3, the benefits of infrastructural interventions can be multiplied through long-term policy strategies at the transport-land use interface. Two strategies have particular potential in enhancing the flexibility and agility of urban transport systems other than the private car: the compact city and the 15-minute city. The compact city has been around for several decades and is related to the US approaches of Transit-Oriented Design and Smart Growth, and the Japanese approach of Transit-Oriented Development. It involves the concentration of housing, office, retail, and leisure developments in high-density, mixed-use areas around in the public transport nodes and restrictions on new developments in open or green spaces in order to reduce urban sprawl. Studies on countries and cities which have implemented compact city policies have shown that this strategy can generate a virtuous cycle: public transport accessibility, usage and profitability improve, which generates financial resources and political momentum for network extension, upgrading of technology, and experimentation with new service models, all which increase accessibility and usage further.<sup>3</sup> Importantly, densification and mixed-use development with appropriate street designs that do not privilege car use can boost the viability of walking, cycling, micro-mobility, and shared mobility.

The 15-minute city concept is much younger, and perhaps known best for its recent adoption in Paris. While the focus of this concept is to persuade people to shift from cars into public and active transport,<sup>4</sup> it is also linked to ideas about the 'smart city'.<sup>5</sup> In 2019, Singapore announced its own version of a 20-minute town as part of its Land Transport Master Plan 2040, which also aligns with its goals of becoming a 'Smart Nation' (Box 4.1). Shorter distances to services and employment can enhance quality of life, social cohesion and local economies. While it may not be possible to implement precisely, the principles underlining the concept, namely reducing time for travel and clustering critical services, can enhance transport systems to adapt to changes and shocks.

### 4.2.2 Integrating the cost of transport (Shift)

Central to improving urban transport conditions is the internalization of the full social and environmental costs of different transport modes. This requires overcoming the political reluctance to introduce any measures that curtail the use of motorized vehicles, especially the car. Road pricing schemes, which have already been implemented in some countries, should become more common. For example, cordon pricing has been introduced in Tehran, where drivers are required to pay an annual access fee. Cities need to ensure that the benefits accrued by such schemes are not offset by the growing levels of motorization.

### 4.2.3 Smart transport systems (Avoid / Shift / Improve)

ESCAP defines smart transport systems as "an agglomeration of diverse technologies that enhance the sustainability of transport systems in a safer, smarter and greener way".<sup>6</sup> Smart transport systems utilize various technologies to monitor traffic conditions and to efficiently manage and control traffic operations. These systems can be fully integrated into vehicle systems, road infrastructure and facilities, and strategies, thereby utilizing existing resources and infrastructure while reducing the need for new infrastructure. Broadly speaking, three main categories of smart transport are advanced traffic management systems, advanced traveller information systems, and advanced public transport systems (Table 4.1).

## Box 4.1 Singapore's vision of a 'Smart Nation'

While the term 'smart city' can be interpreted in different ways, the concept usually involves the integration of various sectors such as transport, housing, and energy, using sophisticated technologies such as the Internet of Things (IoT). It should not be understood as a one-size-fits-all, technologically deterministic solution to urban ills that is focused on optimization and control, but rather a socio-technical constellation in which transport and other urban systems are co-designed by government actors, businesses, research organizations as well as citizens and civil society as an open process of collective learning. While there are many visions of 'smart cities', the 'Smart Nation' initiative has helped Singapore to put these visions to the test.

An important component of this vision is its transport system. In addition to striving to have 20-minute towns, where it only takes 20 minutes for residents to reach their necessary amenities. It is also the first city in the world to pilot autonomous robo-taxis in 2016. The government has allowed 1000 km of public roads to be used for AV testing, and in January 2021 it announced that it was piloting two driverless buses on selected routes. Singapore has also been at the forefront of Mobility as a Service (MaaS)-type platforms such as the Beeline SG, an innovative online marketplace where users can book seats and even suggest new routes. Whether other cities can emulate Singapore in its quest to become a 'smart city' is uncertain, but the city continues to push the boundaries of possibility.



Sources: UITP, 2020; msci, 2020; Intelligent Transport website 2021; and Goodall, Fishman, Bornstein, and Bonthron 2017  
Photo credit: kagenmi@123rf.com

There are also smart transport applications for commercial vehicle operations, which is relevant for urban passenger transport because of their impact on congestion.

**Table 4.1 Types of smart transport systems for passenger mobility**

Category	Main functions	Representative applications
Advanced traffic management systems	Improving traffic operations through traffic management centres where real-time traffic data is collected, processed, and distributed by diverse information/dissemination devices.	<ul style="list-style-type: none"> <li>• advanced traffic signal control</li> <li>• automatic traffic enforcement</li> <li>• electronic toll collection</li> <li>• real-time traffic monitoring</li> <li>• active traffic management</li> </ul>
Advanced traveller information systems	Offering updates with pre-trip and en-route traffic information to travellers through various distributors of processed information.	<ul style="list-style-type: none"> <li>• mobile/online/roadside traffic information</li> <li>• real-time parking information</li> <li>• in-vehicle information</li> </ul>
Advanced public transport systems	Improving efficiency and reliability of public transport services, users' safety, and convenience by employing diverse information technologies and traffic management strategies.	<ul style="list-style-type: none"> <li>• automatic fare collection</li> <li>• automatic passenger information</li> <li>• automatic vehicle location</li> </ul>

Four important areas where smart technologies are contributing to more sustainable transport in Asian cities are described below.

**Traffic incident management** coordinates technological, human, and operational resources to detect and respond to an incident and return a roadway to its full capacity in the aftermath of the incident.<sup>7</sup> The application entails using a variety of technologies and processes to monitor the operation of a freeway and arterial systems along a corridor, respond to incidents and disseminate traveller information. The system aims to improve safety for first responders and the general public and reduce traffic congestion, which in turn reduces excessive fuel consumption and greenhouse gas emissions.

**Road weather management** integrates various components involved in weather forecasting such as surface and atmospheric observations from sensors at weather stations. Data is modelled to mitigate any detrimental impacts of inclement weather on road safety, mobility and sustainability. Weather information is collected and processed in traffic information centres and disseminated through a multitude of channels such as variable message signs so that road users can make effective informed decisions.<sup>8</sup>

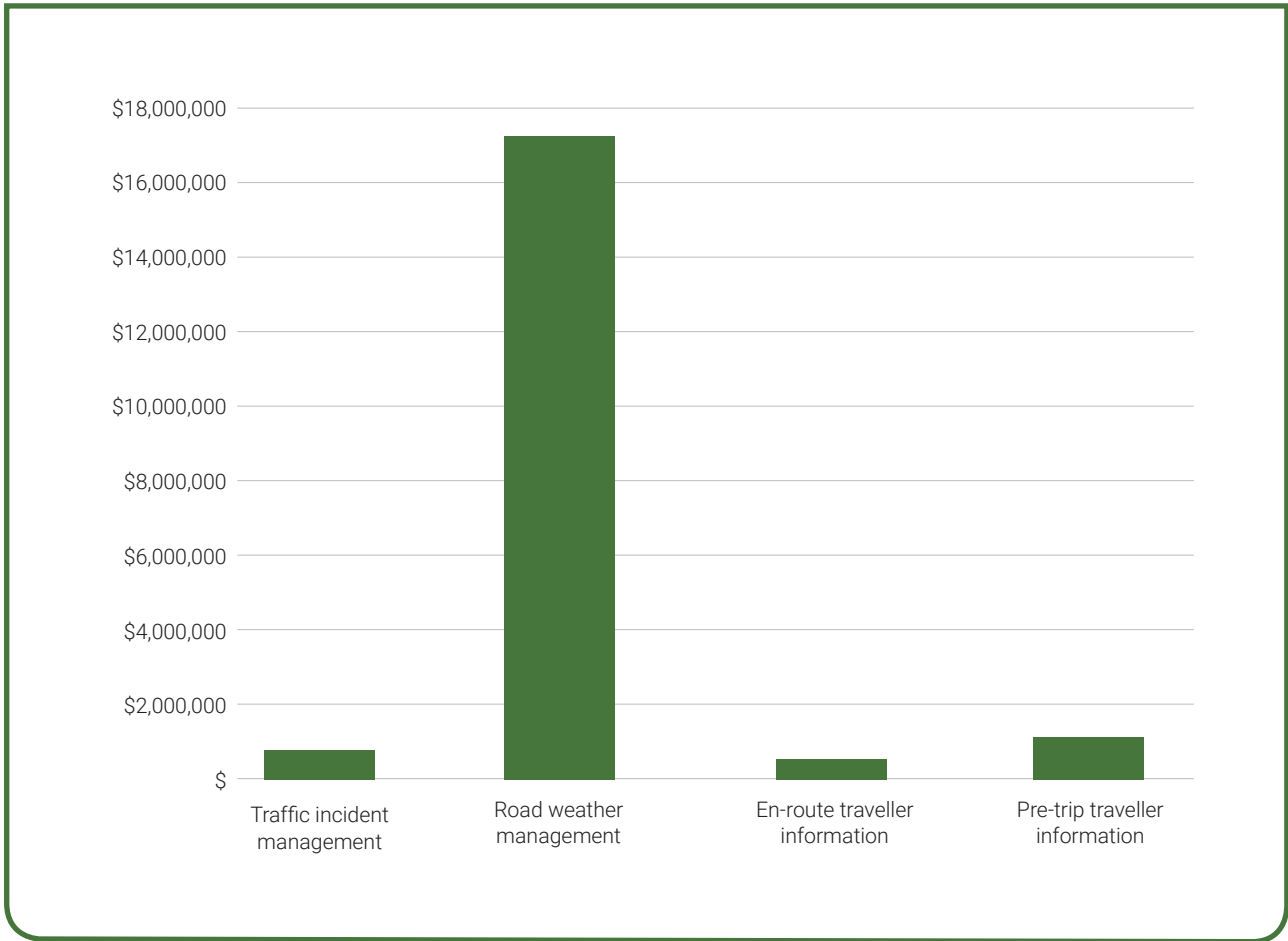
**Pre-trip traveller information** is the traffic condition-related information that travellers obtain from various sources, including, among others, websites, mobile applications, and advisory radio before embarking on a journey. This information assists in planning routes, transport modes, and departure

times, promoting better-informed choices and greater confidence for travellers. This can significantly reduce fuel consumption and greenhouse gas emissions.

**En-route traveller information** provides real-time traffic updates through channels such as variable message signs, mobile applications, and advisory radio, providing a greater utility than paper maps or written instructions. Real-time decisions on routes and modes can be made in response to non-recurring congestion caused by incidents, adverse weather, work zones or other special events, thus saving travel time, improving traffic network performance, avoiding congestion, and ultimately reducing greenhouse gas emissions.

According to an ESCAP study, the largest energy/emission benefit is provided by road weather management (Figure 4.2). Bangkok, Baku, New Delhi, and Suva have all implemented pilots to provide pre-travel and en-route information for travellers. In addition, further examples from other countries in the Asia-Pacific region have found that the deployment of smart transport applications can lead to major reductions in emissions (CO<sub>2</sub>, NO<sub>x</sub>, CO, PM) and to financial savings from reductions in fuel consumption, travel time, and crashes. A recent study shows that the energy and emissions benefits of smart transport systems are high relative to costs.<sup>9</sup> For example, Electronic Toll Systems can reduce waiting times at toll gates, thereby decreasing emissions (Box 4.2).

**Figure 4.2 Average energy/emission benefits by applications**



Source: Recalculated based on the results from ESCAP, 2019b

## Box 4.2 Environmental benefits of Electronic Toll Collection (ETC)

Electronic Toll Collection (ETC) can be found in several cities and countries throughout the Asia-Pacific region, from the Republic of Korea to Turkey to New Zealand. ETC systems automate roadway toll payment collections, eliminating stopping and starting and thereby increasing the efficiency of highways.

Some systems have a single lane of ETC, while others offer multiple lanes of traffic with no option to stop and pay by cash, which mitigates congestion and pollution. These multi-lane free flow systems utilize on-board units (OBU) and/or license plates to collect and charge tolls. A detection system recognizes the OBU or license plate, sends the information to a control centre and then charges the motorist a toll based on the tolling location and time of day.

By reducing congestion and stopping and starting, ETC systems are believed to reduce greenhouse gases. When the Republic of Korea implemented multi-lane free-flow ETC on their expressways, the country noted a decrease in tollgate passing time from 14 seconds to 2 seconds (an 86 per cent improvement). ETC was estimated to reduce 2.3 tons of greenhouse gases annually across the nation, saves an equivalent of US\$ 9.6 million per year.



Source: Ministry of Land, Infrastructure and Transport, Republic of Korea, n/d  
Photo credit: Changju Lee



Into the future, a number of important developments are taking place. One is in connected mobilities, where cooperative-intelligent transport systems and connected vehicles communicate with one another. Technologies which utilize wireless data exchange between vehicle-to-infrastructure, vehicle-to-vehicle and vehicle-to-everything are used to mitigate congestion, reduce fuel consumption and emissions, and increase reliability, mobility and road safety.<sup>10</sup> Another important development is in autonomous vehicles (AV). Autonomous vehicles are able to travel without human intervention and are able to navigate via wireless networks, digital maps, automated controls, communication with smart infrastructure, and communication to control centres.<sup>11</sup>

The development of these technologies is proceeding quickly, but some countries in the region lack policies on smart transport systems, leading to fragmentation, slow roll outs and inconsistency of services. Key challenges which may hinder the wider deployment of smart transport systems are that smart transport systems are still not well known or understood by policy makers in the region, resulting in a lack of policy support, governing direction, and regulatory foundation. More training is needed to effectively utilize these technologies. Given the differences in the urban contexts, it is also necessary to prioritize needs and determine which fundamental requirements need to be established. At the same time, a national, or even regional, strategy could greatly facilitate the harmonized roll-out of new technologies. The lack of interoperability and compatibility between different systems for moving people within a country and among countries will stop countries from maximizing the benefits of smart transport systems.

#### **4.2.4 New energy vehicles (Improve)**

New energy vehicles (electric vehicles, or EV) are increasingly being viewed as a solution for reducing emissions in the transport sector. Indeed, electric vehicles have zero tailpipe emissions, and when paired with electricity generated from renewable sources, electric vehicles could drastically reduce overall greenhouse gas emissions and contribute to transport decarbonization. Shifts from cars to electric vehicles could also lead to improvements in air quality and reduce noise pollution. However, despite the benefits of electric vehicles, they still represented only 2.6 per cent of global vehicle sales in 2019.<sup>12</sup> Figure 4.3 shows the share of new energy vehicles in 2019. China is leading with 58 per cent followed by Japan at 2 per cent, and the Republic of Korea at 1 per cent of the global electric vehicle fleet.<sup>13</sup> Electric vehicles form an important pillar to many governments' climate change mitigation plans as they go hand in hand with efforts to reduce dependence on fossil fuels and increase the share of renewable energies in the energy mix (Box 4.3).

Several member states have introduced government policies to promote electric vehicles and EV charging infrastructure. China, for example, has actively supported EV development and marketing since 2009, beginning with large scale pilot projects under the Ten Cities, Thousand Vehicles Program. Three Chinese cities, Guangzhou, Shenzhen, and Xi'an, operate public transport systems that are 100 per cent electric, and it is estimated that the country has over half a million electric buses.<sup>14</sup> In India, schemes such as the "Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles" FAME Phase I and II, were introduced to support the hybrid/electric vehicle market development. More recently, Thailand launched its electric vehicle policy, which aims to accelerate EV production in the country. Under the plan, 30 per cent of all vehicles made in Thailand by 2030 would be electric. The plan also provides for financial and fiscal incentives as well as safety standards for electric vehicles and battery manufacturers.<sup>15</sup>

Initiatives on electric mobility in the region provide huge opportunities towards low carbon mobility. However, experience suggests that successful introduction of electric vehicles needs careful planning with supportive policies in a range of areas including financial and fiscal issues, regulatory frameworks, and energy policies. Therefore, countries in the region would benefit from experience sharing, norm-setting, and capacity building.

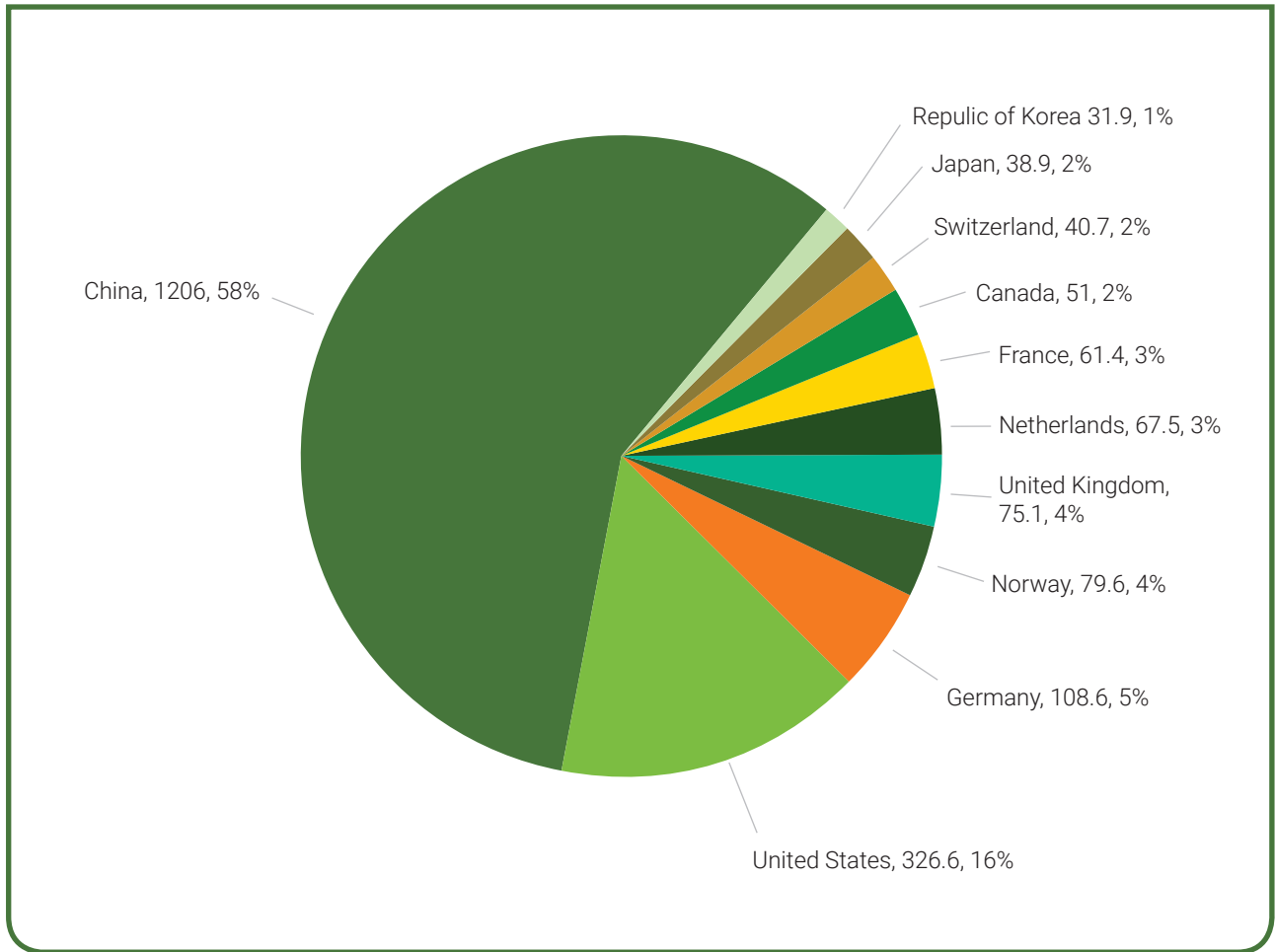
### Box 4.3 Aiming for carbon neutrality in the Pacific

Like other subregions, urbanisation has been gradually increasing in the Pacific. In 2020, over 70 per cent of Pacific population were urban, with Fiji (57 per cent), Tuvalu (64 per cent), Marshall Islands (78 per cent), Palau (81 per cent), and Nauru (close to 100 per cent). As most are located on or near the seacoast, their cities are greatly affected by climate events and natural disasters. Despite the fact that the people living in the Pacific Island Countries contribute a tiny proportion of greenhouse gas emissions each year, the issue of climate change is never far from the minds of policymakers and municipal authorities. Many have therefore developed ambitious climate action plans which mainly target the energy and transport sectors. The key to this transition will be the availability of renewable energy and electric vehicles. Fiji, for example, is aiming to be carbon neutral by 2050, and has announced plans to convert most of its land transport systems to electric vehicles. This will also have repercussions on the air quality of its urban areas. Combined with land-use planning, actions to combat climate change may result in more resilient as well as environmentally friendly transport in Fiji.



Sources: World Bank, Development Indicators (online); Government of the Republic of Fiji, 2018  
Bus station in Suva, Fiji. Photo credit: Madan B. Regmi

**Figure 4.3 Distribution pattern of global new energy vehicle sales in 2019**



Source: IEA, 2020a

#### 4.2.5 Enhancing energy efficiency of vehicles (Improve)

As the transition to full electric mobility will take some time, it is important to apply energy efficiency measures to reduce the growth of carbon dioxide emissions as well as reduce fossil fuel consumption. Energy efficiency is recognized as the most cost-effective means of reducing emissions, and there is an opportunity to ramp up the use of energy-efficient technologies and decarbonize the transport sector. The strategies for reducing emissions are mainly focused on avoiding unnecessary trips, measures to manage transport demand, shifting trips to more sustainable modes for passenger and freight, improving the efficiency of transport operations, and access to renewable energy.<sup>16</sup> Examples of potential emissions mitigation measures for the transport sector compiled by the International Transport Forum.<sup>17</sup>

Switching to cleaner fuels and adopting higher standards for fuel economy and stringent standards for vehicle emissions can contribute to the improvement of air quality. Many initiatives and efforts are underway, for example the Global Fuel Economy Initiative, which aims to double the fuel economy of new light-duty passenger vehicles globally by 2030 and reduce global carbon dioxide emissions by 90 per cent by 2050.<sup>18</sup> Table 4.3 shows the planned progression of fuel economy and emissions standards for light-duty vehicles in selected countries.

**Table 4.2 Fuel economy and emissions standards for light-duty vehicles**

Countries/standards	2020		2025	
	Carbon dioxide emissions (g/km)	Fuel economy (km/l)	Carbon dioxide emissions (g/km)	Fuel economy (km/l)
China	116.8	20.0	95.0	25.0
India	128.6	18.2	111.2	21.0
Japan	115.0	20.3	-	-
Republic of Korea	97.0	24.2	-	-
United States of America	140.0	16.7	113.4	20.8
European Union	95.0	24.6	75.0	31.3

Source: ESCAP, 2020, p.7, Table 1

### 4.3 Analysis of sustainability scenarios using the ASI framework

As noted above, there is a wide range of policies to make the urban passenger transport sector more sustainable. To demonstrate how quantitative analyses can help compare and identify which policies are most effective in meeting policy goals, this section presents a quantitative analysis of energy consumption and emissions whereby a baseline scenario is compared with generated scenarios based on selected Avoid-Shift-Improve strategies, including energy efficiency (SDG7) and shifts to public transport (SDG11). Data from the Shared Socioeconomic Pathways 2 (SSP2) database and the trends, volumes, and structure of passenger transport in the respective countries was used to run the model. Given data limitations, the current exercise looked specifically at China, India, and Japan; South-East Asia (Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam); and the 'Rest of Asia' (Afghanistan, Bangladesh, Bhutan, Nepal, Pakistan and Sri Lanka).

#### 4.3.1 Overview of the transport energy model

The transport energy model used for this chapter is a one-year interval recursive-type model that consists of various tiers.<sup>19</sup>

- For the first tier, the passenger transport demand for each region is computed based on GDP, population, and generalized transport cost.
- At the second tier, the passenger transport demand is divided between short and long distances.
- At the third tier, different transport modes compete for short- and long-distance travel. Here, car,

bus, and two-wheelers are used for short-distance modes, while long-distance modes include passenger rail, domestic passenger air, and international passenger air.

At the next levels, different sizes of vehicles (i.e., small, medium, and large) and technologies are considered. The shares of different distances, modes, sizes, and technologies are computed using market share models, based on the generalized transport cost that includes device cost, fuel cost, carbon tax, and time cost. The energy consumed by passenger transport in each region can be evaluated according to the transport demand for each technology category and technology-wise energy intensities. Consequently, CO<sub>2</sub> emissions produced by the transport sector can be assessed according to the energy consumed and emission intensity coefficient of each fuel.

### 4.3.2 Scenario formulation

A set of scenarios was created to investigate the long-term impacts of low-carbon transport policies on energy use and emission profiles. According to the ASI framework, five representative policy interventions were selected to represent the dimensions of “Avoid”, “Shift”, and “Improve”, as described in Table 4.3 below.

**Table 4.3 Assumptions used for the Model**

<b>Business as Usual</b>	<b>A Business-As-Usual scenario (BAU) was designed as the baseline for comparing with the other scenarios.</b>
<b>Avoid</b>	Not enough time has passed since the COVID-19 pandemic has started to capture the impact of “Avoid” policy measures. As a kind of proxy, <b>Population decline (POP)</b> was used to represent the reduction of transport demand under the “Avoid” category. Although population decline is not a ‘true’ reflection of “Avoid”, the effects are assumed to be similar for the purpose of this exercise. It is assumed that the population will decrease by 10 per cent in 2050 compared with the SSP2 (Shared Socioeconomic Pathways 2) estimates.
<b>Shift</b>	<b>A mass transit-oriented development scenario (MASS) and a car-sharing scenario (SHARE) were applied for the dimension of “Shift”.</b> <ul style="list-style-type: none"> <li>• In the <b>MASS scenario</b>, the modal preference factors of Japan are used as a proxy to reflect the preferences in mass transit-oriented development. It is assumed that the modal preference factors of other countries will gradually converge to Japan’s values by 2050.</li> <li>• The <b>SHARE scenario</b> is represented by an increased load factor, reflecting an increase in shared mobility. In this scenario, it is assumed that the load factor of cars will increase to 2.2 by 2050. Although this is an ambitious assumption given the low peak occupancy rates at present, it is expected that shared services will increase with the initial introduction of autonomous vehicles.<sup>20</sup></li> </ul>

**Table 4.3 Assumptions used for the Model (cont.)**

<b>Business as Usual</b>	<b>A Business-As-Usual scenario (BAU) was designed as the baseline for comparing with the other scenarios.</b>
<b>Improve</b>	<p>An <b>energy efficiency improvement scenario (EE)</b>, an <b>electric vehicle scenario (EV)</b> and a <b>carbon tax scenario (TAX)</b> were created to represent transport technological innovation.</p> <ul style="list-style-type: none"> <li>• In the <b>EE scenario</b>, energy efficiency would be improved by 50 per cent by 2030.</li> <li>• In the <b>EV scenario</b>, it is assumed that EVs will be economically competitive and strongly advocated by the government, and that internal combustion engine (ICE) vehicles will be phased out gradually. Hence, 100 per cent of EV market share will be achieved by 2050 due to the EV policy interventions in this scenario.</li> <li>• The <b>TAX scenario</b> was considered to correspond to a two-degree climate stabilization target. This carbon price pathway was set based on previous studies.<sup>21</sup> The carbon tax scenario was designed according to the “Improve” strategy. The imposition of carbon tax can lower the economic competitiveness of fossil fuel powered vehicles, indicating a technology</li> </ul>

Source for SSP2 data: Fricko *et al.*, 2017

### 4.3.3 Business-As-Usual (BAU) scenario

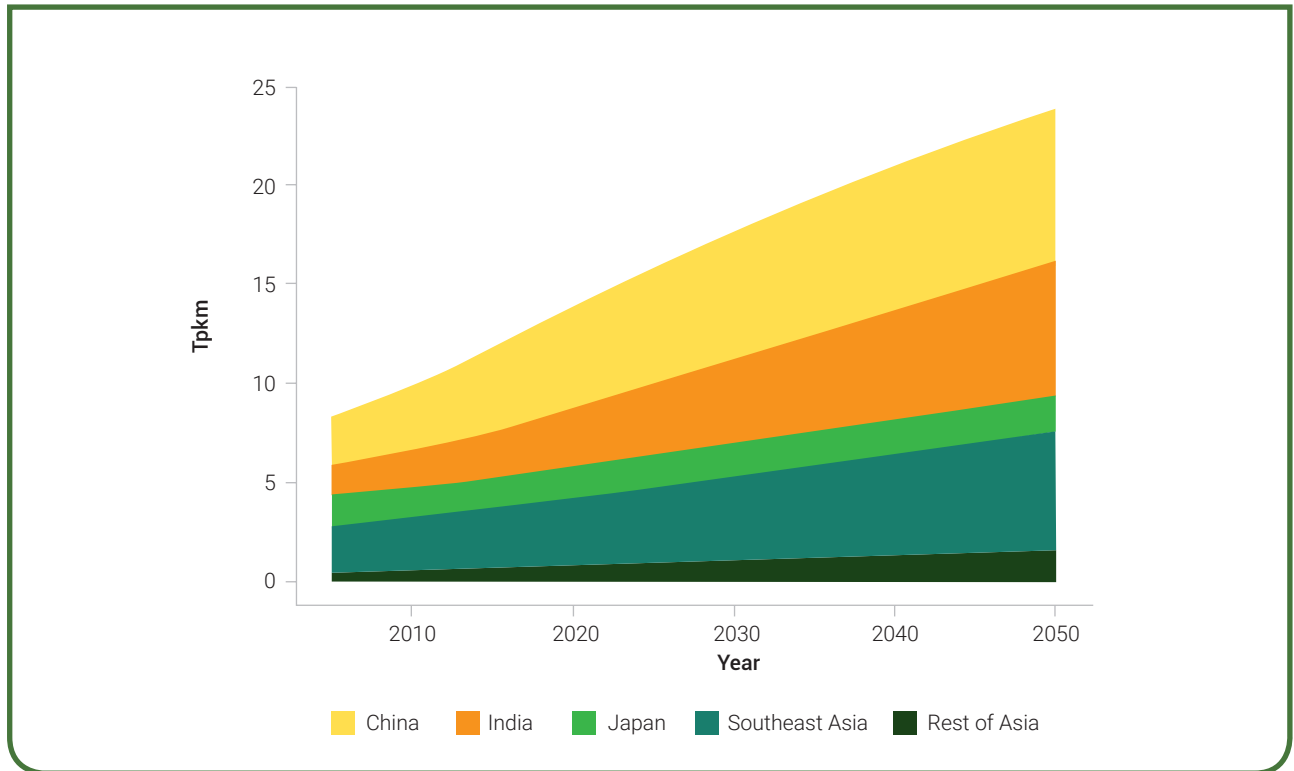
#### 4.3.3.1 Passenger transport demand by region and mode

Passenger transport demand increases dramatically between 2005 and 2050 in the selected countries and regions in Asia under the BAU scenario, in line with social and economic development (Figure 4.4). China and India occupy around half of the transport demand for Asia. Compared with the moderate increase in China, the growth in demand is extremely apparent in India. One reason may be because China's population is expected to gradually decline in the middle of this century.

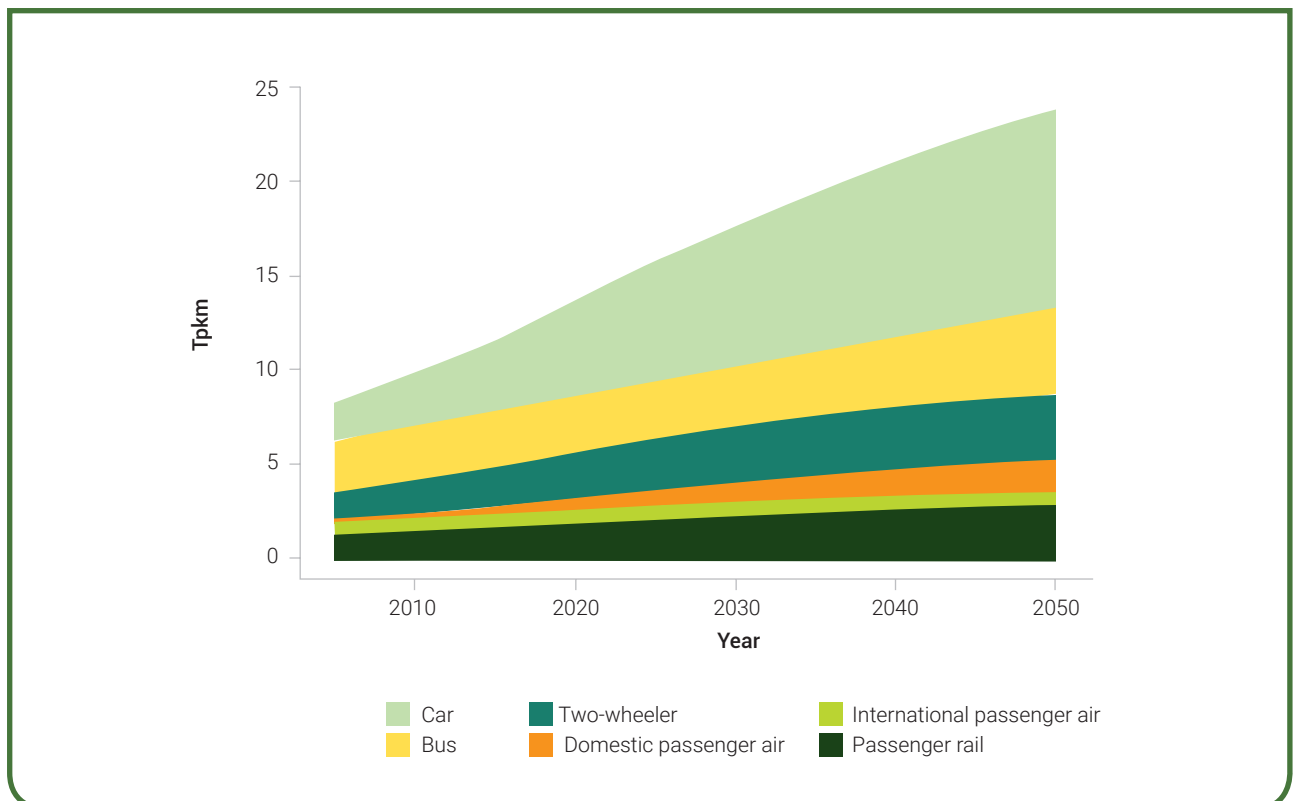
Figure 4.5 illustrates the predicted transport demand by mode in Asia from 2005 to 2050. The main characteristics are a gradual increase in car transport demand and gradual decrease in bus transport demand. In addition to the growth in car ownership caused by economic development, the rising trend reflects the role expected to be played by individual transport modes such as cars in future transport demand.

The predicted value of traffic demand for various transport modes in the selected countries and regions under the BAU scenario is illustrated in Figure 4.6. The transport demand in Japan for all modes is relatively stable in the future. One possible reason is the stable population decline in Japan. Compared with the rapid and continuous increase of total transport demand in India, the total transport demand in China increases significantly in the first stage and then maintains a moderate increasing trend. The changes in modal structure in China and India are similar. While all modes will increase, the demand for cars will increase the most. This reflects the rising ownership of cars in developing countries with rapid economic development.

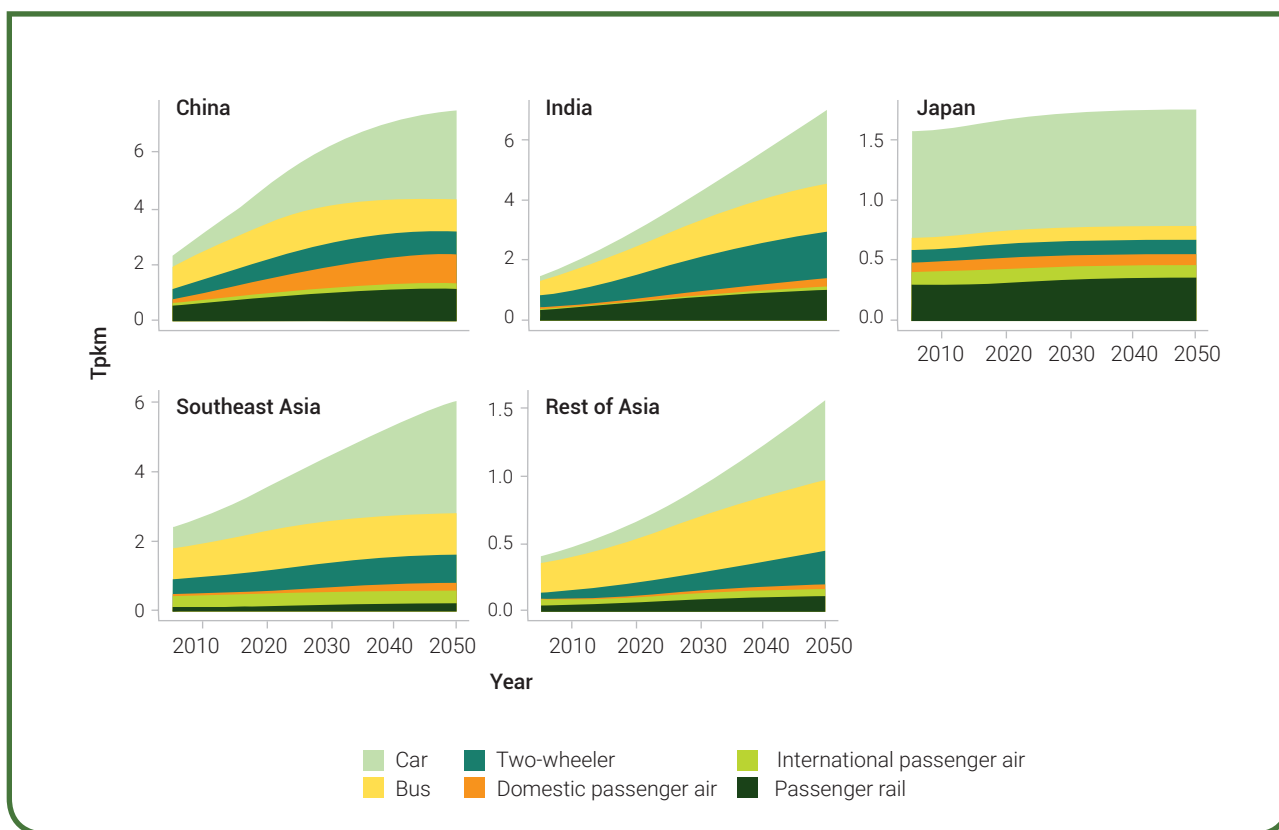
**Figure 4.4 Transport demand from 2005 to 2050**



**Figure 4.5 Mode specific passenger transport demand**



**Figure 4.6 Mode specific passenger transport demand, by country and region**



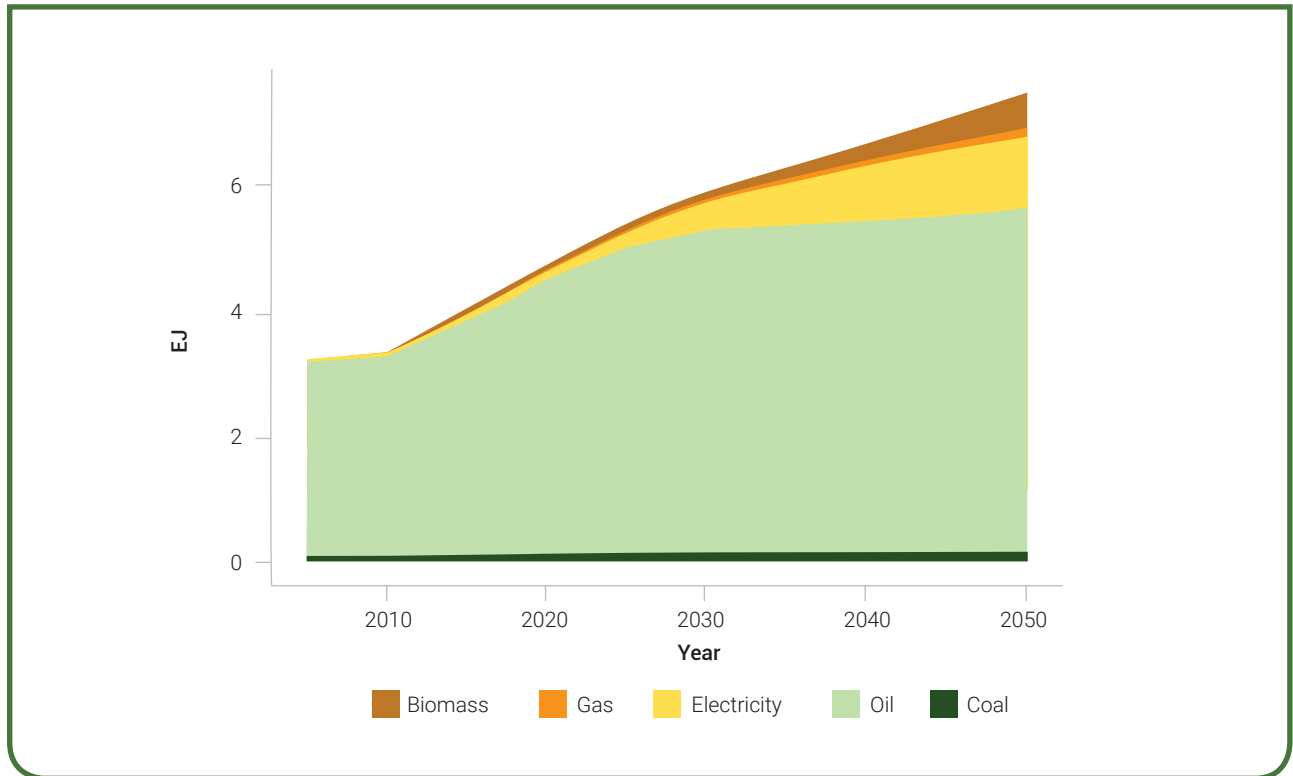
#### 4.3.3.2 Energy demand by region

From 2005 to 2050, the energy consumption in Asia in the BAU scenario, which is calculated based on the baseline scenario, increases continuously (Figure 4.7). By 2050, the electricity, gas, and biomass consumption will have grown significantly. Electricity consumption in transport energy consumption will increase to nearly 3 EJ/year in 2050; biomass consumption will increase to 1.5 EJ/year in 2050; and gas consumption will increase marginally from nearly 0.1 EJ/year in 2025 to nearly 0.3 EJ/year in 2050. Although electricity, gas, biomass, and so on are all showing growth trends, in the absence of any exogenous policy implementation, oil consumption still occupies an overwhelming proportion in the BAU scenario.

From 2005 to 2050, the energy consumption in the BAU scenario also shows significant differences for China, India, Japan, South-East Asia, and the Rest of Asia (Figure 4.8). By 2050, China and South-East Asia will have the highest energy consumption (nearly 6 EJ/year), followed by India and the Rest of Asia. Japan will have the least (less than 2 EJ/year). The trend of energy consumption changes in each region is also different. Compared with India's rapid rise, China's energy consumption will rise significantly by 2030 and then show relatively low growth, while Japan's energy consumption will gradually decline. The consumption of electricity and biomass shows a gradual increase in both regions. Except for India, other regions consume less coal.



**Figure 4.7 Energy consumption in Asia**



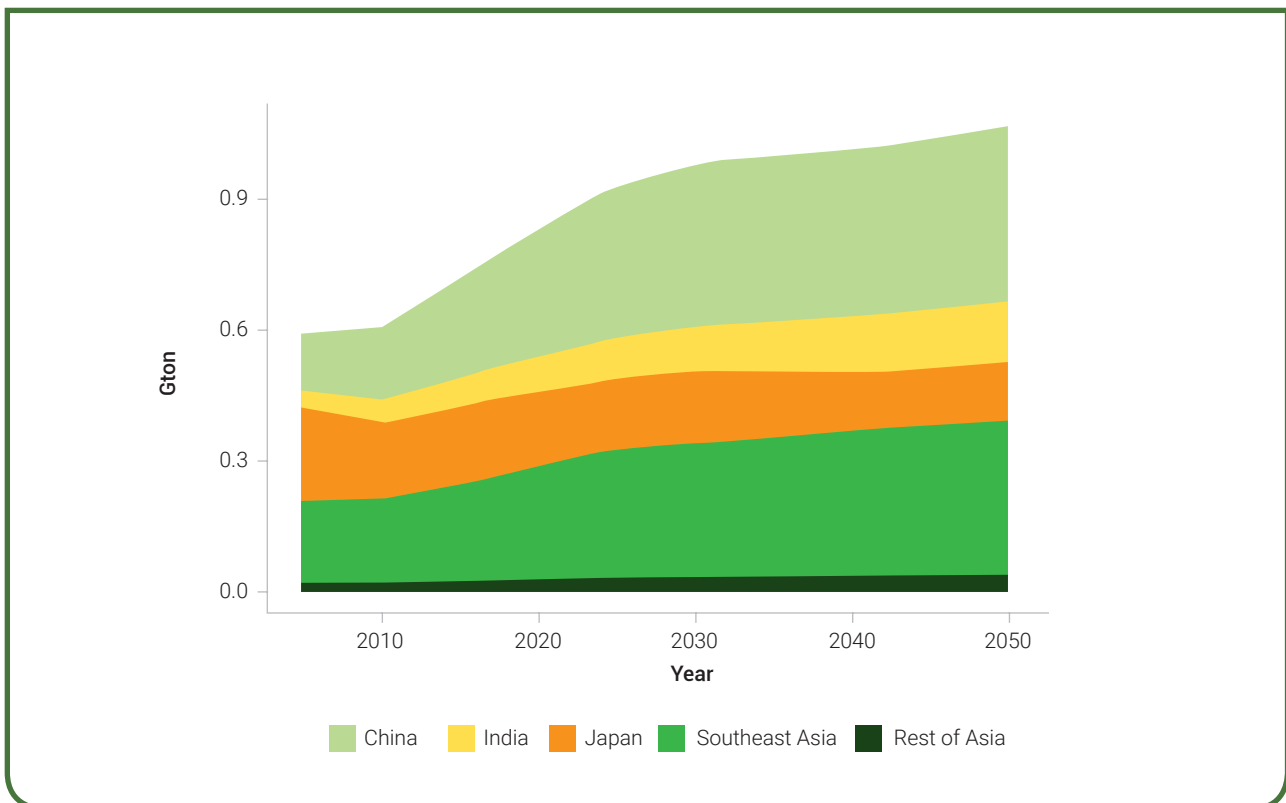
**Figure 4.8 Energy consumption**



### 4.3.3.3 Carbon dioxide emissions by region and mode

Figure 4.9 shows the predicted carbon dioxide emissions in the BAU scenario. Carbon dioxide emissions in Asia have increased continuously from 0.6 Gton/year in 2005 to more than 1.0 Gton/year in 2050. China and South-East Asia are the main sources of carbon dioxide emissions. China's carbon dioxide emissions will rise slowly from 2030, reaching close to 0.4 Gton/year by 2050, while South-East Asia's carbon dioxide emissions will be close to 0.35 Gton/year by 2050. Compared with other regions, India has the fastest growth in carbon dioxide emissions, while Japan's emissions show a downward trend.

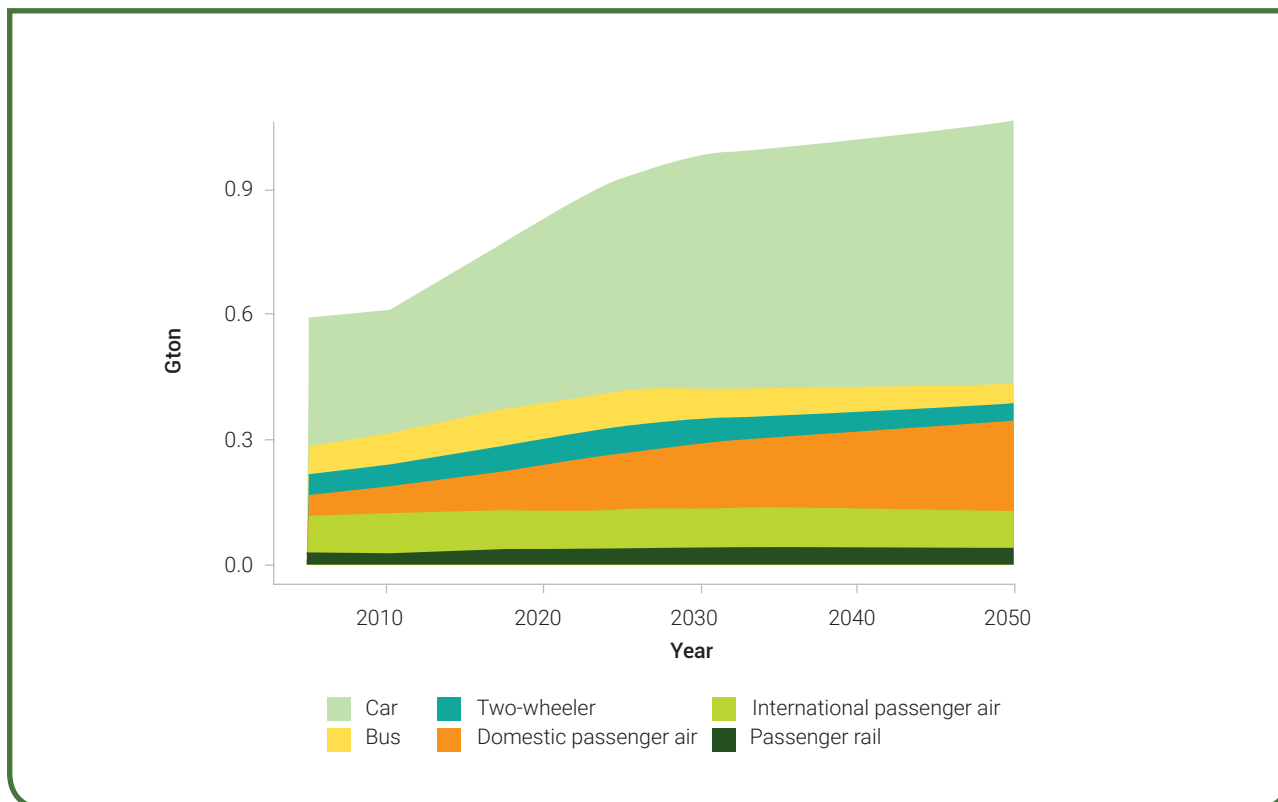
**Figure 4.9 CO<sub>2</sub> emissions projections**



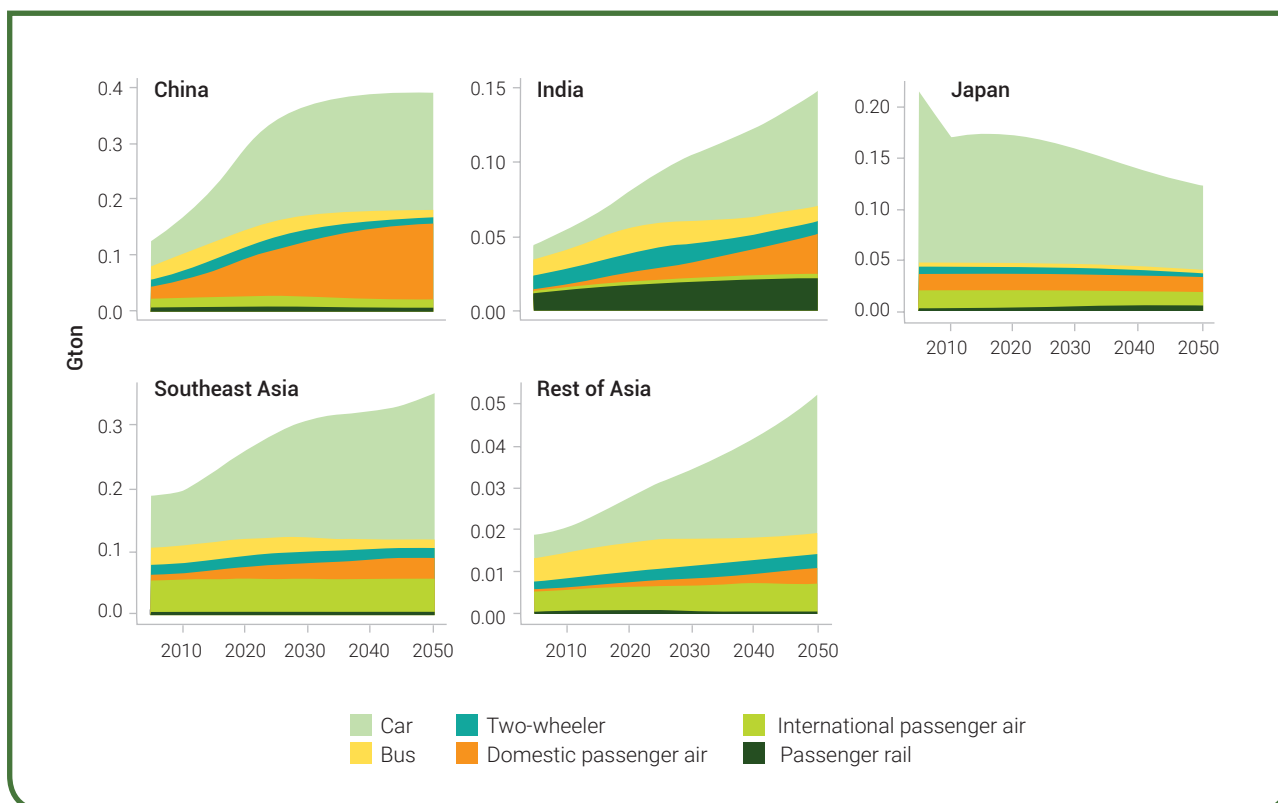
Carbon emission patterns are closely related to the modal split and technology structure. Figure 4.10 shows the predicted carbon dioxide emissions of different transport modes under the BAU scenario. Total emissions will increase year by year from 2005 to 2050, with cars being the main source, followed by domestic passenger air. In addition, the carbon dioxide emissions of buses and two-wheelers have decreasing tendencies.

Figure 4.11 illustrates the predicted carbon dioxide emissions of different transport modes by region under the BAU scenario. According to this figure, Japan's emissions for all transport modes show gradual decreasing trends. Compared with India's rapid rise, China's emissions rise and then grow more slowly after 2030. Mode specific CO<sub>2</sub> emissions in the five countries and regions suggest that cars are still the main source of carbon dioxide emissions. However, China's domestic passenger air is also a major source of emissions, while in South-East Asia and Rest of Asia, international air transport takes up a significant share after cars.

**Figure 4.10 Mode-specific CO<sub>2</sub> emissions in Asia**



**Figure 4.11 Mode specific CO<sub>2</sub> emissions**



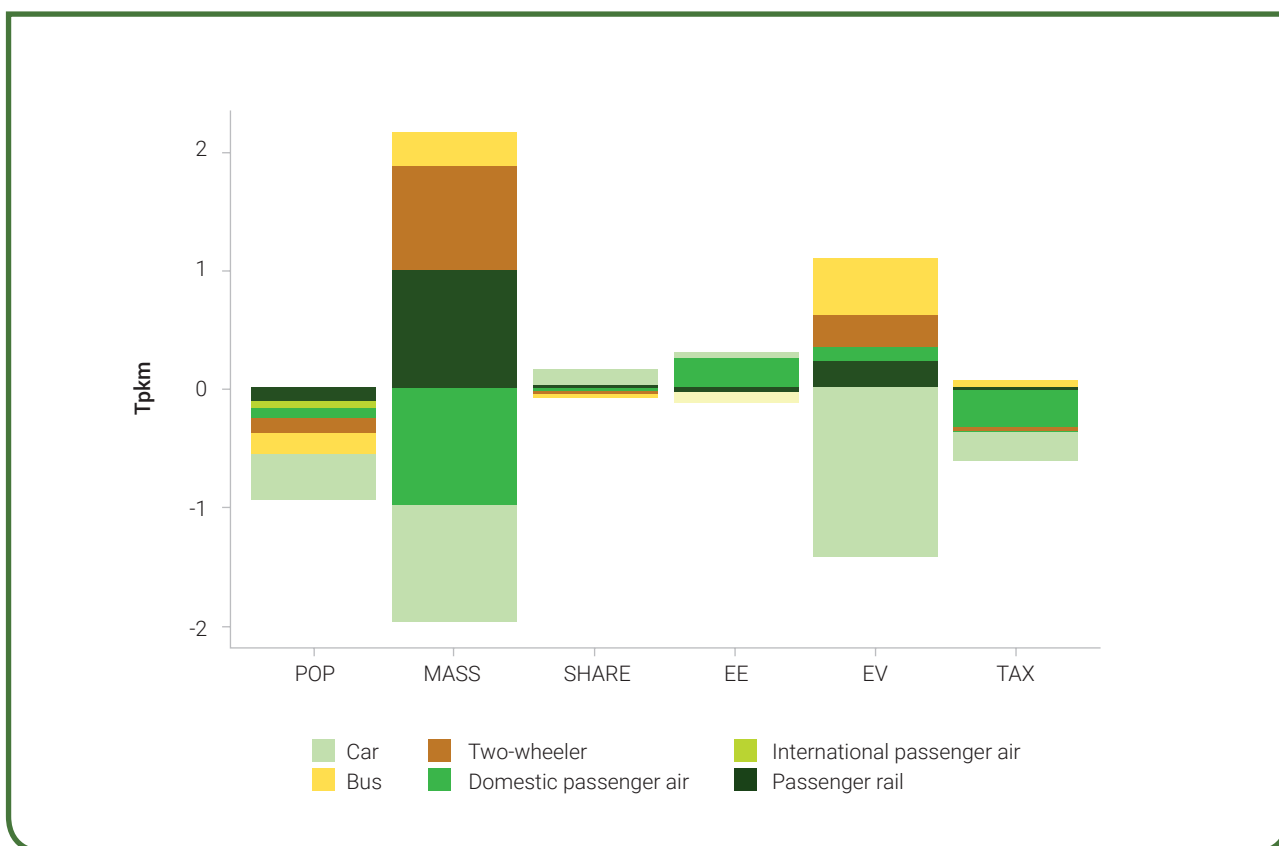
#### 4.3.4 Impacts of policy on transport demand and energy consumption

Figure 4.12 presents the changes of mode-wise transport demand in 2050 under the six scenarios compared to the BAU scenario. The POP scenario generated the most significant impact on demand reduction, with an estimated 1 Tpkm (4 per cent) decrease compared to the BAU scenario, followed by the TAX scenario. The most obvious modal shift can be observed in the MASS scenario, in which modal shift from car and aviation to bus, rail, and two-wheelers occurs. In the EV scenario, demand for cars will decrease, while other transport modes such as bus, two-wheelers, passenger rail and air present significant increases compared to the BAU level. Transport demand will increase in the SHARE and EE scenarios because transport costs decrease in these two scenarios due to the high load factors and improved energy efficiency.

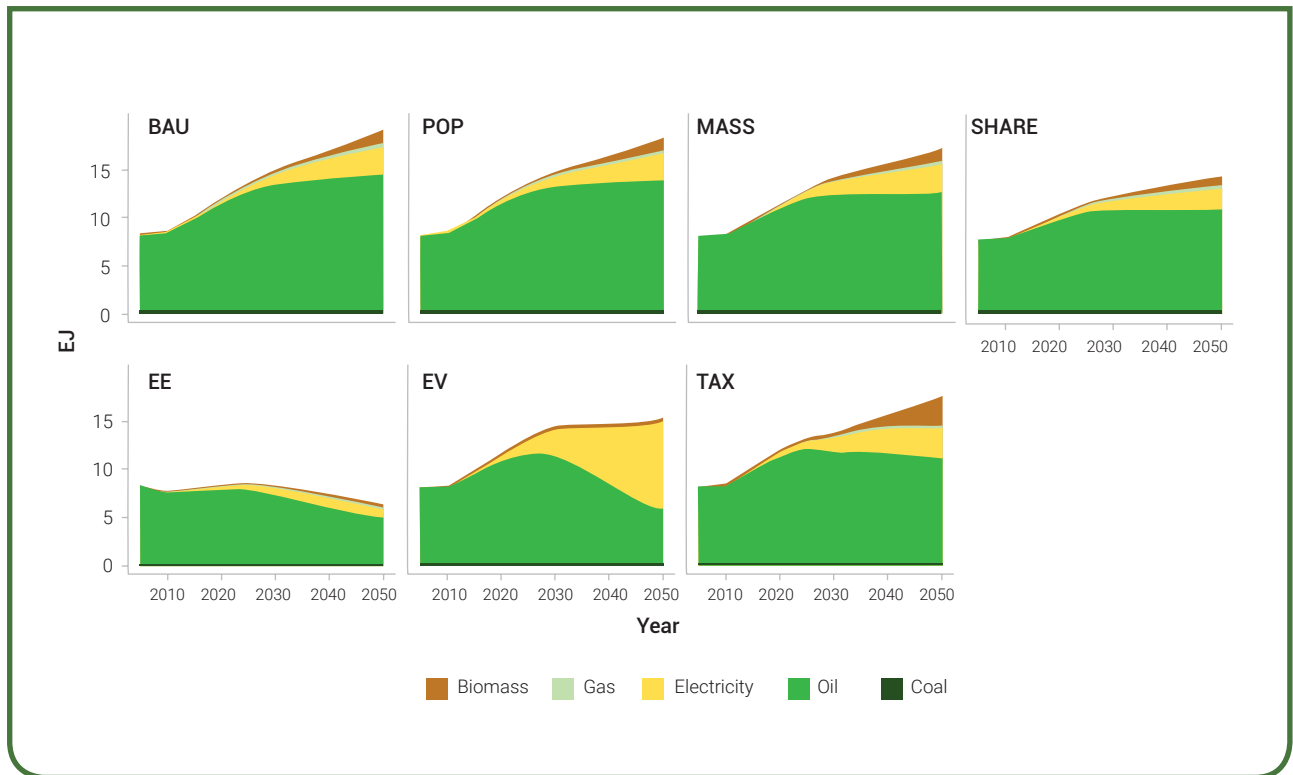
Figure 4.13 compares the energy mix under the different scenarios. Compared with the BAU scenario, the energy consumption in all other six scenarios has decreased. The EE and SHARE scenarios have led to the most significant reduction in the total amount of energy consumption, with the largest reduction of energy consumption in 2050. Meanwhile, the EV scenario has the most significant impact on the energy mix, with the share of electricity consumption in the EV scenario significantly higher than that of the BAU scenario. In the TAX scenario, the consumption of biomass has increased significantly, reflecting the positive impact of carbon taxes on the penetration of renewable energy.

Figure 4.14 shows the comparison on energy consumption of five fuel types including biomass, gas, electricity, oil, and coal in six scenarios compared with the BAU scenario. The POP scenario can reduce

**Figure 4.12 Changes in transport demand by mode for different scenarios**



**Figure 4.13 Energy mix for different scenarios**



**Figure 4.14 Changes of energy consumption in 2050 for different scenarios**



energy consumption, but it is less significant when compared to other scenarios. In the MASS, SHARE, EE, EV, and TAX scenarios, the oil consumption can be reduced to a certain extent. In the EV scenario, the electric power consumption increases significantly. The TAX scenario positively impacts both biomass and electricity.

### 4.3.5 Impacts of policies on CO<sub>2</sub> emissions

Figure 4.15 shows the CO<sub>2</sub> emission trajectories of the transport sector for the different scenarios for 2005-2050, as well as the potential emission reduction rate in 2030 and 2050. Among the six scenarios, the mitigation effect of the POP scenario is least significant, followed by the MASS scenario. The effectiveness of the SHARE scenario and the TAX scenario for emission reduction is roughly similar, while the EE and EV scenarios have the most evident emission reduction effects (Figure 4.15a). The emission reduction for the six mitigation scenarios in Figure 4.15b reveals the same pattern, in that the reduction rates of the EE and EV scenario are about 60 per cent in 2050, while the rate of the POP scenario is less than 10 per cent. Figure 4.15 also reveals that the EE and EV scenario (i.e., technology advancement) are most effective to reduce emissions, while the reduction rates of the POP scenario (i.e., transport demand reduction) and MASS scenario (i.e., transport modal shift) are less than 30 per cent, which indicates that the 'Improve' strategy would be the main pillar to realize transport decarbonization, compared with 'Avoid' and 'Shift' strategies in the ASI strategy framework.

**Figure 4.15 (a) CO<sub>2</sub> emission trajectories from 2005 to 2050; (b) emission reduction potentials**

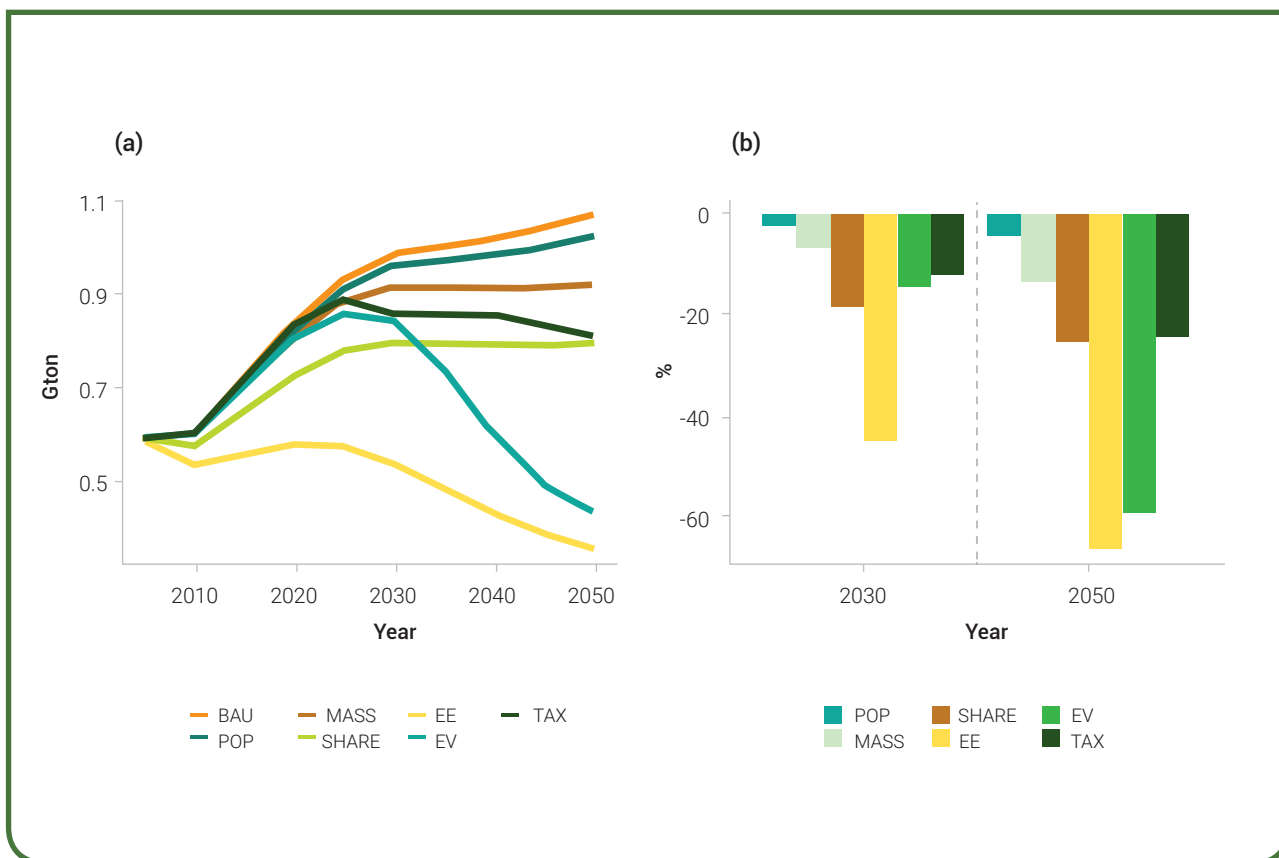


Figure 4.16 displays the cumulative CO<sub>2</sub> emission mitigation potential of the six scenarios (i.e., POP, MASS, SHARE, EE, EV, TAX) compared with the BAU scenario across the five countries and regions. The EE scenario shows the most evident emission reduction potential for all but the Rest of Asia, where the EV scenario presents the strongest emission reduction. Figure 4.16 reveals heterogeneity in the decarbonization potential across regions, where different scenarios produce differentiated impacts on emission reduction. This is probably because the transport and energy systems differ between countries, such as transport patterns, technology composition and energy structure. This suggests that policy measures in different regions should be tailored according to local contexts and national circumstances.

**Figure 4.16 Cumulative emission reduction potential for different scenarios**

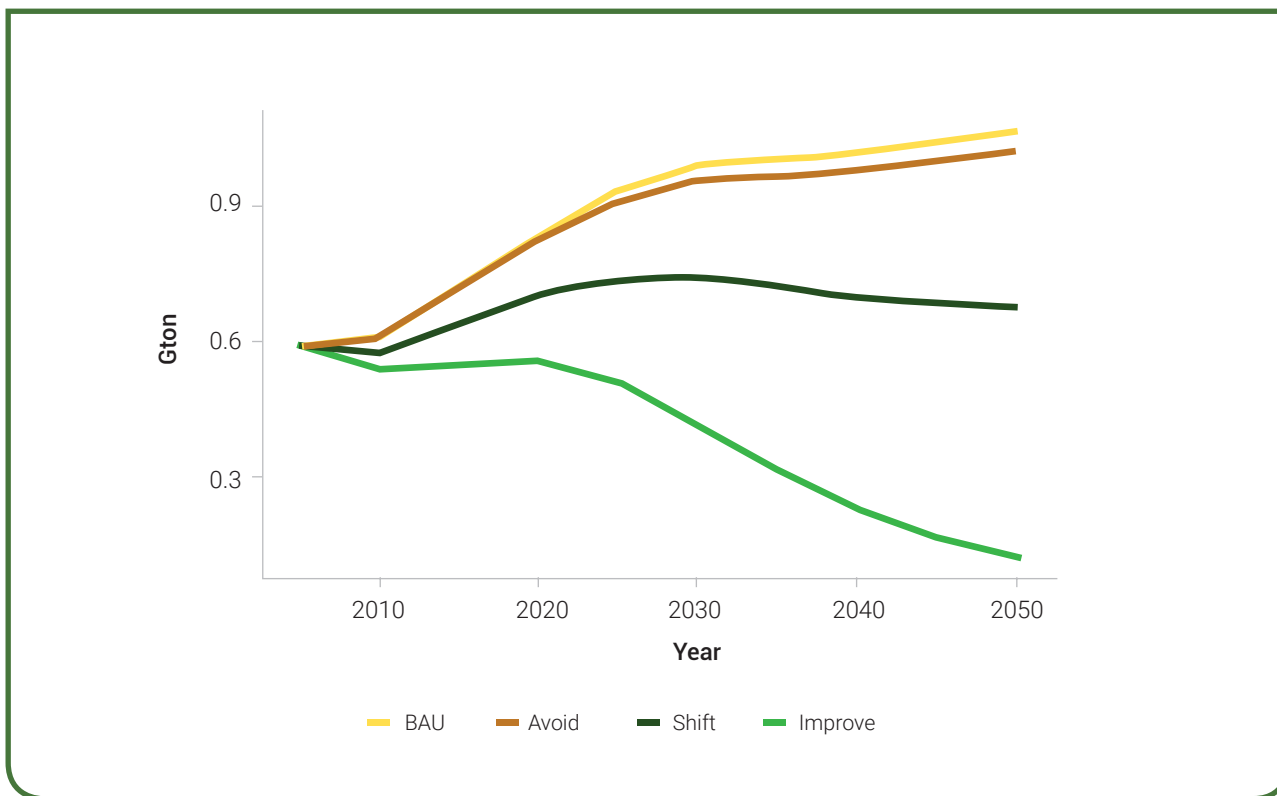


Figure 4.17 shows the decarbonization pathways of combined scenarios according to the ASI framework. Clearly, the ‘Improve’ strategy has the strongest emission reductions, followed by the ‘Shift’, and ‘Avoid’ strategies, implying that technology improvements represented by the energy efficiency improvements, the penetration of EVs, FCVs, and carbon pricing, would play the most important roles in low-carbon development in Asia.

**4.3.6 Summary of modelling results**

Table 4.4 shows reductions of CO<sub>2</sub> emissions in 2030 by scenarios, in comparison with the BAU scenario. It shows that the most effective ways to reduce CO<sub>2</sub> emissions are the “Improve” policies, especially related to energy efficiency improvement (EE). Promoting electric vehicles shows a larger impact on reducing CO<sub>2</sub> emissions in 2050 than in 2030, in comparison with the “Shift” and “Avoid” policies. As for the

**Figure 4.17 CO<sub>2</sub> emission trajectories according to the ASI framework**



“Shift” measures, promoting car sharing services is more effective than promoting mass transit-oriented development. Among all six scenarios, the “Avoid” policies show the least effectiveness to reduce CO<sub>2</sub> emissions.

#### 4.4 Policy implications

An integrated transport and energy model that accommodates detailed transport and energy technology options is a useful tool for capturing the dynamics of transport demand, energy consumption, and CO<sub>2</sub> emission profiles. This methodology allows transport planners, energy experts, climate scientists, and policymakers to collaborate and propose effective policies to decarbonize the transport sector. This analysis also revealed how different transport policies would impact the energy use and emissions in Asian countries. The main policy implications are outlined below.

##### ***Most policies have some benefits, but the Improve policies are most effective***

Most policies, such as travel demand reduction, mass transit-oriented transport development, increasing the vehicle occupancy rate, energy efficiency improvement, promotion of electric mobility, and carbon pricing, can contribute to the decarbonization of the transport sector. However, within the ASI framework, the Improve policies such as energy efficiency improvements and EV adoption offered the most significant emission reduction potential, with a reduction of more than 60 per cent of CO<sub>2</sub> emissions in the BAU scenario. In contrast, the lowest reduction was attributed to travel demand reduction, where CO<sub>2</sub> emissions went down by less than 10 per cent. This suggests that Avoid and Shift policies would moderately influence the energy mix and emission profiles, while policies to promote future technological improvements



**Table 4.4 Reductions of CO<sub>2</sub> emissions in 2030 and 2050 (per cent)**

Reduction of CO <sub>2</sub> emissions: 2030		China	India	Japan	South-East Asia	Rest of Asia
<b>Avoid</b>	Travel demand reduction scenario (POP)	-2.31%	-2.25%	-2.51%	-2.76%	-2.79%
	Mass transit-oriented development scenario (MASS)	-11.82%	-5.34%	0.00%	-5.53%	-4.98%
<b>Shift</b>	Car-sharing scenario (SHARE)	-19.42%	-10.40%	-21.31%	-20.18%	-9.08%
	Energy efficiency improvement scenario (EE)	-44.53%	-46.98%	-45.84%	-45.07%	-45.15%
<b>Improve</b>	Electric vehicle scenario (EV)	-13.68%	-21.66%	-8.63%	-14.75%	-23.02%
	Carbon tax scenario (TAX)	-14.91%	-21.17%	-6.87%	-9.61%	-9.45%
Reduction of CO <sub>2</sub> emissions: 2050		China	India	Japan	South-East Asia	Rest of Asia
<b>Avoid</b>	Travel demand reduction scenario (POP)	-4.07%	-3.97%	-4.51%	-4.74%	-4.62%
	Mass transit-oriented development scenario (MASS)	-22.30%	-13.42%	0.00%	-9.81%	-10.61%
<b>Shift</b>	Car-sharing scenario (SHARE)	-24.03%	-19.20%	-30.00%	-28.42%	-20.12%
	Energy efficiency improvement scenario (EE)	-65.99%	-67.58%	-67.60%	-66.57%	-66.22%
<b>Improve</b>	Electric vehicle scenario (EV)	-51.62%	-57.34%	-62.32%	-65.60%	-72.49%
	Carbon tax scenario (TAX)	-24.55%	-38.57%	-13.73%	-23.58%	-18.47%

in vehicles and energy, such as combustion engine efficiency and improved batteries for automobile applications, are most effective for reducing emissions.

### ***Improve measures are more tech-heavy and may cost more, so other strategies should also be used***

The analysis highlights the need for a balanced perspective between different strategies and policy measures to achieve low-carbon targets. While the Improve strategy appears to have the most positive effects on emission reductions, these policies are highly technology-dependent and constrained by the national or local technical development levels. In addition, more investments are required for the Improve strategy, whereas behavioural interventions in the Avoid and Shift strategies incur lower monetary costs.

### ***Policies need to be adapted to the country's characteristics***

The modelling exercise found that the impacts of policies varied across the different countries and regions, implying that regional disparities deserve careful attention when making low-carbon transport policy and planning decisions. The feasibility and effectiveness of the transport management and planning approaches are determined by the economic development stage of the countries, while the feasibility of policy measures designed according to the Improve strategy, such as the adoption of EVs and renewable energies, depend on the levels of diffusion of low-carbon technologies, which may differ across countries. Moreover, financial incentives for the adoption of advanced low-carbon technologies, such as carbon pricing policies, incur economic costs that will further impose financial pressure on developing countries. A synthetically designed policy package integrating the ASI strategies is needed to match the characteristics of each country.

## **4.5 Moving decarbonization to the top of the transport agenda**

The UNCCC COP26, held in Glasgow in 2021, recognized that rapid, deep, and sustained reductions in global greenhouse gas emissions and CO<sub>2</sub> emissions is necessary to limit global warming to 1.5 °C.<sup>22</sup> Therefore, urgent accelerated actions are required for the dissemination of technologies to reduce CO<sub>2</sub> emissions and decarbonize the transport sector. In this regard, electric mobility, when paired with electricity generated from renewable sources, could drastically reduce overall greenhouse gas emissions and contribute towards transport decarbonization. According to an Australian thinktank, there are also economic benefits to reducing emissions early:

“... it is clear there are significant economic benefits associated with setting a 46 per cent emission reduction target for 2030. These benefits from early action flow primarily from bringing forward emission reductions in sectors like electricity and transport which gives other industries more time to develop the technologies they need to decarbonise.”<sup>23</sup>

Because of different disciplinary conceptions and methodologies, behavioural and technological factors are hard to assess quantitatively using the current generation of transport energy models. Discussions on the positive contribution of an integrated package of measures, such as transport demand reduction, modal shift, and technology improvements, receive relatively less attention in the climate change mitigation agenda. To draw transport and climate change studies closer together, transport planners, energy experts, and climate scientists need to cooperate much more closely. This will help to develop more representative models, thus allowing policymakers to identify innovative and effective solutions for decarbonizing the transport sector.

## Endnote

- 1 Zhang *et al.*, 2018
- 2 Pérez-Martínez and Sorba, 2010
- 3 E.g., Schwanen *et al.*, 2004; Geurs and Van Wee, 2006
- 4 Stanley, Stanley and Davis, 2015
- 5 Moreno *et al.*, 2021
- 6 ESCAP, 2018c
- 7 Carvell, 1997
- 8 Boon and Cluett, 2002
- 9 ESCAP, 2020b
- 10 Medium, 2018
- 11 ESCAP, 2018c
- 12 International Energy Agency, "Electric vehicles" (Paris, 2020). Available at [www.iea.org/reports/electric-vehicles](http://www.iea.org/reports/electric-vehicles)
- 13 Global EV Outlook 2020; The Electric Vehicle World Sales Database
- 14 Bloomberg, 2020.
- 15 The Nation, Thailand unveils roadmap to 30% electric vehicles production in 10 years, 13 May 2021, <https://www.nationthailand.com/tech/40000851>, accessed on 25 August 2021.
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Photo credit: Yijia Chen



## Chapter 5

# Impacts of COVID-19 on Urban Passenger Transport

The transport sector, especially in urban areas, has been hit hard by the COVID-19 pandemic in Asia.<sup>1</sup> Across different cities, overall levels of mobility dropped significantly during waves of infection and government-mandated lockdowns. Reduced numbers of physical trips have been reported for all trip purposes,<sup>2</sup> but especially for social, recreational and leisure activities.<sup>3</sup> Furthermore, many people shifted from public transport to private cars and motorcycles. In some cities, people reported that they were replacing many of the foregone trips with online activity, although the capacity to avoid travel depended on the type of work people were doing as well as their connectivity to the internet.<sup>4</sup>

This chapter presents an overview of the impacts of COVID-19 on passenger transport in the Asia Pacific region. The analysis distinguishes between short-term impacts during government-mandated lockdowns and restrictions, such as changes to people's mobility, their attitudes and perceptions, the operation and management of urban transport systems, and levels of air pollution and CO<sub>2</sub> emission, and longer-term impacts likely to outlast the COVID-19 pandemic. The chapter also offers a framework for understanding and promoting resilience in urban passenger transport based on the concepts of engineering resilience and socio-ecological resilience (Box 5.1).

### Box 5.1 Reconceptualizing 'resilience'

In the transport context, 'engineering resilience' is understood as the capacity of a transport system to:

- (a) resist and absorb the impacts of a disturbance caused by a shock, interruption or disaster in order to maintain an acceptable level of service (= robustness);
- (b) recover and bounce back to the pre-shock steady state of regular and balanced functioning (= 'bouncebackability'); and/or
- (c) transform to a different stage of operation (= adaptability).

However, the experiences of the COVID-19 pandemic suggest that both engineering and socio-ecological resilience are required for the recovery process.

Socio-ecological resilience is defined as a system characteristic that captures the potential for continuous adaptation in light of ever-changing circumstances. Though it is more rarely applied to the transport context, it can complement the insights afforded by engineering resilience in useful and significant ways. The focus is on adaptability rather than robustness. A further useful distinction can be made between flexibility – the ability to reconfigure a system's parameters in light of expected changes, and agility – a system's ability to adapt and evolve in an environment that is characterized by continuous and unanticipated change.

For example, active mobility proved to be resilient to the pandemic, especially because people thought walking and cycling was safer than riding public transport. But the shift to active transport was greatly encouraged by supply-led interventions such as 'pop-up' cycle lanes; policy changes which allowed bicycles to be brought onto public transport vehicles, as well as support employers and the media. Social acceptance of cycling and people's behavioural change (socio-ecological resilience) was complemented by infrastructural interventions (engineering resilience), thereby enhancing the adaptability of the transport system.

Source: Schwanen, 2021

## 5.1 Short-term impacts

### 5.1.1 Mobility, attitudes, and perceptions

While the most apparent impact of government policies to contain the COVID-19 was the fall in ridership levels, transport mode use has been affected more strongly than trip frequencies, with mixed consequences from a sustainability perspective. Online survey research has shown a universal shift away from public transport,<sup>5</sup> although the magnitude of this change varies across and within cities and social groups. A smaller shift has also been reported away from taxi and ride-share services<sup>6</sup> and, in Bangladesh, from paratransit.<sup>7</sup> At the same time, increases in private vehicle use, motorcycle use and cycling and walking have been reported.<sup>8</sup> Pulled rickshaw use also increased in Bangladesh.<sup>9</sup>

The increase in cycling and walking was less universal than the decline in public transport; for instance, it was not observed in the early stages of the first wave of infections in Istanbul.<sup>10</sup> The fall in public transport has been found to be linked to people's perceptions of transmission risks. For example, online survey data collected across ten countries, including India and the Islamic Republic of Iran, show that the risk of contracting COVID-19 was perceived as much higher for bus and tram/metro than for walking, cycling and single occupancy car use, with shared car use taking an intermediate position.<sup>11</sup>

A focus on mode use in general hides important variations according to trip purpose. A study in Bangladesh indicates that the magnitude of changes depended on why trips were undertaken.<sup>12</sup> Paratransit use, for example, was reduced substantially for accessing employment, greengrocers, and markets, but increased for short-distance recreation and medical services. A study in Istanbul shows how changes in mode use depended not only on trip purpose but also on study participants' gender, age, income, and car ownership.<sup>13</sup>

While quantitative evidence is limited, clear social and spatial differences have occurred in mobility reduction and substitution by online activity.<sup>14</sup> For gender, online survey studies have shown that in Pakistan and Istanbul women engaged more in telecommuting than men, with men in Bangladesh also taking more out-of-home trips for shopping than women during the first wave of infections.<sup>15</sup> Multiple studies have suggested that the effects of government-mandated lockdown on mobility levels have been much smaller in informal settlements and cities with extensive informal sectors.<sup>16</sup> Differences in access to, and use of, digital technologies constitute another axis along which inequalities in mobility are likely to have increased, but robust evidence about how this affected trip-making during the pandemic is still limited.

### 5.1.2 Infrastructure, operations and farebox ratio

Many cities in Asia saw a partial or full closure of public transport services or at least a significant reduction in seating capacity (25-50 per cent) at times of high infection levels,<sup>17</sup> with due consequences on revenues. Operational costs have also increased due to the need for extra cleaning and hygiene practices. In Bangladesh, for instance, the farebox ratio has been under pressure because of the government stipulation that seating capacity had to be reduced by 50 per cent,<sup>18</sup> and in Delhi the metro is estimated to have lost some INR 1.609 crore (16.09 million) in the period March-September 2020. While public transport operators have been compensated by the government, many planned investments in network and service upgrades or expansion have been postponed, reduced or cancelled in the past 18 months.<sup>19</sup> At the same time, infrastructure and operations have adapted; for example, pop-up networks of cycling and bus rapid transit (BRT) lanes were set up in Metro Manila,<sup>20</sup> and while municipal authorities in Jakarta also created temporary cycle lanes.

### 5.1.3 Air pollution and GHG emissions

There is now a substantial number of studies analysing the effects of government-mandated lockdowns on air pollution levels. For example, significant reductions in levels of NO, NO<sub>2</sub>, PM<sub>2.5</sub>, O<sub>3</sub> and SO<sub>2</sub> were found for Bengaluru in January-March of 2020 compared to the same months in 2019,<sup>21</sup> while other studies on Indian cities also show large reductions in pollution, although the magnitude varies between and within cities and according to pollutants.<sup>22</sup> Meanwhile, a study on Lahore shows significant reductions owing to the lockdown,<sup>23</sup> but another study shows a more mixed picture for the Bangkok Metropolitan Area, with a 45 per cent reduction in NO during lockdown vis-à-vis the same period in 2019, against similar levels of O<sub>3</sub> and PM<sub>10</sub> and increases for PM<sub>2.5</sub>, NO<sub>2</sub> and SO<sub>2</sub>.<sup>24</sup>

There were also different trajectories for individual cities over time.<sup>25</sup> During lockdown, NO<sub>2</sub> and PM<sub>2.5</sub> levels were significantly lower than before in 6 out of 7 Asian cities shown in Table 5.1; only Jakarta did not see a noticeable decline. A study on CO<sub>2</sub> emissions in India shows a reduction of 28.5 per cent for India from January to mid-June in 2020, compared to mean levels for 2017-2019 for transport (excluding aviation).<sup>26</sup> This reduction amounts to approximately 0.55 MtCO<sub>2</sub>/day generated less by the transport sector in the first 5.5 months of 2020. However, studies also show that pollution levels increased again after lockdowns were lifted in Jakarta and Ulaanbaatar, but declined further in Kathmandu and Dhaka, while remaining similar in New Delhi.<sup>27</sup> Because of the substantial differences between cities, generalisations about how air quality has been affected by lockdowns are best avoided. Moreover, seasonal factors also play a role, and it should be noted that not all observed changes can be attributed to transport because emissions from other sectors (heating/cooling, manufacturing, etc.) were also affected by lockdowns.

## 5.2 Longer-term impacts

### 5.2.1 Modal shifts

The results of several studies suggest that a longer-term move away from public transport will likely outlast the pandemic.<sup>28</sup> Evidence for this claim is limited as it is typically inferred from empirical research on expectations held by members of the public during the first wave of the pandemic,<sup>29</sup> stated responses under a scenario of low infections but before mass vaccination,<sup>30</sup> or revealed behaviour after lockdown(s) have been lifted.<sup>31</sup> Moreover, online surveys are unlikely to be representative of full populations and this discrepancy is likely larger in countries and cities with bigger digital divides, greater poverty and/or more people in informal housing or employment. The ultimate test lies in what will happen once large-scale vaccination has been achieved in Asian countries, and the risk of new variants has subsided.

Paralleling a shift away from public transport, changes are expected towards greater car dependence, more walking and cycling and also private motorcycle use.<sup>32</sup> A survey conducted in India in May and June 2020 among 1,202 individuals from across India suggested growing use of both two- and four-wheelers, including motorcycles and private cars, after the first lockdown in the spring of 2020; however, it was also found that the pandemic is most likely to induce increases in car ownership among middle-income households among whom car ownership is lower than their higher-income counterparts, and who are able to afford this purchase, unlike lower-income households.<sup>33</sup>

It is difficult to find studies devoted to the long-term effects of the COVID-19 pandemic on platform-enabled shared taxis and car-pool services, and almost none has explicitly focused on informal transport modes.



**Table 5.1** PM<sub>2.5</sub> and NO<sub>2</sub> levels in 2020 compared to 2018-2019 for selected cities.

	Dates of lockdown	Before lockdown					
		Average		Difference		Change	
		PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>
Dhaka	26/3-14/6	151.4	7.1	-5.8	0.0	0.4%	0%
New Delhi	25/3-30/6	115.3	6.0	-16.0	-0.1	-12%	-2%
Kolkata	25/3-30/6	121.3	4.3	-15.3	-0.1	-11%	-2%
Ulaanbaatar	10/3-60/6	131.1	1.0	-14.1	0.1	-10%	8%
Kathmandu	24/3-14/6	66.2	1.6	-19.7	-0.4	-23%	-20%
Jakarta	30/3-5/6	41.1	1.6	15.6	-0.2	62%	-12%
During lockdown							
	Dates of lockdown	Average		Difference		Change	
		PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>
		PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>
Dhaka	26/3-14/6	51.3	2.9	3.9	1.1	-7%	-27%
New Delhi	25/3-30/6	44.3	3.5	-27.1	-1.6	-38%	-31%
Kolkata	25/3-30/6	21.7	2.4	-15.3	-0.5	-41%	-17%
Ulaanbaatar	10/3-60/6	20.3	0.9	-6.9	-0.1	-25%	-5%
Kathmandu	24/3-14/6	31.6	2.0	-27.4	-0.5	-46%	-20%
Jakarta	30/3-5/6	48.8	1.6	8.6	0.8	21%	-33%
After lockdown							
	Dates of lockdown	Average		Difference		Change	
		PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>
		PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>
Dhaka	26/3-14/6	29.5	2.0	-1.2	-0.7	-4%	-27%
New Delhi	25/3-30/6	n.a.	3.5	n.a.	0.4	n.a.	-9%
Kolkata	25/3-30/6	n.a.	2.1	n.a.	0.2	n.a.	9%
Ulaanbaatar	10/3-60/6	n.a.	1.3	n.a.	0.04	n.a.	3%
Kathmandu	24/3-14/6	9.3	1.4	-21.7	-0.3	-70%	-16%
Jakarta	30/3-5/6	63.8	2.2	19.0	-0.5	52%	-17%

Source: Benchriff *et al.* 2021, Tables 2 and A2, PM<sub>2.5</sub> is measured by µg/m<sup>3</sup> and NO<sub>2</sub> is measured by 1E15 molecules/cm<sup>3</sup>.

In Bangladesh, a survey found that people's future choices were influenced by previous modal choices. Nonetheless, services with many captive riders, such as motorcycle and minibus taxis, may see a quicker recovery after the pandemic than those that rely on patronage by users who have greater discretion over choosing the service. At the same time, operators of shared taxi and carpool services enabled by digital platforms have shown significant adaptability during the first wave of the pandemic by moving away from ferrying persons towards activity in (non-COVID) patient transport to/from medical service centres, food delivery, logistics and micro-mobility.<sup>34</sup> Also, a Delphi study among 18 mobility experts worldwide indicated the extent to which shared mobility services can re-establish trust among (potential) users as one of the key factors that will decide how platform-enabled mobility services will fare after the pandemic; other factors include public attitudes towards eco-friendly transport, and city-level decisions about investments in transport infrastructures and whether urban planning will move beyond favouring private car use.<sup>35</sup>

### **5.2.2 Digitalisation of mobility**

There is a consensus among studies and experts that the pandemic is a 'game changer' for the digitalisation of mobility. It is widely expected that there will be significantly more business meetings and working from home after the pandemic. However, people in certain occupations, particularly manual and some service jobs, may not have the option of working from home. Furthermore, a partial return to working at the workplace after mandated restrictions or waves of infections have ended has been empirically validated.<sup>36</sup> Expectations regarding online shopping are more equivocal. As described in Box 5.2, the experts in a 2020 survey expected a fundamental shift towards online shopping (Table 5.2), but the expectations of 834 participants in an online survey in May 2020 in Indonesia showed a more nuanced picture.<sup>37</sup> While roughly a third expected to undertake less out-of-home grocery and non-grocery shopping after lockdown and the first wave of infections, half expected to return to pre-pandemic routines and a minority (18 per cent for grocery and 11 per cent for non-grocery shopping) expected to engage in out-of-home shopping more often. Moreover, all else equal, those who had engaged in non-grocery shopping online during the first wave expected to be shopping at least as much as they did before the pandemic.

### **5.2.3 Infrastructure development, air pollution and GHG emissions**

The long-term consequences of the pandemic for city-level transport infrastructure development have remained under examined in the academic literature. The likelihood of delays in investment has been acknowledged for Asian cities in general<sup>38</sup> and for the metro system in Delhi more specifically.<sup>39</sup> However, empirical evidence to back up claims has not been provided. Long-term impacts mainly depend on whether modal shifts away from public transport and towards (private) car use and the substitution of physical trips by online activity will unfold.

## **5.3 Case studies on impacts of COVID-19 on mobility patterns in Asian cities**

### **5.3.1 Bangkok**

Thailand has initially fared well relative to other nations during the pandemic, having maintained a low level of virus cases and deaths throughout 2020. Thailand's Ministry of Health imposed border closures early on. As with many countries throughout the world, travel demand within Thailand plummeted to its lowest during the months of March and April 2020. The government also encouraged people to work from home wherever possible. Bangkok is fortunate in being a city open to remote working, with an agile

**Table 5.2 Experts' agreement about long-term impacts of the pandemic**

Statements in online survey	Experts in India (n=28)	Experts in Asia outside India, China, Japan & Republic of Korea (n=33)	All experts (n=284)
Online working (working at home, neighbourhood satellite offices, cafes, etc.) will become popular	85.7%	66.7%	77.9%
Online shopping will become the most popular shopping activity	89.3%	78.8%	60.9%
Online education will be a standard model of education	25.0%	57.6%	34.3%
Car dependence will become more obvious due to adverse reactions to crowded public transport during the pandemic	75.0%	69.7%	63.0%
More and more people will out-migrate from populated cities	25.0%	27.3%	22.2%
More and more people will choose to live far from the city centre	28.6%	21.1%	20.5%

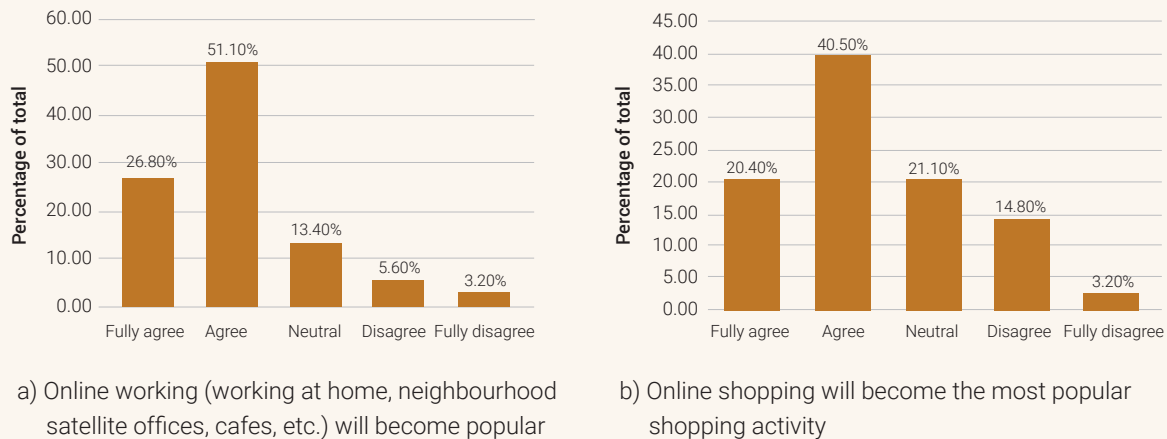
Source: Zhang et al. 2021, page 77, Data includes "agree" and "fully agree".

### Box 5.2 Envisioning a "new normal" after COVID-19

Many people have tried to visualise what the implications of COVID-19 will be on the transport sector after the pandemic is brought under control. For example, the majority of transport experts who participated in an online survey in early 2020 agreed or fully agreed that, after the pandemic, a 'new normal' would emerge in which online working will be popular, online shopping will be the most popular shopping activity, and car dependence will increase because of public concern of crowding on public transport. At the same time, support for the idea of online education as the standard model of education was much lower, and only one-fifth agreed that the pandemic would result in extensive urban decentralisation (away from the city centre) or de-urbanisation (away from large cities).

Levels of agreement among experts in India and Asia outside India, China, Japan and the Republic of Korea were mostly above those for the global sample, especially regarding statements on online shopping and greater car dependence. However, the survey was conducted at the beginning of the pandemic, and expert views may have shifted since then. Results from the second wave of the global online survey of transport experts have not yet been published but are likely to reflect wider geographical differences, given the varied trajectory of COVID-19 in different countries.

## Box 5.2 Envisioning a “new normal” after COVID-19 (cont.)



Source: Zhang *et al.*, 2021

and technically capable workforce. Remote conference technology allowed businesses to be kept afloat. However, restaurants, nightclubs, malls, stadiums, and public parks were ordered to close. Public behaviour shifted significantly, and many people simply did not feel safe to use public transport. As such, public transport lost more patronage than the expressway, with a likely long-term, even permanent, shift to private car usage.<sup>40</sup> The Bangkok Sky Train (BTS) witnessed over an 80 per cent decline in ridership during the month of April on its most used Green Line. Also, during the peak lockdown months in March and April, road traffic was significantly reduced. April 2020 saw a reduction in expressway traffic from 1,095,000 vehicles per day to just 550,000, equating to a 50 per cent drop.<sup>41</sup> However, Bangkok again faced a difficult situation during the second and third wave of COVID-19 in 2021 with much spike in COVID-19 cases and restriction on travel. With restriction being gradually eased, road traffic and public transport began to resume operations.

Thai authorities used several measures to mitigate the risks of infection on public transport. Overall, Bangkok’s social distancing measures led to a reduction in public transport capacity by up to 40 per cent.<sup>42</sup> Mask compliance is very high in Bangkok, as is the case across much of Asia. Bangkok’s Metro system may be held as an exemplary example of effective sanitary and social distancing measures (Figure 5.1). Passengers had their temperatures checked at the gates of the metro stations, and the use of masks was enforced across all public transport systems. In addition to temperature checks, markings were designated on all platforms to demarcate queuing areas for correct social distancing. Alcohol gel was provided at entrances and exits to encourage regular hand sanitisation. The measures for Bangkok’s public bus transport system were less strict. Thailand is one of the world’s foremost tourist destinations

**Figure 5.1** A BTS station and social distancing during COVID-19 in Bangkok



Photo credit: Madan B. Regmi

and the resounding impact of the government's international border closure was abruptly felt by the country's wired transport services. Taxi services in particular suffered heavy losses in revenue, with many seeing large falls in typical passenger numbers due to the decrease in tourists and many passengers choosing to use private cars instead.

### 5.3.2 Greater Jakarta

The impacts of the pandemic lockdown and social distancing policies in Greater Jakarta are comparable to those in other Asian cities.<sup>43</sup> During the first wave in early and mid-2020 the share of the population staying at home increased markedly, while use of the main public transport system – metro, light rail, commuter rail (KEL) and BRT – dropped very strongly. The metro saw a drop of 94 per cent in ridership levels in April 2020, relative to January 2020. Ridership levels recovered only partially after the first lockdown ended (Figure 5.2). As a result of these changes, farebox revenues have dwindled – a situation that may be exacerbated if the government decides to reallocate funding and subsidy for Greater Jakarta's public transport to pandemic-induced financial priorities.

The impacts on public transport are potentially very serious as Greater Jakarta scores relatively well on the public transport related items in the SUTI. The city-region's public transport is relatively affordable, offers good quality and reliability, and access is decent. Investment has been excellent, although the fair box ratio is low. Moreover, car use roughly tripled and motorcycle use grew by at least a factor of nine between 2000-2018.<sup>44</sup> Greater Jakarta's public transport could bounce back if public trust in its various systems is restored rapidly. This means that measures are needed to minimize the risk of infection post-pandemic, including continuation of the hygiene and cleaning practices that were adopted during the COVID-19 crisis, improving ventilation in vehicles, acceleration of the transition towards digital payment systems, and better provision of real time information on passenger and crowding levels on vehicles and in stations. For the medium and long term, greater modularity in the design and operation of urban rail and bus systems can enhance the robustness of public transport.

**Figure 5.2** Commuters in the subway in Jakarta during COVID-19



Photo credit: Selenia

### 5.3.3 Kathmandu

In Kathmandu, a series of safety measures were issued to mitigate the risk of transmission on public transport. From July 2020 onwards, instructions were put forward to wash busses daily and disinfect them after every use. Hand sanitisers were made available for all passengers, mask use was compulsory, passengers were required to leave a seat vacant between them and the next person, and ticket collectors/drivers were given training in the correct use of personal protective equipment, such as masks, face shields, and gloves. Moreover, the Government of Nepal allowed operators to increase the price of a ticket fare by fifty per cent to help cover the additional costs of undertaking covid safety measures. Moreover, the operators indicated that, as a result of the large drop in passenger volume, even the increased price fare was not sufficient to cover the cost of maintaining such strict hygiene measures. Buses were being operated mainly to engage drivers and keep the batteries charged. Some operators maintained that they were operating at less than ten per cent of their usual volume during March. As in other Asian cities, more and more people have opted to walk for shorter trips, or use private vehicles, such as motorbikes or cars, for longer journeys. The Taxi Entrepreneurs' Association reported in 2020 that their daily passenger collection rate has remained at a steady reduction of 60 per cent.<sup>45</sup> The adverse financial impacts on Kathmandu's public transport system continue as the second wave of infections passes through the Asia-Pacific. It has been observed, for example, that many bus operators have left Kathmandu and returned to their native village, with many also unwilling to return due to the fear of another lockdown. The maintenance requirements set forth during the lockdown have led many to abandon their fleet of buses, leaving them susceptible to rust and damage to tires. The economic repercussions of this abandonment could be potentially severe, as the Transporter Entrepreneurs' Association maintains that every bus in operation creates 5 additional jobs in Nepal, from manufacture to repair.

### 5.3.4 Yangon

Shortly after the discovery of COVID-19 cases in Yangon, the country's largest city, the government enforced stay-at-home orders, curfews, bans on public gatherings, and closures of public events, entertainment venues, and religious institutions. Moreover, a suspension on international flights was enforced. On 30 November 2020, the government's Central Committee for Prevention, Control and Treatment of COVID-19 extended this international travel ban. As of December 2020, the number of confirmed cases of COVID-19 detected in Myanmar surpassed 90,000 (WHO), making it the third-most affected nation in South-East Asia.<sup>46</sup> Public transport in Yangon consists primarily of public buses and the circular railway. In response to the pandemic and rising infection levels, Ministry of Transport and Communications advised that commercial bus lines to continue operating but to limit the number of passengers to 50 per cent capacity.

A similar reduction in numbers was experienced by Yangon's Circular Railway, which reduced the number of operational railways within Yangon by between 40 and 90 per cent of the typical daily frequency. Moreover, railway runs which had previously operated lines four times in the morning and evening saw their services halved. Some services struggled more than others. For example, the express bus line companies suspended their services in light of the stay-at-home order issued by the government. The Yangon Bus Service (YBS) is the major provider of public transport to Yangon's inner-city commuters. The service was created in 2018, replacing the existing fleet of buses with a new model imported from the Republic of Korea, which is considered safer. Currently there are around 100 YBS bus lines, two circular routes and two airport shuttle buses. By July 2020, daily ridership increased up to 1,180,829, with 3939 bus services running continuously to the end of that month. However, shortly after, following the outbreak of the second COVID-19 wave in August 2020, daily ridership decreased to 94 per cent.<sup>47</sup> Overall, the private commercial bus lines have fared the worst. Even after travel restrictions were lifted, public sentiment about nonessential travel continued to affect bus companies. Cargo truck companies have also been affected by curfews and travel restrictions.

### 5.3.5 Metro Manila

In order to ameliorate the consequences of the epidemic, in March 2020 the Department of Transport released guidelines for various public transport modes that included details on the allowable capacities of public transport vehicles. Severe travel congestion followed due to checkpoints and lower public transport supply. Moreover, the reduction in public transport capacity resulted in long queues, crowding, and disregard for social distancing. The abrupt halt in transport services caused various mobility problems for essential health workers as well as difficulties in reaching essential services. Only private vehicles with one passenger were allowed, provided that they only go out to buy essential items. Government offices and local government units provided free rides, but these were still not enough.

Moreover, the closure of most businesses left many citizens jobless and reliant on government assistance in the form of either cash or food packs. According to a World Bank study, unemployment tripled to 17.5 per cent in April 2020, with the poorest households experiencing lack of income. Around 40 per cent of households were unable to buy essential food products due to lack of money and mobility restrictions. In a nationwide survey of more than 74,000 firms conducted by the World Bank and other partner agencies in July 2020, 40 per cent reported to have temporarily closed while 15 per cent had closed permanently. Two of the most affected industries with the highest number of closures belonged to the transport and tourism sectors, which are highly dependent on person and goods movement.

Although transport operations have already resumed, the transport sector has been identified as among the most vulnerable. It is suffering from reduced revenues due to capacity restrictions and additional costs due to sanitation protocols. This has resulted in a lower availability of public utility vehicles (PUVs).

In September 2020, the government enacted a recovery act which provides a comprehensive program to lead the country towards recovery from the COVID-19 pandemic. Under the Response and Recovery Interventions in the law, the Department of Transport (DOTr) was tasked to facilitate partially subsidized service-contracting of PUVs as a form of temporary relief for adversely affected workers in the public transport sector, and at the same time improve the levels of service of public transport. Also, funding has been issued to temporarily sustain the livelihood of displaced workers in the industry through service contracting.

While the COVID-19 crisis has caused a severe economic shock, there is general agreement that it has also served as a catalyst for the hastened implementation of various reforms in the transport sector which had previously started but had suffered from slow adoption.<sup>48</sup> For instance, the use of technology and digital innovation as measures to deal with the mobility restrictions are welcome improvements that are expected to stay beyond the pandemic. Examples of these measures include online applications for drivers' license, motor vehicle registration, certifications, and revision of records; online franchise-related transactions; cashless transactions at toll ways; cashless transactions in Public Utility Vehicles; and Automated Fare Collection system in Railways.

Another outcome of the pandemic has been increases in bicycle usage. There has been increase in imports of bicycle. The government has also responded to the increased demand for cycling by planning and implementing a metropolitan wide network of segregated bicycle lanes, and by supporting educational information programmes and developed guidelines to promote safe use and responsible use of active transport modes. Finally, under the recent Build-Build-Build programme, the government has planned several large transport infrastructure projects, including a subway and more BRT, railway lines, and the completion of integrated terminals in order to stimulate economic development once the pandemic is over.

#### **5.4 Implications of the experience of COVID-19 for “building back better”**

As this chapter has outlined, the COVID-19 pandemic is likely to have both short- and long-term impacts on urban transport systems, not only in Asia but also other regions of the world. There are an increasing number of studies seeking to understand pandemic-related changes to mobility in Asian cities and more widely have now been published. The literature has focused more on short- than long-term changes to mobility in Asian cities. For the short term, enhancing bouncebackability when the COVID-19 pandemic subsides is essential. To counter these trends, the following policies are recommended.

##### ***Restoring confidence in public transport***

Rapidly restoring public confidence to pre-pandemic levels must be at the heart of efforts to help public transport recover quickly: enduring lack of trust will diminish individuals' mobility capabilities, depress ridership, and harm public transport's fare box ratios in the medium term. Concrete interventions to restore public confidence include post-pandemic continuation of the hygiene practices, such as the visible and frequent cleaning vehicles and provision of hand sanitizer.<sup>49</sup> Acceleration of the transition towards



digital payment systems may also help, as well as improved ventilation in vehicles and real-time information provision on crowding levels in vehicles and stations. In the medium term, rapid electrification as well as further digitalization in service operation, real-time customer information provision and payment systems can enhance flexibility and agility as well as increase patronage.<sup>50</sup>

### ***Consolidate efforts to promote active transport and integrate informal transport***

New transport technologies and infrastructure for active travel need to be complemented with substantial investment in public transport technologies and infrastructure. In the short term, the widely introduced pop-up infrastructures for walking, cycling and micro-mobility, as well as in some cities BRT, should be consolidated, spatially extended and be accompanied by complementary infrastructure, for instance for bicycle parking and storage.<sup>51</sup> It would also be good to extend or introduce bicycle and e-bike hire and e-scooter schemes at locations that are easily accessible and with rates that are affordable to all social strata across the whole urban area – not just for already privileged middle-classes in dense, well-to-do neighbourhoods. The pandemic has also drawn attention to informal transport service providers. On the one hand, informal transport providers were affected as much as other public transport operators during blanket lockdowns, but provided alternatives to congested public transport for virus-wary passengers. On the other hand, their economic and social vulnerability was exposed, furthering the argument for the need to try to integrate them into the formal transport system. The long-term impacts on informal transport services is an interesting area for further research.

### ***Ensure that positive initiatives from the pandemic don't lead to inequality***

There seems to be a general consensus that the pandemic accelerated the introduction of digital technologies in many aspects of urban transport provision, such as cashless ticketing, real-time information provision, and congestion management. While some of these developments are welcomed by digitally connected people, other groups without smartphones or financial services are at risk of being excluded from these technologies. Other reasons why social and spatial inequalities in realised mobility and accessibility may increase are if the fares of public, shared and informal transport services increase, services are rationalised and investment in infrastructure development are reduced, and/or tailored to the most profitable services and routes. Governments should monitor the impacts of these new initiatives.

## **5.5 Aspiring for adaptability for resilient urban transport systems**

The experience of the pandemic has encouraged a reconceptualization of the concept of resilience. Most people would interpret resilience to be about engineering resilience, which is premised on equilibrium thinking. According to this concept, a disruption to the 'normal' stable state is viewed as a threat to system functioning. However, the socio-ecological resilience approach sees disruption as an opportunity and as triggering renewal, innovation, and system transformation. While they may have multiple, locally stable equilibria, systems are often in dynamic disequilibrium. Change is therefore seen as the default, and the future of a system is understood to be largely unpredictable.

Both approaches can help policymakers to better prepare for complex emergencies. It is difficult to isolate transport systems from other systems – e.g., energy, land use, and information technology – because these are closely interconnected, meaning that disturbances and changes cascade and multiply through and across them, causing multiple direct and indirect effects.<sup>52</sup> Consider, for instance,

how climatic change can lead to more intense bursts of precipitation in certain places, affecting power cables and power stations, with consequences for electric transit systems, traffic signalling systems, and EV charging stations. Thus policy-makers need to understand resilience as capturing the potential for continuous adaptation in light of ever-changing circumstances.

## Endnote

- 1 Earley and Newman, 2021; Rothengatter *et al.*, 2021
- 2 Barbieri *et al.*, 2021; Hasselwander *et al.*, 2021 for Metro Manila
- 3 Anwari *et al.*, 2021 for Bangladesh; Shakibaei *et al.*, 2021, for Istanbul
- 4 Zhang *et al.*, 2021
- 5 Anwari *et al.*, 2021; Hasselwander *et al.*, 2021; Shakibaei *et al.* 2021; Zhang *et al.*, 2021
- 6 Rothengatter *et al.*, 2021; Shakibaei *et al.* 2021
- 7 Anwari *et al.*, 2021
- 8 Anwari *et al.*, 2021; Zhang *et al.*, 2021
- 9 Anwari *et al.*, 2021
- 10 Shakibaei *et al.*, 2021
- 11 Barbieri *et al.*, 2021
- 12 Anwari *et al.*, 2021
- 13 Shakibaei *et al.* 2021
- 14 Gutiérrez *et al.*, 2020; Hasselwander *et al.*, 2021
- 15 Anwari *et al.*, 2021; Shakibaei *et al.*, 2021
- 16 Gutiérrez *et al.*, 2020; Anwari *et al.*, 2021; Sharifi and Khavarian-Garmsir, 2020
- 17 Earley and Newman, 2021; Zhang *et al.*, 2021
- 18 Anwari *et al.*, 2021
- 19 Early and Newman, 2021
- 20 Hasselwander *et al.*, 2021
- 21 Gouda *et al.*, 2021
- 22 Khan *et al.* 2021; Kolluru *et al.*, 2021; Kumar *et al.*, 2021; Mandal *et al.*, 2021 Rahaman *et al.*, 2021; Vega *et al.* 2021
- 23 Pervaiz *et al.*, 2020
- 24 Sangkham *et al.*, 2021
- 25 Benchriff *et al.*, 2021
- 26 Parida *et al.*, 2021
- 27 Benchriff *et al.*, 2021
- 28 Beck *et al.*, 2020; De Haas *et al.*, 2020; Gutiérrez *et al.*, 2020; Raunak *et al.*, 2020; Barbieri *et al.*, 2021; Rothengatter *et al.*, 2021; Zafri *et al.*, 2021a
- 29 De Haas *et al.*, 2020; Raunak *et al.*, 2020; Barbieri *et al.*, 2021
- 30 Zafri *et al.*, 2021a
- 31 Beck *et al.*, 2020; Rothengatter *et al.*, 2021
- 32 Shakibaei *et al.*, 2021, for Istanbul; Raunak *et al.*, 2020; Zafri *et al.*, 2021a; Zafri *et al.*, 2021b
- 33 Raunak *et al.*, 2020
- 34 Combs and Pardo, 2021; Shokouhyar *et al.*, 2021
- 35 Shokouhyar *et al.*, 2021
- 36 Beck *et al.*, 2020; De Haas *et al.*, 2020; Irawan *et al.*, 2020; Shakibaei *et al.*, 2021; Zhang *et al.*, 2021
- 37 Irawan *et al.*, 2020
- 38 Earley and Newman, 2021
- 39 Rothengatter *et al.*, 2021
- 40 Siridhara 2020
- 41 Siridhara 2020
- 42 Siridhara 2020
- 43 Resdiansyah, 2021
- 44 Resdiansyah, 2021
- 45 Poudyal, 2020
- 46 Strangio, 2020
- 47 Thein, 2020
- 48 Gaspay, 2021
- 49 Raunak *et al.*, 2020; Hasselwander *et al.*, 2021; Shakibaei *et al.*, 2021
- 50 See also Earley and Newman, 2021
- 51 Hasselwander *et al.*, 2021; Nikitas *et al.*, 2021; Zafri *et al.*, 2021a
- 52 Markolf *et al.*, 2019



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# Chapter 6

## Conclusions

This Review has discussed a wide variety of issues pertaining to the sustainability of passenger transport in Asian cities. As cities look at how to 'build back better' on the back of the COVID-19 pandemic, they should focus on both system consolidation and system transformation: they should make public transport more robust and adaptable, whilst enabling deep changes towards low-carbon and socially just urban mobility. This requires a more creative and comprehensive approach to policy-making which looks holistically at transport systems, not only at individual problems. There are multiple ways in which flexibility and agility of urban transport systems in Asian cities can be strengthened, but often these policies can only achieve their full impact when they are complemented by other policies. For example, reallocating road space away from private car use should be complemented with regulatory and pricing measures to make fossil fuel-powered private car use less desirable.<sup>1</sup> Another example is the need to develop appropriate infrastructure and regulatory frameworks to make walking, cycling and other forms of micromobility safer and better integrated with other modes. The electric vehicle revolution which is expected over the next decade will require robust energy grids and proper battery disposal systems.

The COVID-19 pandemic also underlined the need for a shift in the mindset of policymakers to think beyond the transport sector and strengthen linkages to other sectors, including health, social welfare, energy, environmental protection, security, and so on. Such multi-stakeholder coalitions are needed to deal with unexpected external crises. There may also be trade-offs between policies, requiring additional measures to mitigate potential negative effects. For example, cashless ticketing and payment systems can enhance the efficiency of public transport, but those without access to smartphones and financial services will be excluded if there are no alternative ticketing systems. In other words, all three principles of sustainability, environmental, social inclusiveness and resilience, need to be addressed at the same time.

This chapter presents selected policy recommendations for moving Asia's urban passenger transport towards more sustainable systems. Rather than presenting an exhaustive list, the major conclusions drawn from the issues discussed are highlighted here.

## **6.1 Make urban transport more environmentally sustainable**

### ***Reduce petrol-based private transport modes and promote electric transport***

Projections by the International Transport Forum suggest that global passenger demand (measured in vehicle-km) will be more than double between 2015 and 2050, with most of the growth occurring in Asia.<sup>2</sup> Therefore, if governments are serious about reducing energy use and emissions, they have to remove incentives for fossil fuel-powered private transport modes and direct more investments into public transport. A critical step towards this goal is to reduce or remove fuel subsidies. As the results of the modelling exercise in Chapter 4 suggest, another step is to improve transport technologies. Fuel efficient vehicles, clean fuels (including electricity), and electric vehicles can contribute to decarbonizing the transport sector, but these technologies will only slow down, not reverse, the rise in CO<sub>2</sub> emissions/capita. Furthermore, replacing fossil fuels with biofuels or electricity requires policymakers to be mindful of the impacts of those sources: not all biofuels are good for the environment, and continuous efforts need to be made to enhance the sustainability of electricity sources. Efforts to make paratransit environmentally sustainable by transforming them to electric mobility or adopting energy-efficient technologies may be accelerated with special programmes to cover the costs for paratransit operators. Smart transport systems will also help to reduce road congestion and air pollution, increase people's accessibility, ensure the smooth delivery of freight, and cut energy consumption.

### **Promote mass public transport systems**

To pre-empt a further transition towards full hegemony of the private car transport system across Asian cities, a wider, long-term transformation of urban transport is required. To achieve this, in turn, requires a continued commitment and holistic approach to urban planning, which includes land-use as well as transport policies, and aims to enhance the mobility capabilities of all city residents and visitors.<sup>3</sup> Given the blows dealt to farebox ratios and finance resources by the pandemic, financial support through government subsidies and other means would be helpful in the short and medium term.<sup>4</sup> Such support can also pre-empt operators raising fares and be tied to conditions that disallow fare increases, because higher fares will likely further disadvantage low-income workers and neighbourhoods<sup>5</sup> and intensify existing transport inequalities.

### **Promote micromobility and active transport**

Shared bikes, e-bikes and e-scooters can, under certain conditions, make short-distance trips and first/last-mile trips to public transport stops flexible, fast, and efficient.<sup>6</sup> Those conditions include safe road infrastructure and parking/storage, clear regulation, affordable prices, and payment methods that are also accessible to low-income groups. Micromobility schemes need to be developed in consultation with rickshaw or motor taxi drivers to minimize competition and ensure that a substantial number of those drivers can be employed in the operation of new micro-mobility schemes. Additional road space for active travel is essential, and this involves reallocating road space away from private cars.<sup>7</sup> From a user point of view, segregated physical infrastructures such as dedicated sidewalks and bike paths will be preferable, but modular road designs whereby road space can be allocated more flexibly to different uses also merit careful attention, as such an approach could have facilitated changes in road uses needed during the pandemic.

## **6.2 Enhance social inclusiveness and safety**

### **Towards an urban transport system which meets everyone's needs**

The core objective of long-term transport planning must be the enhancement of people's mobility capabilities – their potential to undertake trips and reach destinations, and thus their freedom to undertake the activities they value – in a manner that does not diminish the mobility capabilities of others.<sup>8</sup> The traditional focus on traffic movements must be made subservient to the goal of satisfying the needs of the people who live in a city. In this regard, the mobility capabilities of all social strata in a city should be enhanced, not just the capabilities of select groups. But this is not an easy task. For example, creating high-quality physical infrastructures for cycling and micro-mobility is not enough to guarantee use across all strata and groups; cultivating cycling-related skills, confidence, and aspiration through cycling lessons in primary and secondary education, through dedicated workshops and via smartphone apps is important too, especially for disadvantaged groups.<sup>9</sup>

Furthermore, enhancing the environmental sustainability and resilience of urban transport systems without paying attention to transport justice will also potentially be counter-productive if it intensifies social tensions. Transport justice includes the distribution of benefits and costs or harms (distributional justice); how the decision-making process is controlled; and the extent and ways in which the knowledge, needs, values, customs, and capabilities of different groups are recognized and respected (justice as recognition).<sup>10</sup> Although more research is needed to understand the complex ways in which transport

affects different groups, it is clear that policymakers and other professionals need to take transport planning out of its institutional silo and integrate it with urban planning, public health, social care, and economic activities to make their transport systems more inclusive.

To be inclusive, transport systems must also be safe and secure for all users. As noted in Chapter 3, road crash fatalities in the Asia-Pacific region continue to rise as levels of motorization increase, with Vulnerable Road Users such as pedestrians, cyclists and motorized two- and three-wheeled vehicles accounting for over 50 per cent of fatalities. Urban passenger transport systems can be made safer through activities under the Global Plan for the second Decade of Action for Road Safety 2021-2030, which promotes a “safe system approach”. This approach includes using multimodal transport and land-use planning policies to enhance safety, which overlaps with many aspects of environmental sustainability. In this regard, governments should integrate social, environmental and resilience concerns into the design of urban passenger transport policies. For example, safety aspects should be fully integrated into active transport infrastructure design. The adoption and application of smart transport technologies can also enhance both safety and environmental sustainability.

### 6.3 Integrate resilience into urban and transport planning

#### ***Address the immediate impacts of COVID-19 on transport preferences***

There is a consensus that public transport will struggle to recover in terms of both ridership and financial health for some time. Similar yet less pronounced effects may occur for platform-enabled shared taxi and car-pool services, although the evidence for this claim is very limited. At the same time, private car reliance and, to a lesser extent, motorcycle use and active travel – walking, cycling and micro-mobility – may increase. Most unclear is how informal transport services will be affected in the medium-long term, mostly because the impacts of the pandemic on informal transport have hardly been examined so far. According to the academic literature to date, the modal share of public transport; access, quality, reliability, and affordability of public transport; and the investment and operational costs of public transport are among the most likely dimensions of urban transport in Asian cities’ transport systems to be affected by the pandemic. As discussed in the introduction, ESCAP’s Sustainable Urban Transport Index (SUTI) will be a helpful tool that allows cities to track not only progress towards sustainability in their local transport system, but also long-term impacts of the pandemic (Box 1.2).

#### ***Climate-proof urban transport systems***

Apart from mitigation strategies, adaptation in the transport sector is necessary for transport systems as they are vulnerable to increasing weather and climate impacts, including heat waves, floods, cyclones, and so on. Climate proofing transport infrastructure will increase the reliability of transport services and increase ridership over time. Adaptation has been mentioned in 86 per cent of NDCs, but in only 16 per cent of the transport specific adaptation strategies, which focus mainly on vulnerability assessments and infrastructure planning.<sup>11</sup> Transport sector adaptation measures now can make infrastructure more resilient while decreasing operation costs in the future. Therefore, flexibility and agility in light of changing climatic conditions must be built into any medium- and long-term plan for the upgrading of infrastructure for sustainability transport, including active travel. With all these interventions, it will be important to place public acceptability and procedural justice centre stage,<sup>12</sup> which can be realized through more participatory planning processes.



## 6.4 Harness the power of new technologies

Looking to the future, technology and innovations should be at the forefront of attempts to make passenger transport more sustainable. The scenario analysis and modelling described in Chapter 4 demonstrated that enhancing energy efficiency and adoption of electric mobility have high potential to reduce emissions from public transport. These would have an even higher impact if combined with the smart transport technologies and innovations such as passenger information systems, automatic toll payment, and congestion charging can help to green the passenger transport systems. With the continuing evolution of such technologies, a new era of transport systems is forthcoming which depend on big data, the Internet of Things (IoT), and machine learning. Many countries in the Asia-Pacific region are attempting to shift their traditional transport technologies to systems with greater automation. Less developed countries are also actively adopting advanced techniques to increase the capacities of their transport systems.

However, new technologies often require a certain amount of initial costs for their implementation, posing difficulties to developing countries. Financial support for smart transport from bilateral development agencies and multilateral development banks can help these countries to adopt smart transport systems for passenger mobility. Such technologies can raise the quality and efficiency of urban passenger services, making them more welcoming, easier to navigate, faster, and safer. Looking to the future, these changes to transport and land use planning could be placed under the broader umbrella of transitioning towards smart cities in the medium and long term.

Investment in digital infrastructure will enhance the flexibility and agility of urban transport systems if it gives users across all social strata and locations within the urban area – including informal settlements – greater discretion over whether to undertake physical trips or engage in online activities. Here the importance of enhancing the capabilities of transport system users comes to the fore: they can only benefit directly from improved digital infrastructure if they have the skills and can afford online activity participation. Enhancing IT literacy and overcoming digital divides must be tightly coupled to transport policy.<sup>13</sup>

## 6.5 Build capacities of local governments and transport system operators

As Chapter 3 highlighted, governance issues have a strong bearing on the success or failure of sustainable transport policies on the ground. A combination of strong administrative arrangements boosted transport planning capacity, and proper coordination between land-use and transport policy-making is needed. Rather than spreading transport tasks across a myriad of agencies, these should be combined under an umbrella agency, with an integrated ideology and focus. This is particularly important in large metropolitan areas which contain several local governments and include intra-urban and inter-urban transport infrastructure and services. These institutions should be granted real decision-making power, human resources, and financial capacity so that they are empowered to prepare comprehensive and integrated long-term visions for sustainable transport. It is also important to enhance the capabilities of transport operators, including informal transport providers. Professionalization and consolidation of informal transport provision, through training and service contracting, can generate greater operational efficiency and financial stability at both operator and system levels.<sup>14</sup>

## 6.6 Direct more financing to sustainable transport

Municipalities should also look for innovative ways to finance their transport-related projects rather than simply relying on financial help from higher levels of governments. At the same time, the introduction of national policies on sustainable transport should be supported by clear guidelines and regulatory changes to facilitate their promotion. Using financial instruments such as Land Value Capture to develop and extend mass transit systems, as discussed in Chapter 3, can be very effective. Where Public-Private Partnerships (PPPs) are used, contracts should be designed in such a way that eases the financial burden of cities, rather than leading to legal and financial disputes. Developments along major road corridors which fall outside municipal jurisdictions should also be subject to strong planning controls. The political influence of both public and private transport operators should be taken into consideration by inviting all operators to partake in the planning process. As the pandemic demonstrated, an overdependence on farebox revenues adds to the vulnerability of service providers. New sources of income will provide stability to operators and enhance the resilience of public transport systems.

## 6.7 Strengthen monitoring and research capacities

There is a growing recognition that policymakers in the Asia and Pacific region could benefit from more robust research and evidence-based analyses. There are already significant transport research capacities in the region, but their outputs are underutilized by policymakers. Meanwhile, governments need to develop their own expertise in understanding academic outputs, including both quantitative modelling and interpretivist methods. They could benefit from engaging in more participatory and deliberative processes with relevant stakeholders.

There is a huge research gap on transport issues in moderate sized and smaller cities (e.g., one million and under) in the Asia-Pacific region, although a substantial portion of the population lives in these cities. It may be possible to improve transport systems in these cities without the daunting costs and complexities associated with improvements in larger cities. Furthermore, in many Asian cities, “low tech” solutions may be more appropriate than expensive ones. In this regard, additional research on conventional bus services and other forms of travel used by non-drivers and groups at risk of social exclusion is needed. The proposed ESCAP Transport Research and Education Network, expected to be launched during the Fourth Ministerial Conference on Transport in December 2021, can enhance collaboration among research and educational institutes working in sustainable transport in the Asia and Pacific region.

## 6.8 Regional cooperation for sustainable urban transport

The need for urgent action on climate change has brought urban passenger transport to the top of the region’s transport agenda. There are many ways in which countries can support each other in designing policies, advocacy and creating awareness. For example, as noted in Chapter 4, countries are at different stages in utilizing smart transport technologies, so they can share experiences in how to smoothly roll out such technologies in passenger transport systems. Countries which share similar cultural, climatic or topographical characteristics can also learn how to adapt new transport services to suit the mobility needs of their local populations. ESCAP and other international organisations should continue to facilitate cross-country and cross-city learning.

The publication of this *Review* coincides with the Fourth Ministerial Conference on Transport, to be held in December 2021. Transport ministers from across the Asia-Pacific region are considering long term strategies to enhance economic, environmental, and social sustainability of transport systems and services. The proposed regional action programme on sustainable transport development (2022-2026) includes low carbon transport, urban transport and social inclusiveness in transport and mobility as priority thematic areas and related actions. In addition, the proposed ministerial declaration also highlights the importance of enhancing resilience of transport systems and mobility. It is hoped that the adoption of the new regional action programme and ministerial declaration will motivate national and local governments to initiate and implement the recommended policies and actions. This would drive the momentum to make urban passenger transport more sustainable, inclusive, and resilient in the Asia and Pacific region.

## Endnote

- 1 Rothengatter *et al.*, 2021
- 2 ITF, 2017
- 3 See Stanley, Stanley, and Hansen, 2017, for a comprehensive discussion on the areas which should be considered to make cities more liveable.
- 4 Anwari *et al.*, 2021; Rothengatter *et al.*, 2021
- 5 Gutiérrez *et al.*, 2020
- 6 ITDP, 2019
- 7 Earley and Newman, 2021; Nikitas *et al.*, 2021; Zafri *et al.*, 2021a
- 8 Schwanen, 2021
- 9 Schwanen and Nixon, 2020
- 10 For example, Verlinghieri and Schwanen, 2020
- 11 SLOCAT, 2016
- 12 See also Nikitas *et al.*, 2021
- 13 Anwari *et al.*, 2021
- 14 Hasselwander *et al.*, 2021



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